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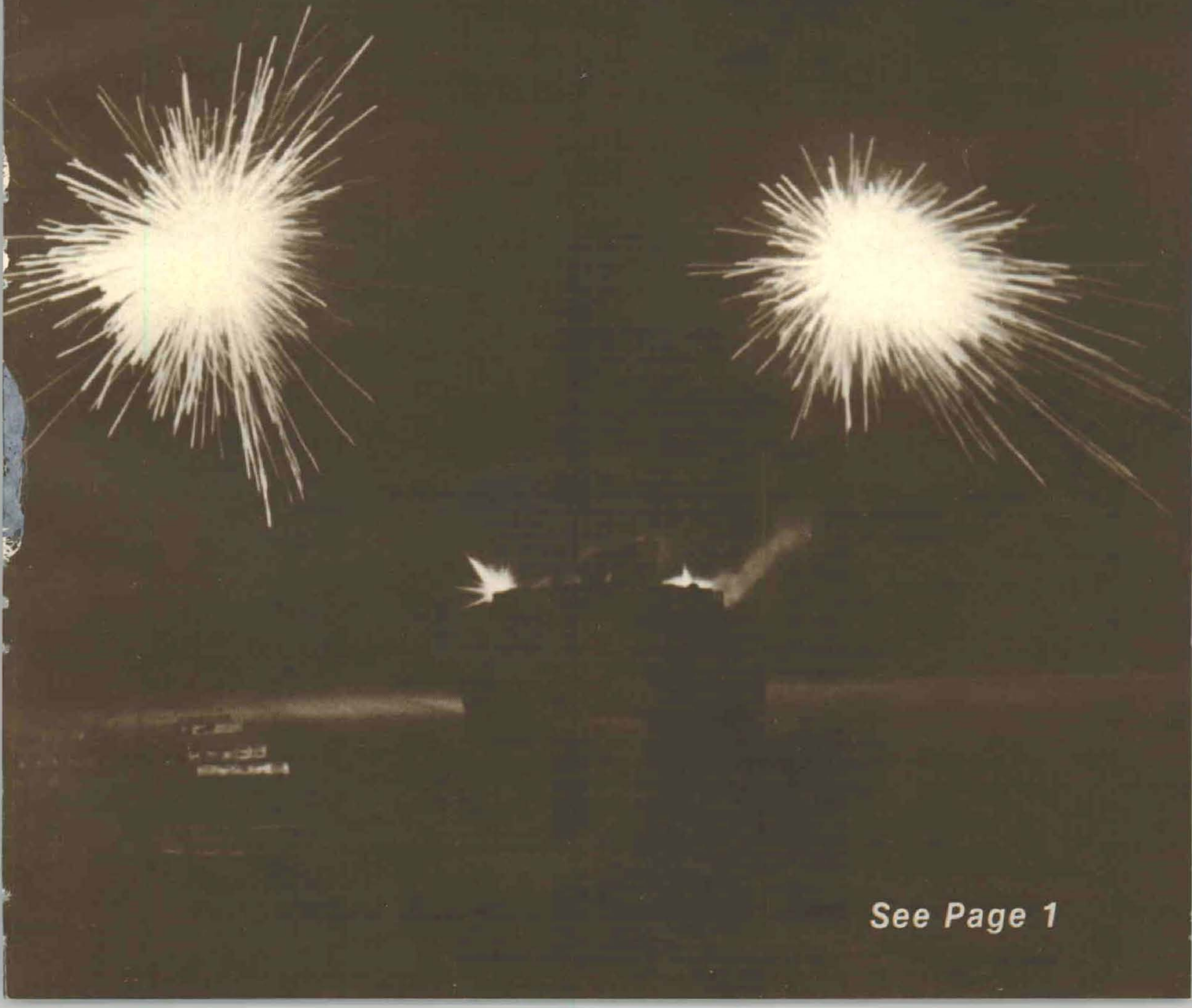
MAY-JUNE 1982

SMOKE/OBSCURANTS



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ARMY R,D&A

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ABOUT THE COVER:

Smoke Employed by Armored Vehicles: A night test firing of L8A1 RP smoke grenades launched from the M250 Smoke Grenade Launcher mounted on the M1 Abrams Tank (front cover) and M1 Abrams Tank in smoke after test firing a salvo of 12 L8A1 grenades (back cover) during development testing of the M1 Tank at Aberdeen Proving Ground, MD.

FEATURES

DEPARTMENTS

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

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Smoke and Obscurants Program

"Keep on Smokin'"

By COL Samuel L. Eure & LTC Joseph A. Traino III

The place is Central Europe, 0720 hours, 24 August 1985, two hours after the outbreak of hostilities by Warsaw Pact Forces. A forward observer of the 1st Guards Army in the Fulda Gap area reports the movement of a NATO tank battalion into its blocking positions. He designates, with a laser, the target for attack by a Soviet guided missile.

NATO tanks slow their movement. Suddenly smoke clouds rapidly form 50-meters forward of the tanks, creating a dense, engulfing, white screen. Minutes later the incoming precision guided missile impacts harmlessly on the leading edge of the smoke cloud. Survivability of NATO combat power in this situation is the pay-off directly attributable to the Army Smoke/Obscurant Program.

The roots of the contemporary smoke and obscurants technology base program lay in minds of scientists and engineers of the Army Materiel Command laboratories in the early 1970's.

Conscientious engineers in the Army Missile Command (MICOM) were asking themselves what smoke and dust would do to the performance of their anti-tank guided missiles. Scientists at the Army Mobility Equipment R&D Command (MERADCOM) and Edgewood Arsenal were pondering how they could improve their camouflage and screening smokes to be better countermeasures.

By May 1972, MERADCOM had proposed a plan for screening, signaling, and marking munitions systems to revitalize a program which had been minimally funded for the previous 10 years. That plan was expanded to include efforts at Frankford Arsenal, Edgewood Arsenal, MICOM, and the Army Electronics Command (ECOM).

The anti-armor systems program review in April 1976 expanded the scope of the technology base program. By August, the Under Secretary of the Army signed a project manager charter for smoke/obscurants. That charter required the PM to ensure that necessary research and exploratory development was conducted to provide a technology base for smoke/obscurant materiels and dissemination devices and to develop information on the effect of smoke on other weapon technology.

The technology base program for smokes and aerosols established several goals: support the improvement of inventory smoke materiel; evaluate foreign smoke materiel; reinforce acquisition of new smoke materiel; develop a technical means to counter hostile smoke; assess the impact of hostile smoke and natural aerosols on the propagation of electromagnetic radiation and prototype electro-optical systems; and develop means of measuring in both laboratories and the field natural and artificial aerosols.

In order to implement that technology base charter responsibility, the DARCOM deputy for Science and Technology created the Smoke and Aerosol Steering Group on 18 February 1977. It was composed of senior members of ARRADCOM, MICOM, MERADCOM, ECOM, TECOM, Harry Diamond Laboratories, with PM Smoke as its chairperson.

Terms of reference dedicate the steering group to coordinate several DARCOM programs directed toward advancing smoke and aerosol technology. The terms also provide a structure for the research and exploratory tasks being executed by the DARCOM laboratories in smoke and aerosol technology. Under that structure, the tasks are grouped into four areas:

Area 1 is concerned with the identification, characterization, and elimination of aerosols, both natural and manmade. This area contains the technology base from which future smoke materiel will be developed.

Area 2 is concerned with measuring and quantifying the effects of natural and man-made aerosols on the propagation of electromagnetic radiation.

Area 3 utilizes the data bases created by areas 1 and 2. for creation of simulation and math models.

Area 4 is not correlated with the terms of reference of the steering group. The steering group identified a shortfall in the capabilities to measure dense aerosols and especially non-spherical particle aerosols such as dust. In order to address this shortfall, area 4 was devoted to establish a technology base for aerosol characterization by improving methodology and instrumentation.

Having received direction and guidance from the DARCOM Smoke and Aerosol Steering Group, the DARCOM laboratories set out to expand and broaden the smoke and aerosol technology program. Specific goals which were established for area 1 are to develop a full obscuration capability; characterize battlefield obscurants; and develop a capability to eliminate obscurants.

Goals of area 3 are to assess the human factors of smoke; develop models which will represent natural and artificial aerosols; develop models of energy propagation through aerosols; and develop models and simulations of system performance.

Thus far, the following goals have been achieved:

- Evaluations have been made of all known foreign smoke formulations.
- Technology is in hand to provide the battlefield commander the capability of removing some natural aerosols to enhance battlefield operations.
- Low energy electromagnetic propagation, through both natural and artificial aerosols, is relatively well understood. Developmental systems which rely on the propagation of electromagnetic radiation for their function, have been optimized for their performance in aerosol environments.
- Improvements in instrumentation and methodology which have resulted from these tech base efforts have been applied in development testing and in special tests.

Next Generation of Smoke Materiel

Army smoke/obscurants programs are being directed to develop a variety of new smoke and obscurant materiels which will increase battlefield capability in three ways:

- All smoke and obscurants will provide a combat multiplier.
- New obscurants will counter new high technology weapons now being introduced by threat forces.
- Extension of smoke/obscurant technology in the area of large area screening will better hide our rear areas.

As a corollary to our smoke generation, the ability to dissipiate and/or eliminate obscurants generated by nature and threat forces will enhance our probability of "the first kill" at long standoff ranges.

Except for a few notable exceptions, new smoke projectiles, rockets, and grenades to be fielded within the next five years will incorporate basically the same types of smoke which we find on the battlefield today. What is being improved are the technology and dissemination methods.

Smoke ammunition will produce obscuration more efficiently, providing as much as a 2 to 8-fold decrease in the number of munitions required to produce the same obscuration as current munitions and systems. These near-term smoke systems are grouped as armored vehicle self-protection and projectile-delivered smoke.

Armored Vehicle Self-Protection Smoke Systems

Since 1977, the U.S. Army has been fielding a family of smoke grenade launchers, based on United Kingdom systems, to provide self-protection to armored vehicles. These launchers are of two basic types: a 12-tube launcher presently used on the heavier tank-type vehicles, and an 8-tube launcher for lighter weight vehicles such as the M113 family. Both use the UK L8A1/L8A3 red phosphorous smoke grenades.

Smoke grenade launcher systems are primarily intended to defeat, or degrade threat force electro-optical devices and weapons, such as day and night sights, anti-tank guided missiles, laser range finders, and laser designators.

Based on an Army Materiel Systems Analysis Activity study, these systems may produce, in many cases, greater than 2-fold improvement in survivability of armored vehicles on today's high intensity battlefield against currently fielded threat anti-tank missiles.

Under the direction of PM Smoke, engineers and technicians of the Chemical Systems Laboratory, working in conjunction with engineers from Teledyne Continental Motors, developed and evaluated the first Vehicle Engine Exhaust Smoke System (VEESS) for the M60A1 and M60A3 Tanks to complement the smoke grenade launcher capability.

Vehicle tests, conducted by the Army Test and Evaluation Command and the Army Armor and Engineer Board, have demonstrated that the reinforced smoke screen is effective in obscuring vehicles from observation in the visual and some infrared regions.

Projected Smoke Systems

While self-protective smoke supports armored vehicles and large area screening smoke can cover entire unit areas, the tactical commander's plans include use of smoke to obscure the enemy's vision close to his weapon sites. When time and distances become critical, artillery, mortar and rocket smokes can be readily projected into the enemy's area.

White phosphorous (WP) smoke projectiles are bulk-filled spotter/marker rounds and have been used to obscure the enemy's vision. White phosphorous was selected for munitions because it ignites upon exposure to air and burns rapidly. Rapid burning however, is one of WP's weaknesses—the heat of the burning causes the smoke to pillar and rise above the height of ground-to-ground sighting.

A second common smoke projectile uses a hexachloroethane-zinc mixture (HC) contained in canisters which burns to produce a smoke screen. Each canister burns for several minutes. HC smoke munitions produce a dense smoke which cools rapidly and may cling to the ground. Weaknesses of HC smoke are the limited number of canisters which can practically be placed in a projectile and the shorter than desired burn time.

To provide enhanced survivability to the Army, both in the offensive and defensive mode, improved artillery and mortar smoke screening ammunition is being developed for several weapon systems. Improvements in hardware design call for use of smoke submunitions to provide larger area coverage, better distribution and a continuous smoke screen for longer duration.

The M259 2.75-inch smoke rocket warhead is an example of this new munition concept. The rocket functions at a pre-set time in the air above the target, expelling submunitions which fall to the ground over a large area and burn for several minutes.

The second member of this submunition generation of smoke projectiles is the XM825 155mm WP smoke projectile.

The XM825 will be type classified in the near future. When fielded, it will deliver smoke to anywhere within the range of the companion M483A1 projectile using essentially the same firing tables.

The XM819 81mm red phosphorous (RP) smoke cartridge is the next member of the submunition smoke family to follow the XM825 155mm projectile.

A member of the Improved 81mm Mortar System, the XM819 provides a several-fold increase in smoke screening effectiveness over current WP bulk-filled munitions, which have the same pluming characteristic as the 155mm bulk-filled munitions.

Large Area Screening

Although the U.S. has not quantified the increase in survivability resulting from large area screening, the Soviets cite a 3-fold increase in survivability resulting from the use of smoke in the attacker's ranks during the offense.

One product improvement soon to be applied to the current U.S. M3A3 Smoke Generator will provide the capability of using both diesel fuel and fog oil to produce visual screening smoke. Another improvement will permit mounting the generators on moving tracked and wheeled vehicles.

Development of a new generation large area smoke generator to be fielded in the late 1980's has been initiated. The new generator will not only have enhanced reliability, availability, maintainability, and durability characteristics, but will be capable of producing a smoke screen which attenuates threat guidance and control signals throughout a wide range of the electromagnetic spectrum. It will be capable of being mounted on multiple vehicles.

Countering High Technology Weapons

Both the U.S. and threat forces are introducing new high technology weapons and observation devices which operate beyond the visible portions of the electromagnetic spectrum. These devices may operate in either the visible, IR, or other wave bands. Current missile and munition guidance and control devices (such as target seekers, semiactive laser homers, and semiautomatic command-to-line-of-sight links), use the visible to IR band.

Devices now in development will probably use IR bands. It is essential that their effectiveness be countered in order to retain the significant increase in survivability which our current smoke provides us.

How About The User?

How do you sort fact from fiction? How do you keep current with threat, countermeasures, and new developments? An assistant smoke project manager for tactics and doctrine is assigned and the mission of working through the TRADOC Combined Arms Center and with the TRADOC Centers and Schools to keep all elements moving toward the same common goals.

Those common goals very broadly encompass two tactical considerations: we must be able to operate in, around, or through smokes and aerosols which the enemy is certain to employ, and we must be able to present him the same problems by our employment of smoke.

The DARCOM community is aggressively grappling with the hardware issues involved: make more capable electro-optical devices, "smarter" weapons, and more efficient smoke delivery systems.

Fielding

Today, almost all of the USAREUR tank assets are equipped with the earlier described M239 launchers. Present fielding is being directed to equip other heavy armor vehicles, both in USAREUR and other major commands.

Recommendations resulting from the 1980 Army Chemical Systems Program Review acknowledged the requirement to accelerate application of smoke launchers on armored vehicles. These and other recommendations were incorporated in the approved Army Chemical Action Plan, June 1981.

Initial fielding of the M250 Smoke Grenade Launcher on the M1 Abrams Tank and the M243 Smoke Grenade Launcher on the M901 Improved TOW in USAREUR has been completed.

Procurement, Production and Readiness

Production and inventory build-up for smoke materiel began in the mid-1970's with an urgent product improvement action to increase the functional reliability of the M84A1 HC Smoke 105mm Cartridge and the M116 HC Smoke 155mm Projectile.

Since FY 76, a significant investment has been made for production of the product-improved M84A1 and M116A1 artillery smoke screening rounds.

Additionally, funds have been expended for smoke grenades and launchers which will increase battlefield survivability of our tracked vehicles.

Steps have been taken to replenish the stockpile of M5 HC Smokepots (ground type) and M4A2 HC Smokepots (floating type), used for peacetime training, and a product improvement is on-going aimed at a FY 85 production cut-in of an RP smoke mix.

The military life of the M3A3 Mechanical Fog Oil Smoke Generator is being extended by an on-going depot rebuild and refurbishment program, as is an initiative to improve the generator's RAM-D characteristics. A second initiative is to adapt the smoke generator for use on wheeled and tracked vehicles which will provide large area smoke screening to forward areas of the combat zone.

Countermeasures Testing in Smoke/Obscurants

The Soviet military can and will project limited visibility conditions in the form of man-made smoke/obscurants to any point on the battlefield as suits their needs. It is part of their training, doctrine and "basic load." They are also prepared to operate in smoke and contend with battlefield dust and dirt, and it is a major part of PM Smoke's mission to develop information that will let the tactical commander know how these systems will or will not work in the face of all battlefield obscurants.

Almost any electro-optical system (eye, laser, designator, night vision device) can be defeated if the electromagnetic energy between the target and observer can be sufficiently reduced or modified. For example, it takes only a relatively small white phosphorous smoke cloud to degrade visual systems. Larger clouds of white phosphorous smoke are required for IR devices.

Systems operating in the visible region are quite easily defeated by existing inventory smoke. However, more smoke/obscurant is required to defeat systems operating in the IR regions. What is not commonly recognized is that easily achievable levels of standard smoke/obscurants have negative effects on sophisticated target acquisition and designation systems, anti-tank guided missiles and precision guided munitions.

PM Smoke both sponsors and participates in field obscuration tests. Among these are extensive tests entitled "smoke weeks." To date, four smoke week tests have been conducted at various locations around the country.

Electro-optical system developers record how their systems perform during smoke week demonstrations. These data are then collected by PM Smoke for the smoke week report. Detailed data are also available to specific users on magnetic tape.

Many systems have availed themselves of the smoke week testing while in various stages of development.

Electro-optical devices come to smoke week not only from within the DARCOM family of MACOMs and PMs, but also from other services, from industry and academia, and on some occasions from allies. So, it can be truly said that smoke week serves the entire community.

Aside from the smoke week test reports, the foremost method of disseminating information on the effects of smoke and obscurants on electro-optical systems (and vice versa) is PM Smoke's annual smoke symposium. Six such symposia have been conducted. Representatives from the Army, Navy, Air Force, industry, the academic world, and allied nations are invited to participate.

Test methodology and instrumentation are improving and are approaching the stage where more operationally oriented, less constrained tests can be designed. Initial planning is being done for more dynamic tests in which the targets, target detection, acquisition and designation systems and the obscurants are not limited to fixed positions.

In the near future, a series of tests will address the obscuration performance of top attack systems, laser systems, and new developments in night vision devices and precision guided laser systems. Also, tests are planned for the performance of electro-optical devices in man-made obscurants in both cold and arid environments.

The key to the success of our high technology weapon developments depends on knowledge of the effects of obscurants on the performance of these systems. Likewise, our capability to develop obscurants that will deny the enemy's high technology weapons depends on the same data. The Army Smoke/Obscurants Office will continue to assure that such data are developed and disseminated in the most accurate, timely, and economical manner.

COL SAMUEL L. EURE is project manager for the Army Smoke/Obscurants Program, Aberdeen Proving Ground, MD. He was commissioned as a second lieutenant in the Chemical Corps in 1956 following graduation from Virginia State College with a BS degree in chemistry. He holds a master's degree in physics from U.S. Naval Post Graduate School, Monterey, CA.

LTC JOSEPH A. TRAINO III is the assistant project manager for Logistics in the Office of the PM for Smoke Obscurants. He holds a BS degree in chemistry from Penn Military College and an MA degree in logistics management from Central Michigan University.

Many Improvements Cited . . .

Atlanta Seminar Focuses on New Acquisition Initiatives

Progress, problems and potential improvements relative to the materiel acquisition process was a major topic of discussion for more than 350 senior Army and defense industry representatives at DARCOM's Atlanta VIII executive seminar, in Atlanta, GA. This year's meeting was geared to the theme: "Progress Under the Leadership and Direction of the New Administration." Special emphasis was placed on management issues of mutual concern.

Established in 1974 at the recommendation of DARCOM's Principal Assistant Deputy for Research, Development, and Acquisition Mr. John D. Blanchard, the Atlanta seminars provide a forum for executive level communications directed toward improving the methods of accomplishing the Army's materiel acquisition and support mission.

Former DARCOM Commander GEN Henry A. Miley, Jr., now President of the American Defense Preparedness Association which assisted in the administrative details of the meeting, welcomed the attendees, observing that this Atlanta meeting was the biggest ever and should therefore be the most productive ever.

Mr. Blanchard opened the formal program with a statement of the purpose and objectives of the Atlanta seminars. He stated that the purpose had not changed from that which he had advocated when urging the initial Atlanta I meeting; to engage in discussions that would promote greater understanding of the sometimes conflicting interests which must be reconciled by DARCOM and defense industry in best serving the needs of the Army and corporate stockholders. Blanchard explained that the objective was to leave the meeting with a clearer understanding of each other's principal objectives and concerns. His personal request to each attendee was that each ask themselves the

DARCOM Commander
GEN Donald R. Keith

following question: "Am I doing all that I can to help the Army solve its acquisition problems while attending the corporate interests, or are my efforts focused more narrowly on just the latter goal?"

DARCOM Commander GEN Donald R. Keith opened the formal presentations with a keynote address on DARCOM's achievements, shortfalls and ambitions, and the challenges facing both DARCOM and industry. He began his remarks by commenting on the Atlanta VIII theme.

Keith stressed that he was encouraged by the Reagan Administration's continued support for bolstering the nation's defense posture and that one of its highest priorities was to improve the weapons acquisition system. The challenge of improving the acquisition system is being taken very seriously, he said.

Relative to the Carlucci initiatives, the General noted that there are no "reluctant dragons" and that he personally supports the initiatives 100 percent. The "new" acquisition system will become a way of life throughout DARCOM, he added.

Keith explained that previous DARCOM commanders and contractors deserve tremendous credit for many of the new weapon systems in the Army's current inventory. He added, however, that the challenge now is to buy weapon systems at more economic rates, and get them to the field.

Creation of a DARCOM forward element in Europe, said Keith, is another important step toward improved readiness. This concept provides for a command and control element headed by a brigadier general. Its purpose will be to provide central management for the numerous modernization/fielding activities administered by DARCOM people throughout Europe.

Some of the other key DARCOM achievements in recent years, noted Keith, are the expanded support roles of the Army's depots: greater "mileage" from Army engineers and scientists; and the DARCOM Resource Self Help Affordability Planning Effort. Additionally, he explained that he has called on project managers to get the labs more involved in their projects when they have problems.

Similarly, a challenge has been issued to lab directors to think more about how their work can transition to production and to call out manufacturing technology work that should be started in order to make that possible. Industry, he added, must share in this.

The DARCOM commander then reviewed some of the major shortfalls relative to RD&A. "In my judgement," he said, "the transition from R&D to production has been our nemesis." He noted that in the mid-70s many people, including himself, believed that industry could efficiently produce new systems as long as the Army was able to get them through R&D. This, indicated Keith, was an incorrect supposition.

It is obvious that the industrial base was unable to do all of the things people thought it could, continued Keith. In fact, a recent article in *Fortune Magazine*, said Keith, stated that for years production has been ignored while corporate managers focused on marketing and finance. This trend, fortunately, seems to be changing.

He stressed that he believed American industry now seems to recognize that they must reward top-notch production people in the same way they have been rewarding their financial and marketing managers. Said Keith: "There is also evidence that plants are being modernized in an attempt to increase productivity."

The Army, explained the General, has also not done all that it could. For example, the Army's manufacturing technology program—although good—has been quite limited in some cases. Additionally, lead times for the combat developments community have been too long and cost discipline was not adequate.

The toughest challenge facing both the Army and industry, according to Keith, is cost control. This is a shared problem and marketeering arguments are not going to save the day, he added.

Relative to shortfalls on the readiness side of the house, Keith noted that the most significant problem is the shortage of equipment throughout the Army. Additionally, not enough has been spent during the R&D process to insure that systems are maintainable and supportable. He cautioned that in most cases, a combat unit is better off without an item of equipment if the alternative is equipment that is not supportable.

Other key shortfalls, said Keith, have been lack of emphasis on repair parts, soldiers manuals, acquisition of training devices, and reliability and maintainability. Failure to design integrated logistics support into the front-end of the R&D cycle has resulted in many of these shortfalls.

The keys to improving the weapons systems acquisition process, stated the General, are embodied in the Carlucci initiatives and the ability to develop a complete acquisition strategy from development through procurement and fielding. Additionally, the requirements process must also be stabilized because the days of repeated changes are over, and programs that cannot be seen through to completion will not be started.

Several substantial improvement initiatives are underway, noted the General. These include better cost estimating, more "should cost" studies, development of a risk assessment model, and establishment of new management control system. He expressed his strong commitment to funding manufacturing technology and to redirecting the focus away from specific systems toward generic technology.

Finally, with regard to logistics, Keith said he hopes to improve mobilization planning to include industrial preparedness planning. Among recent initiatives in this area is a new prioritized list of the items considered most critical.

The DARCOM General closed his address by stating that he believed that Atlanta VIII was a "most critical" conference, both for industry and for the Army.

"Program Status—The Army's FY 82 Program and a Look at the Out-Years," was the subject of the first

DARCOM Deputy Commander for RD&A
LTG Robert J. Lunn

of three panel discussions at this year's Atlanta seminar. DARCOM Deputy Commander for RD&A LTG Robert J. Lunn served as moderator. Other panelists were LTG Richard H. Thompson, deputy chief of staff for Logistics, DA; Dr. Richard Haley, DARCOM assistant deputy for Science and Technology; and MG Patrick M. Roddy, director, Program Analysis and Evaluation, Office, Chief of Staff, DA.

MG Roddy gave the first formal panel presentation, which was devoted to a discussion of the FY 82 and FY 83 budgets and Army resources since 1980. The Reagan administration, he said, has really addressed the global threat that had not previously been given the attention it should have. Under the previous administration's budget, noted Roddy, there would have been shortages in several areas. The budget under the new administration, however, eases many of these shortages and offers a dramatic change.

Roddy indicated that the FY 83 budget calls for an 18 percent increase in real growth relative to both procurement and RDT&E. The real purchasing power of the Army has been substantially improved and many things are a lot "healthier" said Roddy. MG Roddy closed by stating that the FY 83 budget which was submitted under the Reagan administration is the same one which would have been submitted in FY 87 under the previous administration.

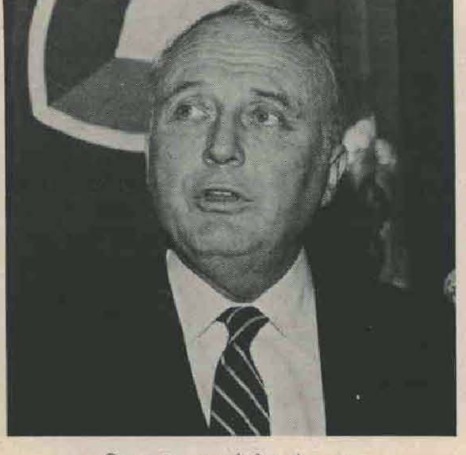
MG Roddy was followed at the podium by LTG Thompson who discussed "Logistics Support—Myths and Realities". One of the big myths, he said, is that all of the Army's money is going into new equipment while readiness and sustainability are being neglected. The reality is that the FY 83 budget does address readiness and sustainability. For example, major problems in support of the RDF are being addressed, and logistics-over-the-shore improvements are very promising.

Dr. Haley provided the audience with some insight into the FY 84 budget and a look to the future battlefield in the year 2000. Emphasis, he said is being given to technological thrusts that will provide a high return-on-investment.

Future forces in the year 2000 must have staying power, noted Haley. He added that operations on the integrated battlefield will be highly dispersed, and that operations of small units must be highly synchronized through good command, control and communications. Some of the major thrust areas, discussed by Haley, were self-contained munitions, the soldier-machine interface, and biotechnology. He stressed that the success of these new thrusts depend on the innovations and creativity of industry.

Following the formal panel presentations, a series of questions were submitted to the various panel members. Subjects included funding, inflation, long-range RDA planning, contracting out, and improvements to the requirements process.

Luncheon speaker Secretary of the Army John O. Marsh Jr. discussed the continuing problems faced by the Army regarding public support for its programs and cost considerations. He began by stating that Congress controls manpower ceilings and funding and therefore could be viewed as a "weather-vane" which reflects public opinion and attitudes. Said Marsh: "We must be attentive to what Congress says."



Secretary of the Army
John O. Marsh Jr.

Secretary Marsh devoted a major portion of his address to cost considerations, which he termed "very important." He posed the following question: What needs to be done to get a better handle on Army costs? He responded by saying that there must be a keen awareness of cost considerations and that this awareness must permeate the total force—from the Chief of Staff to the newest Army recruit. Additionally, he said we need a good Under Secretary (which we have in Mr. Ambrose) with a broad sensitivity to manufacturing and cost affairs.

Other factors which impact on costs are the press, private and semi-private organizations, and requirements of the Nunn amendments. Answers to many of our problems, said Marsh, lie with those in the audience. Specifically, the answers will result from cost control, production of high quality items, and timely deliveries, he added.

Marsh maintained that affordability must be considered early in concept development and that we must always be willing to expend equipment before people. He noted strongly that affordability must play a greater role and total life cycle costs must be considered early.

The Army Secretary closed his luncheon address with the following quote by Abraham Lincoln: "The dogmas of the quiet past are inadequate for the stormy present."

A review of the "Carlucci Initiatives" was presented by Assistant Deputy Chief of Staff for RD&A MG Stan R. Sheridan in his address on The Defense Acquisition Initiatives of the New Administration—Where Are We? He noted at the outset that the Department of the Army is very serious about the initiatives.

MG Sheridan explained that the following management principles underlie the 32 initiatives: improve long-range planning; delegate more responsibility and authority, while strengthening accountability; use lower risk approaches; use more economic production rates; make costing/budgeting more realistic; consider readiness and sustainability early; strengthen the industrial base; and increase competition. A complete text of the 32 initiatives was made available to each Atlanta VIII attendee following MG Sheridan's speech.

Army Vice Chief of Staff (now Chairman-designee of the Joint Chiefs of Staff) GEN John W. Vessey moderated the second Atlanta VIII panel discussion. It was devoted to a review of the findings and recommendations of the U.S. Army Cost Discipline Advisory Committee. Vessey explained that the advisory committee was convened specifically to address the problem of costs.

Army Vice Chief of Staff
GEN John W. Vessey

Members of the panel, all of whom were also members of the Cost Discipline Advisory Committee, were Mr. John D. Nichols (committee chairman), president, Illinois Tool Works, Inc.; Mr. Paul J. Miller, Jr., former vice president, Ford Aerospace and Communications Corp; GEN Henry A. Miley Jr., (USA Ret.), president, American Defense Preparedness Association, and Mr. Jack E. Hobbs, Office, Assistant Secretary of the Army, Research, Development and Acquisition.

Mr. Nichols reported on the findings of the advisory committee. He stressed that the committee found a great deal of enthusiasm to solve the cost problem. A popular hypothesis, he said, is that if inflation goes away then cost growth will also go away. He stressed that this was not true and that a lot of cost growth is controllable.

Nichols indicated that his committee found that quantities of systems always increased and that improved technological capabilities always occur. These recurring factors contribute to cost increases.

If the Army expects to get a handle on cost increases, said Nichols, it must de-institutionalize adversary relationships and encourage the exchange of information and the early identification of potential problems in its major acquisition programs. Additionally, the Army must learn to manage in an unstable environment.

Nichols also stressed that the Army should establish a risk review team at the ASARC level. However, he cautioned that a new organization to control costs was not needed. *Early* identification of risks is what is really needed.

The Selected Acquisition Report, continued Nichols, is a bad document because it tries to do too many things. However, the SAR is the only place where the status of an entire program is identified.

Nichols stressed that the committee found that the greatest cost increases occurred when a program transitions from the development phase to the production phase. Changes which occur prior to production are also much too great and there is too much reliance on indices published by the bureau of labor statistics. Finally, Nichols noted that the Army's project managers are not working closely enough with the commodity commands.

GEN Vessey returned to the podium following Nichols' report

DARCOM Principal Assistant Deputy for RD&A
John D. Blanchard

and stated that the recommendations of the Cost Discipline Advisory Committee will be implemented. Said he: "If we don't implement them it will be the result of a conscious decision not to, not from benign neglect."

The final Atlanta VIII session was devoted to an open forum of questions and answers. Responses were provided by a panel of senior government executives. Panel members were Assistant Secretary of the Army for RD&A Dr. Jay R. Sculley; DARCOM Commander GEN Donald R. Keith; LTG Robert J. Lunn, DARCOM deputy commander for RD&A; LTG Harold F. Hardin Jr., DARCOM deputy commander for Materiel Readiness; LTG Richard H. Thompson, deputy chief of staff for Logistics, DA; and Assistant Deputy Chief of Staff for RD&A MG Stan R. Sheridan.

Some of the questions submitted to the panel, and the responses were as follows:

Question: We have been falling behind the Soviets. Are we not on a losing course?

Response (Dr. Sculley): We definitely need a policy adjustment. An Army Board for Science and Technology has been established to look at the Army's piece of the problem. We also need to make the graduate environment in science and engineering more attractive. This is a national problem.

Question: How can we reduce the adversary relationship between the Army and industry?

Response (GEN Keith): We can do it by better management on both sides and by not trying to hide problems.

Question: What specific actions are being taken relative to multi-year procurement?

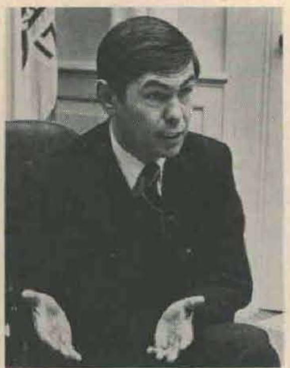
Response (MG Sheridan): The TOW system on the Bradley, Viper, and Pershing II are areas we are looking at for multi-year procurement applications. I think we are going to see a lot more multi-year procurements. I also think that multi-year procurements can and will save us a lot of money.

Question: As long as inflation is underestimated the Army is going to be looked at unfavorably. What can we do about it?

Response (LTG Thompson): I think this is basically a problem of format. We are going to develop system-unique indices. GEN Vessey also wants us to find out what we are doing to ourselves. I think there are a number of positive actions taking place.

The Atlanta VIII seminar was concluded with remarks from GEN Keith. He termed the meeting "excellent" and said that he looked forward to progress reports at next year's Atlanta gathering. He stated also that the Carlucci acquisition initiatives didn't present anything that could not be achieved.

ASA (RD&A) Dr. Jay R. Sculley



Assistant Secretary of the Army (RD&A) Dr. Jay R. Sculley was interviewed recently at the Pentagon. He responded to a series of key questions related to the Army's materiel acquisition process.

Q. In recent years, you are the second assistant secretary for RD&A to have come to this position from academic life. Did you feel this to be a handicap in any way or was it an asset?

A. In reviewing my background, I think I should stress that it is not exclusively academic. I have served in industry as a consultant, was employed by the Dupont Company as a design engineer, and was the general manager of a paper recycling company. Therefore, I am not completely unfamiliar with the industrial community. I have also been involved in research efforts with the Department of the Army over the past 13 years.

Most recently my time has been spent in the academic community, and I had to learn a great deal about materiel acquisition. That need for knowledge was and continues to be a bit of a handicap. My military background, although it was in the Air Force, really has been helpful.

My engineering background enables me to understand the technical aspects of most areas and it gives me a good insight into the development process.

Part of my role in the academic community was to ask questions. I used to tell cadets that there is no such thing as a "bad" question. However, there can be bad answers, and I think that part of my present job is to ask questions and identify those answers that I feel are inadequate.

I believe that life in the classroom prepared me extremely well for this particular role and I hope that my questions will help us uncover the right answers.

Q. When you first came aboard as ASA (RD&A), and after an initial break-in period, what did you see as the greatest area or areas of need for improvement in the Army's materiel acquisition process?

A. I believe that the Army's primary area for improvement is that of cost discipline, we have to discipline every aspect of our materiel acquisition process. In the requirements area, we have to limit ourselves to what's good enough and then use product improvement programs to develop growth potential which exists in our system. This is one aspect of cost discipline.

We must also discipline the program change process. I believe stability is the key to efficiency. Changes, whether they are related to performance, delivery date, or funding, drive costs and managers up the wall. We must make sure that only necessary changes are made and that they are made at the right time.

Funding changes are worthy of special mention. We must discipline ourselves to avoid false economics of program stretchouts. This, of course, leads to an even more difficult aspect of discipline. When faced with the probability of uneconomic rates of production across the board, we must have the discipline which enables us to make the tough decisions on whether programs should be cut.

You may have noticed that I discussed "cost discipline" rather than "cost control." There are factors over which we have no control, such as the national economy, and the costs of energy, and critical raw materials. It is presumptuous to say that the Army can control costs. However, we can discipline ourselves so that the cost growth that does occur is primarily the result of the factors I just cited.

Q. Mr. Ambrose, the Army's Under Secretary, apparently devotes a great deal of his time to materiel acquisition matters. Knowing Mr. Ambrose's background and interest in materiel acquisition, how does your office interface with him on these matters.

A. It should be noted that the Under Secretary has a specific charter which gives him overview authority in the RD&A process. Certainly, the relationship between Mr. Ambrose and our office is complementary. Mr. Ambrose has an extensive background in management of industrial R&D and production programs. For example, he played a key role in program reviews. These reviews focused on identifying problem areas and initiating corrective actions.

The function of my office, as I view it, is to take a somewhat broader look at Army acquisition programs and to locate potential problems so that the Under Secretary's expertise can be brought to bear on the subject. We also provide knowledge and experience in areas such as procurement policy and contracting.

Q. For the last several years we have heard a good bit about the so-called "bow-wave" of modernization costs. Have the Reagan budgets aided materially here, in terms of being able to buy needed quantities or has inflation eroded much of what was hoped could be accomplished under the new administration's philosophy?

A. I believe that we have, in fact, cut into that bow wave. We are buying more tanks, trucks, and air defense missiles than we would have under the previous administration's program, and we are providing these items at more economical rates of production.

The bow wave will always be present in some form. However, if we maintain more economical rates of production, the Army will get more for its dollar and begin to cut the bow wave down to size. Thus far, the Reagan budgets have been a promising start toward this objective. We have to sustain our momentum in order to realize the long-range benefits of what we have started.

Q. Has the Army's support of the technology base effort been reduced in any way in order to support modernization?

A. The Army considers the technology base to consist of program elements in the 6.1, 6.2, and 6.3A area. Because these program elements are less specific (fewer line items), they are more vulnerable to change during the internal DOD budget process. However, I am not aware of any conscious decisions to reduce the technology base effort in order to support force modernization.

In terms of real growth, funding for the technology base, excluding ballistic missile defense, increased 10 percent in FY 82 over FY 81. The FY 83 request represents a 28 percent increase in real growth over FY 82. Both of these are above past DOD guidance for real growth relative to the tech base.

Q. What are the areas of greatest potential you see emerging from the Army's tech base efforts?

A. Last summer, through the Army Science Board Summer Study, research thrust areas were identified. I think the report from the Summer Study has been very well received with the Army.

Included among the key areas identified was what we term VISTA (Very Intelligent Surveillance and Target Acquisition). These systems incorporate minicomputers and microprocessors into sensors. Distributed C^3I (command, control, communications, and intelligence), also identified by the Summer Study, enables users at all command levels to access C^3I on the basis of individual requirements.

Another important area is brilliant munitions. They are smarter than smart munitions because no external designation of the target is required. These are literally autonomous systems.

Biotechnology, which incorporates genetic engineering to develop vaccines, antidotes, and sensors for CW/BW agents, is another key area. Also important is the field of man-machine interface. All of these items were among the thrust areas that were identified in the Summer Study. They have been endorsed by my office and the Office of the Under Secretary of the Army, and they are currently under review for implementation and enhancement.

"I believe that the Army's primary area for improvement is that of cost discipline, we have to discipline every aspect of our materiel acquisition process . . ."

Q. How do you see the so-called "Carlucci Initiatives"? There are those who say they have heard all of these things before—only the names have changed. Do you feel the entire government's management modus operendi will permit much streamlining, shortening, eliminating or reducing micro-management?

A. We recognize that successful implementation requires enhanced management at all levels. On November 17, 1981, Mr. Carlucci directed the Council On Integrity and Management Improvement to establish a task force on acquisition improvement. The task force was composed of many of the senior managers in the Services and was directed to conduct an in-depth review of progress to date, including a viable implementation plan.

The task force was divided into four teams, each chartered to review progress on several of the 32 initiatives and coordinating their work throughout with permanent action officers in OSD, the Services, and the Defense Logistics Agency. All of the teams reported encouraging progress.

One of the primary obstacles to implementation, as you pointed out, has been the "we have heard it all before" attitude. Let me assure you that we are dead serious about these actions and we are focusing our attention on accomplishing them from the highest to the lowest level. The work is being carried to the field primarily by the Defense Systems Management College through the use of a "road show" briefing.

The Services have developed implementation plans, milestones, and directives for the affected agencies. We may not resolve all the issues but we have already come a long way and we will continue to seek better ways to improve the Army's acquisition process.

Q. The magazine has been advised that the Secretariat is creating a new board of Army science and technology to work closely with the National Academy of Sciences. What can you tell us about this board—its objectives, composition, when it will be formed, and its relationship to the existing Army Science Board?

A. Your information is correct. The National Research Council, through its Assembly of Engineering, will establish a board on Army science and technology to provide assistance to the Army in the fields of engineering, science, research, and technology.

The board is being established at the request of the Under Secretary. The National Research Council, as you know, is the working arm of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Incidentally, a contract arrangement regarding the new board was established in February of this year between the Army Research Office and the National Academy of Sciences/ National Research Council. We envision the board of having about 12 members representing a range of industrial, governmental, and academic experience and expertise appropriate to the board's charge. Board members will be selected and appointed in the near future. The membership will reflect the knowledge and experience necessary to provide an effective response to a broad range of Army missions and responsibilities.

During its initial operation, the board will receive a presentation on the Army's needs for science and technology, plans, and existing methods and approaches for managing the Army's R&D program and its operational requirements. Based on these presentations, and other sources of information, the board will identify research gaps, major issues, and suggest high priority topics for the Army's R&D program.

Although the board will be located within the assembly of engineering, the National Research Council will bring talent and experience from the entire institution to bear on the activities of the board.

Other major units of the National Research Council may, at times, take full responsibility for carrying out specific studies or segments of studies.

The National Academy of Sciences, as you recall, was established by Congress during the Presidency of Abraham Lincoln to investigate, examine, experiment and report on any subject of science or art when called upon by the departments in the government. This responsibility is carried out by the National Research Council, through hundreds of short-term committees and ongoing boards, such as the Air Force and Naval Studies Board.

The bottom line is that this administration will leave no stone unturned in improving the process of how we conduct research, development and acquisition.

Space Age Materials Application to Military Bridging

By Edward E. Rudy

Suppose you were told you were driving or walking across a bridge fabricated of whiskers! It's highly possible this could happen, but the whiskers would be of a different type than normally associated with that word. When used in today's materials context the term whiskers applies to a fibrous composite of chopped fibers in a matrix such as conventional fiberglass.

Since metallic structures have sharp limitations for the Army's mobile bridging, the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, is currently studying the application of composite materials to mobile bridging structures.

Composite materials may be defined as a combination of two or more materials that are insoluble in one another to form a singular material whose properties are better than its individual constituents. One of the earliest composite materials used by man was clay and straw bricks around 4000 B.C. The most common composite material in use today is fiberglass.

The modern class of composite materials is referred to as "advanced" due to the introduction of very high-strength materials and versatile matrix systems. Advanced composites may be classified in four distinct groups: fibrous, laminated, particulate, and hybrid. Fibrous composites include continuous fibers or whiskers in a matrix. Laminates are layers of various materials placed relative to each other to maximize the properties of the total composite. Particulates are particles in a matrix such as concrete. Hybrids include more than one kind of fiber matrix material system combined to optimize the properties of the individual systems in the composite.

The matrix is a binder material whose purpose is to support, protect and transfer stress in the composite, and it has lower density, strength and stiffness than fibers or whiskers. The most commonly used matrices include epoxies, polyimides, thermoplastics, polyesters, metallics, rubbers, and ceramics. Some fiber and matrix properties are shown in Figure 1.

Advanced composite materials offer potential improvement over metallic components in the following properties; strength, stiffness, corrosion resistance, wear resistance, attractiveness, dimensional stability and repeatibility, (i.e. molding), weight, fatigue life, temperature-dependent behavior, thermal insulation, thermal conductivity, and acoustical insulation. Potential problem areas include anisotropy, chemical instability, moisture degradation, dissimilar material, thermal stability, abrasion, impact, joints, and cost. Both advantages and disadvantges must be considered whenever the use of composite materials appears to be beneficial.

Current uses of advanced composite materials include structural components of military and commercial aircraft, sporting goods, automotive components and other earth and space structures. The largest percentage of items fabricated are aircraft components. However, these components are manufactured by labor intensive hand lay-up techniques which inherently makes the items costly.

The MERADCOM Marine and Bridge Laboratory is responsible for providing the best possible mobile bridg-

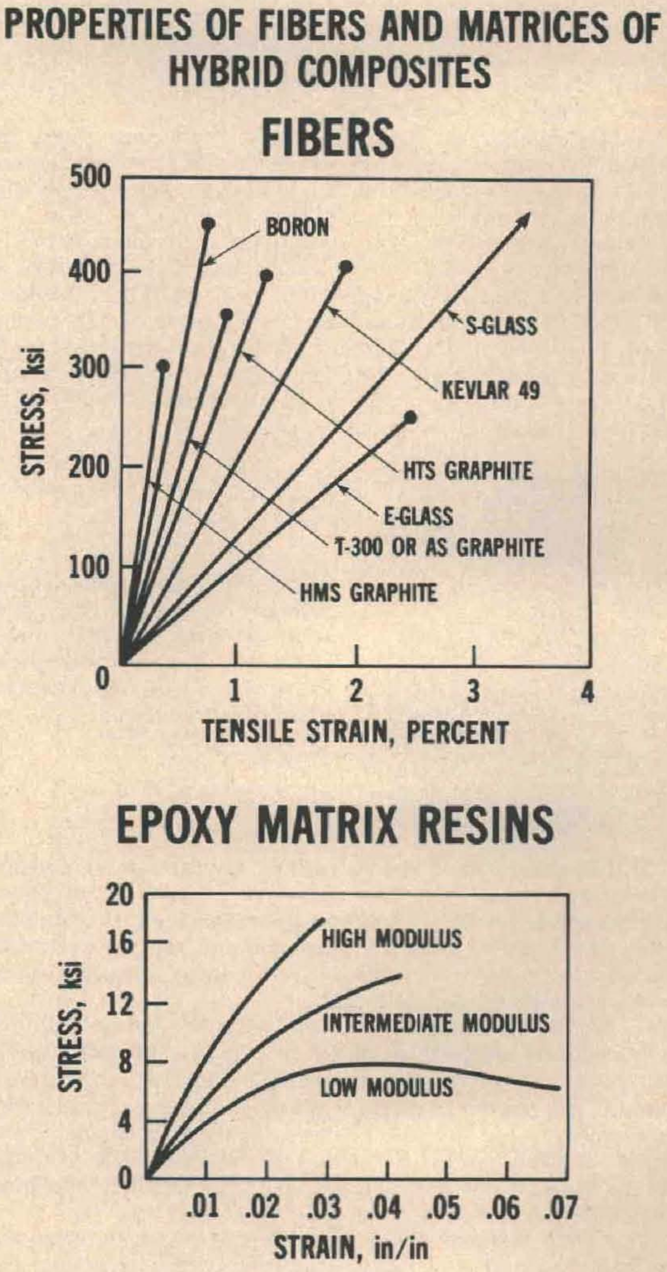


Figure 1

ing for the Army, bridging that is the most efficient structure possible, i.e. the most load carrying capacity from the lightest weight structure. Composite materials with their great strength-to-weight ratio are obvious candidates for these structures, particularly graphite/epoxy and metal matrix materials. However, the advantages and disadvantages of the candidate materials must be carefully weighed before they can be substituted into the bridging structures. These structures have to serve in a variety of modes and environmental conditions including both dry and wet gap crossings.

The test bed for possible composite materials substitution is the Rapidly Emplaced Mechanized Bridge (REMB) metallic prototype. Bridge areas currently under consideration for composite material substitution are the traversing or launch beam, the bottom chords and webs of the individual bridge girders, and the tensile reinforcement system for bridge lengths over 31 meters. Another possible area of application is the access/egress areas of the bridge site.

One of the initial efforts undertaken in the composite materials program is the aluminum graphite/epoxy sandwich panel. This panel is a first of its kind due to the unique zero degree only filament wound construction, its purely tensile application and its installation as a structural member of a mobile bridging system. The aluminum plate sandwich panel configuration was chosen to protect the graphite/epoxy plank from the environment and physical abuse, to provide panel transverse stiffness and to provide a method of attachment to the bridge girder. The panel is installed as the bottom chord of the girder utilizing a tongue and groove system with bolted connections.

Continuous filament winding was chosen as the manufacturing method primarily because it is the most advantageous when considering both mass production and low cost. The method utilizes a rotating mandrel that draws the fiber filaments from spools through an impregnation system. Filaments consist of fiber bundles called tows, numbering from just a few to thousands of fibers per tow. These tows are wound onto spools by the pound.

The graphite fiber used in the bottom chord was selected for its high tensile strength (350 ksi) and high elastic modulus (50×10^6psi). The fiber was laid on the mandrel in tows of 12,000 filaments utilizing a wet continuous resin impregnation system developed by the contractor, Fiber Technology Inc. or Provo, UT. The aluminum sandwich sheets, each 0.125 inch thick rolled 7075-T-73, are placed both top and bottom on the mandrel. Attachment and connection holes are predrilled to avoid delaminations in the finished panel. The sheets are then over-wrapped with enough graphite/epoxy to form a finished panel 0.375 inches thick. The fiber content of the finished graphite/epoxy panel is approximately 60 percent by weight. Fiber contents up to 75 percent are possible.

This graphite/epoxy layer is then pressed (debulked) to meet the dimensional constraints and to expel any trapped air in the composite. The panel is then time-temperature cured utilizing a two temperature curing process. The aluminum sheets are then adhesively bonded to the composite with a room temperature cure adhesive and the remaining finishing work on the panels is completed. The final dimensions of the panel are 263 inches long, 24 inches wide and 0.625 inches thick.

The panels are then attached to the bridge girders by sliding them onto the machined tongues and the lateral location holes are drilled. Alignment of the panel is critical at this point to insure interchangeability of the bridge components. To achieve this goal, the steel connector hinges are attached and aligned precisely before the holes are drilled and the panel bolted down. The girders are then assembled into bays and the bays into a complete bridge.

The aluminum graphite/epoxy sandwich panels produced in this manner have a design tensile strength of 140,000 psi and an elastic modulus of 24×10^6psi. This results in a composite panel that weighs 35 percent less and is at least three times as strong as the aluminum panel it replaces.

All panels were proof tested in tension to a load of 500,000 pounds and two were pulled to a failure load of 675,000 pounds. The failures were due primarily to loss of the friction joint at the connectors rather than to tensile failure of the panels. The proof load of 500,000 pounds is the highest load that the panels will see as part of the bridge structures while undergoing a Military Load Class (MLC) 70 crossing (one M-1 Abrahms tank). This load constitutes the design load for the composite material structural requirements for this bridging.

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Impact of the Technology Base on Soviet Weapon Development

By Herbert P. Ely

Discussions of the Soviet technology base often result in widely different conclusions. Some will cite such things as Sputnik, particle-beam weapon programs, and high-energy lasers and conclude that the Soviets are technologically very advanced. Others will look at the general shoddiness of Soviet consumer goods, the continual efforts to buy new industrial processes from the West, and the relatively low share of Nobel prize winners and conclude that Soviet science is hopelessly backward. Both assessments have validity, yet when viewed from the standpoint of the threat presented by the Soviet research and development (R&D) base, both miss the point.

The relevant question may be posed as follows: Since the Soviets have had a very uneven R&D base, one which has constrained them in many ways, how have they been able to develop and field effective weapons in large numbers? This is the important question since it is fielded equipment, not laboratory technology, that will influence the outcome of any future conflict.

The answer to this question will cover four major factors that determine the Soviet ability to operate at the technological frontier: (1) the R&D base, (2) the generation of weapon requirements from military doctrine, (3) the management process for developing and buying weapons, and (4) the philosophy and practice followed by Soviet designers. These four factors interact with one another in a way that may be called the Soviet technological strategy.

There have been several attempts to assess the Soviet R&D base and its support of the overall Soviet economy. General indicators such as (1) the persistent inability to produce enough grain to feed the Soviet people, (2) the unusually high infant mortality rate—roughly three times that of the United States, and (3) the low, declining life expectancy—now approximately 64 years for males, all argue that the Soviet economic and technological base is failing to provide for some vital national needs. It has long been clear that the Soviet R&D base does not respond quickly to many national needs. Leonid Brezhnev in 1971 lamented Soviet inability to innovate:

"We must create conditions that will compel enterprises to produce the latest type of output, literally to chase after novelties, and not to shy away from them as the devil shies away from incense." Nearly 10 years later, before the most recent party Congress, Chairman Brezhnev said:

"However, frequently one encounters impermissible sluggishness in putting promising development into production—whether the matter is the continuous casting of steel or powder metallurgy, unique direct current transmission lines or obtaining high-strength artificial fibers. We must look into the reasons that we sometimes lose our priority and spend large sums of money to purchase from foreign countries equipment and technologies that we are fully capable of producing ourselves, and often of higher quality too."

Professional surveys of the technological status of Soviet industry have reached similar conclusion. R. Amann, J.M. Cooper, and R.W. Davies compared Western and Soviet technologies in eight major industries and concluded that in most of these technologies the gap between the USSR and the West does not appear to be any smaller now than it was 15 to 20 years ago. This is true both for the prototype stage of development and for diffusion of new technologies through the economy.

There are many reasons for the lack of Soviet industry ability to innovate. Joseph Berliner, an economist at Brandeis University, has explored the problem of technological innovation in their centrally planned economy that operates without a market mechanism. Questions of organization, supply of new products, materials, skilled labor, prices, and incentive for managers to undertake the rapid and unpredictable change inherent in innovation are all explored.

In some cases, rapid innovation has been possible. In mission-oriented changes, such as orbiting a Sputnik, for which the central government can set a high priority, success has been achieved in the planned economy. This was especially true if they drew upon only a few suppliers and supporting industries that could also set the priorities necessary for rapid change.

In many other cases, the R&D base failed to introduce new technologies. Those failures occurred when changes in one industry, such as advanced computers, required many other changes on the part of supporting industries. Often these multiple and rapid changes have been beyond the abilities of a centrally planned economy. The Soviet industrial manager knows that any change in his plant is likely to call for changes on the part of his suppliers. Since the suppliers are not likely to cooperate without changes in the 5-year plan, the manager is unlikely to innovate unless pressed to do so.

While the reasons for it are many, the fact is that the Soviet R&D base has displayed weaknesses and has been uneven. While they are compensating for this in weapons design, the Soviets have also undertaken several efforts to improve their science base and to create special pockets of strength and centers of scientific excellence.

First of all, the Soviets have thrown large amounts of manpower and money into the scientific effort. Marxist-Leninist doctrine regards science as a major contributor to the building of a socialist society. As a result, science has high national prestige, and the scientist and engineer enjoy privileges and perquisites not granted to other members of the classless society.

The Soviet scientific establishment is now the largest national scientific organization in the world. It leads industrial nations in numbers, having one-fourth of the world's scientific workforce. Of the 1,262,200 total in 1977, 35,000 have doctorate degrees (which is comparable to post doctoral work) and 353,400 have the candidate degree (which is comparable to the PhD).

This cadre works in 5,000 scientific institutions, a significant increase from the 300 that existed at the turn of the century. Women play a major role in Soviet science. Almost 50% of all scientific workers are women. Few, however, have been made members of the Academy of Sciences.

Budgetary numbers, while only estimates, reflect this activity. In 10 years the Soviets nearly tripled the R&D budget, reaching an estimated 3% of gross national product in 1977. At the same time, U.S. government and private expenditures reached 2.3% of gross national product.

This mammoth effort is managed through the same central planning machinery as is the rest of the Soviet economy. Extensive and elaborate planning mechanisms enable the Soviets to look at national needs and allocate scientific resources to meet them. These needs include defense-related basic research, performed in accordance with the priorities established by the Military Industrial Commission (VPK), which reports directly to the Presidium of the Council of Ministers. Military-related basic research may be done by one of the industrial ministries, or it may be done on contract by the Academy of Sciences or one of its institutes. The Academy retains overall supervision. The Academy also has "invisible institutes," not officially listed, which contribute directly to the Soviet military R&D base.

A third reason the Soviets may be able to field an effective fighting force, even though they have an uneven R&D base, is that they have a well-conceived military doctrine and a process for converting that doctrine into design requirements. Technology occasionally changes doctrine. Postwar development of Soviet military doctrine and its impact on the battlefield are well reviewed by Harriet and William Scott in *The Armed Forces of the USSR* (Westview

Press, 1979). Soviet military historians have subjected the experiences of the Great Patriotic War (World War II) to extensive analysis. This close and careful thought about the battlefield ultimately leads the military to specify what it wants in a new weapon. As stated in Volume VI of the *Soviet Military Encyclopedia:*

"The initial document for the development of weapons and military equipment is the tactical-technical assignment (TTZ), which is the result of a special study of the operational factors and conditions of employment."

Meeting the TTZ performance standard is the prime criterion of a designer's success. Introducing new technology is secondary. An example of how this process works can be seen in the development of the soviet BMP, Boyevaya Mashine Pekhoti (fighting vehicle for infantry). Its requirements and design are described by COL Daniel Malone (*National Defense, July-August 1979*). An extended doctrinal debate led the Soviets to move away from a concept of an armored infantry transporter, such as the preceding BTR series of fighting vehicles. The debate addressed three questions:

- How best can the productive capacity of Soviet factories be used to develop an armored vehicle for motorized infantry?
- How can the new automatic rifles (the AK-47 and AKM rifles) best be exploited?
- What tactical problems should be addressed?

These questions were answered in the context of an extended debate about nuclear war and the need for a vehicle that could function in high tempo, fast-moving, "widely separated armored formation, swarming through and around zones of radiation and nuclear destruction or conducting warfare with greatly increased conventional firepower, speed and maneuver, as an adjunct to nuclear attack." The BMP, introduced in 1967, admirably meets this requirement.

In addition to the R&D base and doctrinal foundation, the Soviets have a set of design practices and a design philosophy that enables them to effectively use available technology. Compared with Western designs, Soviet design emphasize:

- *Simplicity.* In general, Soviet systems are relatively uncomplicated compared with similar Western equipment.
- *Commonality.* Once a basic system or subsystem is developed, it is used on as many systems as possible. With this approach the R&D base does not have to develop as many new systems or to innovate as frequently.
- *Gradual change.* This principle is very close to that of commonality. Each weapon system is very closely related to its predecessor, minimizing the need for innovation and controlling risk. Perhaps the Soviet approach is best summed up in the *Soviet Military Encyclopedia*, which calls for unification of design. Under this concept a single design will serve as a basis both for product improvement and for families of systems.

US AND SOVIET LAND FORCES PROCUREMENT

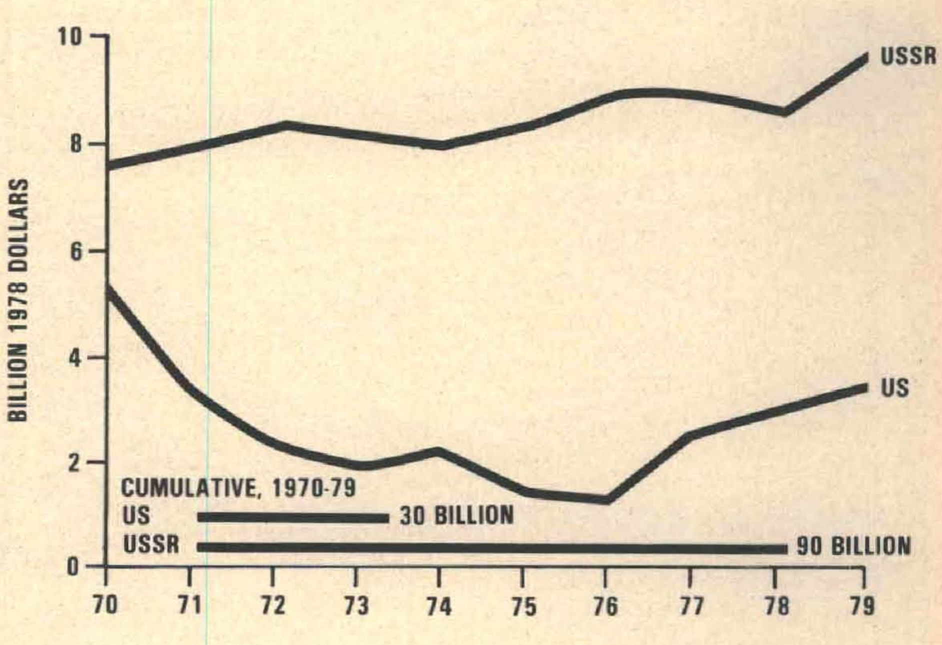

Figure 1

It is the last factor, management and resources, that converts doctrine, R&D base, and design practices into the effective fighting force already fielded by the Soviets. The large amounts of equipment, 50,000 tanks in the field, and the effectiveness of these systems are chiefly the result of heavy Soviet expenditures on arms development and procurement. Both the total procurement and the amount spent on land forces are large. (Figure 1). It is important to note that not only are these figures large, but they are also growing at a steady rate—giving military customers, R&D planners, weapons designers, and manufacturers a predictable environment in which to work.

It is the very effectiveness of the Soviet technological strategy and its consistency in converting mostly incremental technological advances into fielded equipment that form the bulk of the threat. The cumulative impact of these changes often goes unnoticed or is obscured amidst concern over advanced research and technological surprise. Although new-in-principle weapons *may* be developed and although the Soviet advances at the technological frontier *may* markedly change the threat, it should be remembered that the technological strategy will almost certainly extract an increasingly effective fielded fighting force from an existing technology base.

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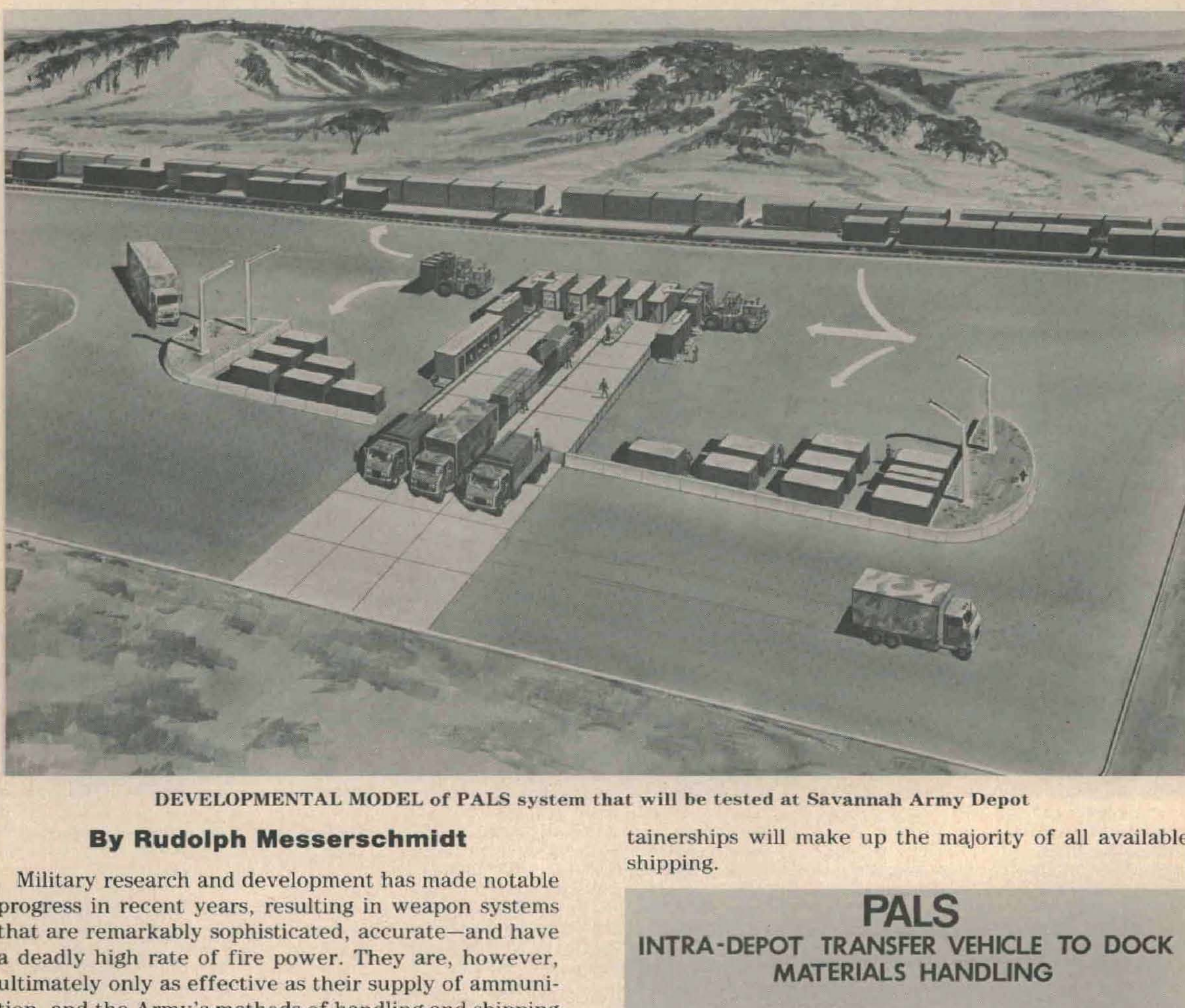
PALS—Robotics System

A New Look In Ammunition Handling



DEVELOPMENTAL MODEL of PALS system that will be tested at Savannah Army Depot

By Rudolph Messerschmidt

Military research and development has made notable progress in recent years, resulting in weapon systems that are remarkably sophisticated, accurate—and have a deadly high rate of fire power. They are, however, ultimately only as effective as their supply of ammunition, and the Army's methods of handling and shipping ammunition have changed very little since World War II and remain by comparison, little better than they were then.

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) is working on improving ammunition handling at CONUS Military Supply Bases with a remarkable system called PALS. PALS, short for Prestaged Ammunition Loading System, is a system engineered concept of ammunition outloading that will enable the Army to take full advantage of the economics of containerized shipping.

By 1985, nearly 55 percent of this country's cargo ships will be able to carry containerized cargo and containerships will make up the majority of all available shipping.

Ammunition consumption accounts for 35 to 40 percent of all tonnage shipped in warfare. Therefore, a logistical distribution system that can make full use of containerized shipping methods for supply and resupply of military explosives is critical to our combat readiness now and in the years ahead.

PALS, being developed under a DARCOM approved Letter of Agreement between MERADCOM and the Defense Ammunition Center and School (the user representative), is designed to shorten the turn around time for outloading large quantities of commercial freight containers at CONUS ammunition facilities during a national emergency. Its operational concept is to handle ammunition outloading as a total system process from the storage site to the mode of transportation.

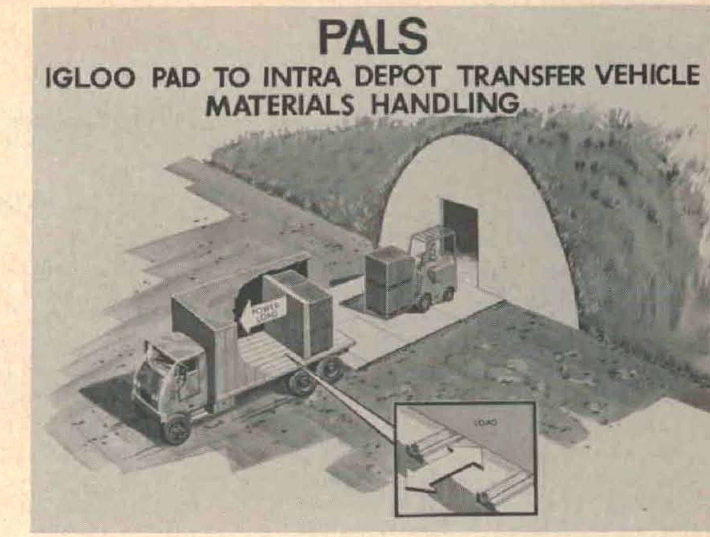
The process begins when palletized loads of ammunition are moved by a pneumatic/electric forklift from the igloo to an intra-depot transfer vehicle equipped with a powered floor cable conveyor system which facilitates loading and unloading the cargo. When this vehicle is fully loaded it carries the ammunition to a loading dock, where it is ejected onto a prestaging conveyor system. The powered conveyor then moves unit loads of ammunition through a conditioning section where plywood separators and cribing is added and next through the register section where it is sized and centered, ready for automatic container outloading.

Optical scanners read bar codes on the ammunition pallet as it passes through the register section to produce the shipment and inventory documents. The prestaged container-load of ammunition then moves onto a dock-mounted roller mat where it is inserted into the commercial cargo container fitted with bulkhead and sidewall fill dunnage by a robotic apparatus. A companion robotic device then installs the end-gate structure and closes out the dunnage load.

The container handling production line is located at the end of the dock and it moves perpendicular to the ammunition handling production line. The 20-foot freight containers are placed onto this conveyor system where they are repositioned to another work station every 10 minutes until they are stuffed and accepted for surface and seagoing transportation. Using the PALS system, the Army will be able to maintain an outloading rate of 100 containers per day per facility by reducing the present outloading time from two hours to 15 minutes.

The heart of the system is a commercial dock mounted loader (DML) developed by the Automatic Truck Loading System (ATS) Corporation in Carlisle, PA. It can outload a 40-foot commercial van with 50,000 pounds of lading in 5 minutes. ATS, Inc. has contracted with MERADCOM to develop the PALS materials handling system which will embody the DML technology in its design.

A critical element of PALS is the dunnage subsystem.



It must secure the ammunition in accordance with procedures approved by the Association of American Railroads and the U.S. Coast Guard.

Thus, two prototype PALS dunnage systems were developed by the U.S. Army Defense Ammunition Center and School, Savanna, IL, and demonstrated at the ATS, Inc., facilities in Carlisle, PA, to insure compatibility with the DML. They were then successfully safety tested by the Regulatory Agencies. The PALS dunnage system for 155mm separate loading projectiles weighs approximately 1200 pounds less than the current wooden system and will allow 3 additional pallets to be shipped in each container.

The PALS R&D program has taken shape in an era of austere funding and is providing new insights into technology that will provide depots, plants, and ports a readiness capability to meet ammunition shipping requirements without a large increase in personnel. PALS will also allow Army facilities to operate more efficiently in peacetime. The system has the potential for saving more than $400 in shipping costs per container. That is more than $40,000 per day for each depot using the PALS technology. A demonstration system is tentatively scheduled to be operationally tested at Savanna Army Depot, IL, in 1985.

RUDOLPH MESSERSCHMIDT is project engineer for the PALS system, and a senior mechanical engineering technician with 30 years experience in hardware development. Additionally, he is a member of the Society of American Military Engineers, the American Defense Preparedness Association, and the National Fluid Power Society.

Defense Against Terrorism . . .

The Army's Physical Security Mission

By Gerald Malakoff

Physical security has become a matter of great concern to the Department of Defense. The threat of terrorism, theft, sabotage, vandalism and espionage is increasing against non-combat military targets such as arms rooms, nuclear facilities and communications centers, to name a few of the more obvious.

The need has a direct parallel in the public and quasi-government areas as the Munich Olympic massacre so vividly demonstrated. Physical security is no longer limited to the keen senses of the sentry.

In meeting the threat arising out of the Vietnam war, the military has developed sophisticated sensors and technology to enhance the ability to detect and monitor an intruder in a tactical environment. The advances in those technologies expanded the base of knowledge applicable to interior physical security.

The three services were assigned different responsibilities within the sensor technology area. Eventually, the Army's concern about vulnerability of military facilities led to a facility intrusion detection mission.

Although physical security technology applies equally well for both military and non-military applications, it is a violation of federal law for the military to apprehend or monitor the activities of civilians. Thus, the special sensor technology expertise available in the Army is transferred to the civilian sector through an adivisory role.

The DOD support of the 13th Olympic Winter Games is a prime example of Army/civilian cooperation. The Army role at Olympic Village started even before the International Olympic Committee chose Lake Placid as the site. It began with the emergence of sensor technology as a major Army mission area.

The application of sensor technology in the role of detection is relatively new. In the early 60s, the Mobility Equipment Research and Development Command (MERADCOM) began investigating a border intrusion detection system.

However, it was not until the mid 60s when the demands of Southeast Asia operations for early warning, surveillance and target acquisition systems resulted in a comprehensive battlefield sensor program effort.

In 1966, MERADCOM was requested to urgently develop a family of exterior sensors for use in Southeast Asia. These sensors were referred to as unattended ground sensors, and were designed for use above or below ground to detect the activity of aircraft, vehicles and people. They were delivered by artillery, by hand, or dropped from aircraft.

Sensing technologies, eventually utilized, included seismic, magnetic, acoustic, electromagnetic, infrared and night vision. Related technologies were also advanced to solve the problems of data transmission, target classification, false alarm rate, cost and so forth.

Emphasis then shifted from sensor technology for tactical operations to physical security. In 1970, the Army was assigned the responsibility to coordinate all research, development and test engineering in physical security within DOD. This role change resulted from concern with the theft of weapons from military arms rooms, and the vulnerability of military bases and installations.

Concern was so great that it resulted in the formation of the Physical Security Review Board with membership representing the Army, Navy, Air Force, Marines, Reserve and National Guard.

MERADCOM was assigned responsibility to conduct the interior program. That agency proceeded to develop an arms room intrusion detection system, designated the Joint-Services Interior Intrusion Detection System, commonly known as J-SIIDS. It was during the testing program of this system that the wide variations of equipment capability became apparent.

On-going programs are aimed at developing an advanced and standardized system for joint-Service use. That system will be capable of detecting intrusion into, theft and pilferage from, or espionage/sabotage activities against all types of facilities located anywhere in the world.

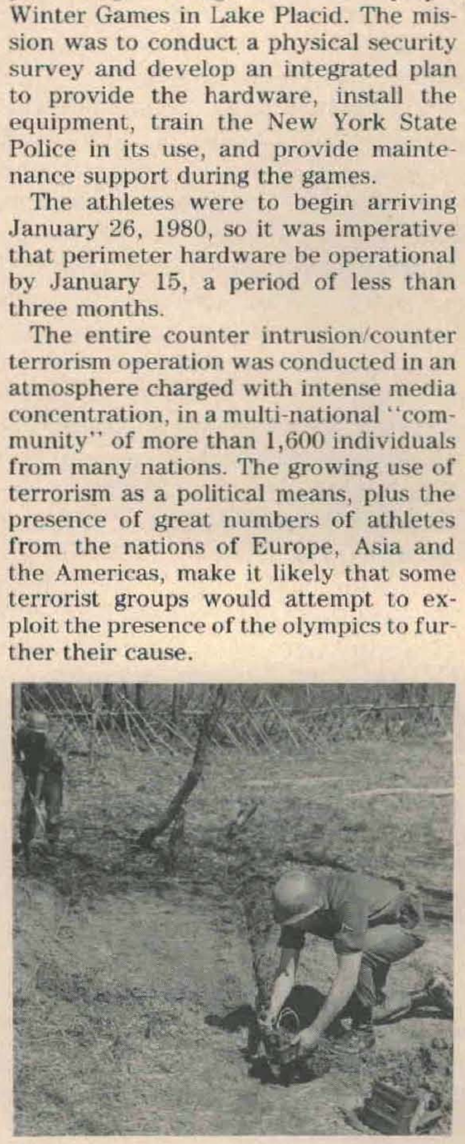
In 1978, the Project Office for Physical Security Equipment (POPSE) was created to serve as the central Army focal point and provide management of the Army physical security equipment program. Principle mission objectives are to develop, acquire, provide and support the most effective security systems, at the most reasonable cost, which will ensure the protection of DOD resources.

POPSE will also assure that the Army's efforts are coordinated with the other Services programs to form a DOD integrated program.

In October 1979, POPSE was directed to assist the New York State Police in providing the physical security at Olympic Village during the 13th Olympic Winter Games in Lake Placid. The mission was to conduct a physical security survey and develop an integrated plan to provide the hardware, install the equipment, train the New York State Police in its use, and provide maintenance support during the games.

The athletes were to begin arriving January 26, 1980, so it was imperative that perimeter hardware be operational by January 15, a period of less than three months.

The entire counter intrusion/counter terrorism operation was conducted in an atmosphere charged with intense media concentration, in a multi-national "community" of more than 1,600 individuals from many nations. The growing use of terrorism as a political means, plus the presence of great numbers of athletes from the nations of Europe, Asia and the Americas, make it likely that some terrorist groups would attempt to exploit the presence of the olympics to further their cause.



Multipurpose Concealed Intrusion Detector (MCID), an early development of a physical security sensor, uses magnetic sensing to detect intruders.

A successful terrorist penetration, taking of hostages, and the potential death toll, such as occurred at the 1972 Munich Summer Olympics, could not be permitted the slightest chance of success at the 1980 Winter Olympic Games. The emphasis on security had to rank extremely high on the list of priorities, before and during the games at Lake Placid.

It was generally agreed that the Olympic Village, the official residence of the athletes and staff, was vulnerable. Vulnerability existed because of a variety of reasons: first and foremost was the fact that athletes lived together by national groups. This meant a high degree of potential hostages would be concentrated together, especially in the midnight to dawn time frame when no events were scheduled.

At all other times national groups would be dispersed and the opportunity for seizing hostages reduced accordingly. Achieving the degree of physical security-counter intrusion protection required, brought into play both civilian and military technologies.

Principal subelements and technologies employed included unattended ground sensors. These detect seismic, magnetic, infra-red or acoustic stimuli. They are capable of detecting a wide variety of intruders over a diverse range of terrain and climatic conditions.

A control center with special sensor monitors, recorders and large area displays were used to permit the positive tracking of intruders along the various avenues of approach leading into the olympic village.

Close circuit television utilizing small, commercial cameras suitable for operation under weather extremes, and various lighting conditions, were employed as part of the Village's perimeter defense system. These cameras were used in conjunction with hard-wired monitor and recording sets in the security control center.

Four x-band, low power, short range military doppler radars were used to supplement perimeter surveillance and to confirm targets as an integral part of the village's perimeter defense system. Audible signals permit target type classification, and a range gate permits determining range and azimuth to the intruder.

Night vision devices were deployed with the New York State Police. Goggles permitted zone patrol and reaction forces to operate under conditions of virtual total darkness. The tripod-mounted night observation device utilized image intensifier technology for surveillance of VIP transient aircraft on the ground at Saranac Lake Airport.

Directional Infrared Intrusion Detector (DIRID), a Vietnam-era hand-emplaced tactical sensor, was used by N.Y. State Police for Olympic Village surveillance.

Lighting was also an important part of the physical security system. A good lighting system serves to enhance the effectiveness of patrol and surveillance forces, and materially improves the effectiveness of television equipment and monitoring operations. Duress sensors were used by guards to alert the control center in an emergency, by sending silent signals to the monitor located in the control room.

No doubt discouraged by these precautions, no terrorist incidents occurred during the 1980 Winter Olympics and the spirit of happiness, conviviality and fellowship prevailed. This joint military/civilian security effort was highly successful, and it demonstrated that Department of Defense elements were fully capable of providing a quick reaction capability which is not found elsewhere in these areas.

Military support involved specialized physical security technology, protective surveillance and counter intrusion assistance to civilian law enforcement and security authorities. It further showed that a combination of tactical and commercial equipment offer advantages for short term mission requirements in terms of its ease of operation, quick deployment, ruggedness recoverability, and logistic train for maintenance and resupply.

The project achieved its goal and was a credit to all organizations and personnel who participated, and valuable lessons learned will be applied to future DOD supported civilian security operations.

The Counter Surveillance/Counter Intrusion Laboratory of MERADCOM continues to conduct research and development to improve on the Army's physical security mission. Today, the main emphasis of the physical security program is on the development of the Facility Intrusion Detection System, commonly referred to as FIDS. It is a highly secure and modern microprocessor controlled system for Joint Services application.

The basic FIDS employs a variety of intrusion detection sensors, surveillance systems and deterrent devices to protect up to 256 internal and external areas. These areas are connected by a secure communications link to a command, control and display console.

The threats of terrorism, sabotage, theft, vandalism and espionage remain a matter of great concern to the Army. These continuing threats are being executed by an increasingly more sophisticated adversary. They are constantly being analyzed to insure that the security equipment being developed by MERADCOM will meet the safeguard requirements of the Department of Defense.

GERALD MALAKOFF is technical assistant to chief, Counter Surveillance/Counter Intrusion Laboratory, U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA. He received his BS degree in electronic engineering from the University of Arizona in 1958. He has been involved with R&D and/or logistics throughout his professional career.

Spares Provisioning for the Project Manager

By MAJ Bruce D. Sweeny

The Department of Defense currently has thousands of ongoing materiel systems in development, but it will never field most of them. Among the systems fielded, most will be delayed and will suffer lower operational availability than required. The causes are often ignorance or neglect on the part of the project manager and his staff. This is especially true in the realm of acquisition logistics.

Project management offices are often responsible for development and acquisition of several independent nonmajor materiel systems. Unfortunately, most of these offices have access to too little expertise in acquisition logistics. Yet, the PM is directly responsible for the effectiveness of the logistics development of his projects.

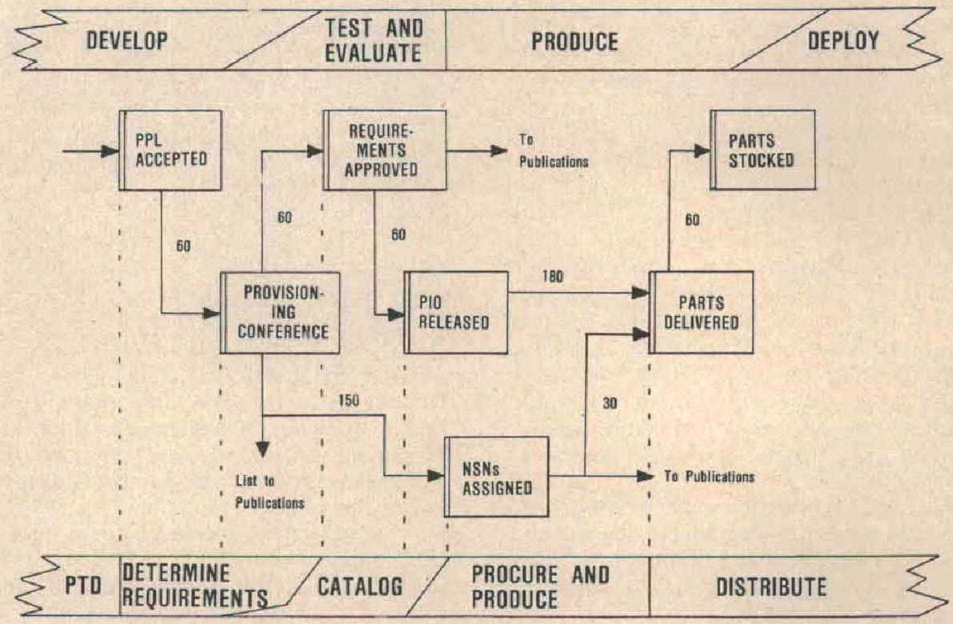
The ultimate purpose of project management is to provide a useful, reliable, and *supportable* item to the field user. Spares provisioning provides a focus for integrated logistics support development, which, if sufficiently understood and managed by the PM, can insure effective logistics support at the time of initial deployment.

Initial spares provisioning is the process of placing spare and repair parts in the hands of using activities who must operate and maintain an end item for an initial period of service. This initial period extends up to four years from the date of initial deployment, and it is here that the reputation of the new item is made or lost.

Equipment failures are to be expected, but, if repairs cannot be made in a timely fashion for lack of the correct spare parts, the equipment gets a bad name. During this initial period, experience is gained on actual demand for parts.

The initial provisioning cycle very often aborts or becomes so muddled that exceptional efforts are needed to support continued deployment and operation.

Normally, the corrective process takes one of two routes. Either the provisioning must be redeveloped or parts acquisition must be accomplished outside the automated process. Both alternatives result in wasted funds and lost time. Most important, the early deployed systems are without proper support—destroying system credibility.



Basic Process (minimum times shown in days)

The two overriding concerns of any manager are time and money. Frequently, the time required for the administrative phase of provisioning exceeds the lead time for initial production, especially for commercially available or modified commercial hardware.

Costs of spare parts approximately equal the acquisition costs of the end items over the operational life cycle.

Because of this impact, project management staffs must understand the process, recognize potential pitfalls, and know apriori solutions or approaches available. Effective management depends on advance knowledge, realistic planning, and efficient organization.

The Basic Process

As shown in the accompanying chart the spare and repair parts provisioning process links with the overall development, production, and deployment phases of materiel acquisition. A brief description of the provisioning process may facilitate understanding common problems and potential solutions.

The process divides functionally into five tasks—documentation, determination of requirements, cataloging, parts procurement, and distribution. Preceding all of these tasks, of course, is the need to plan ahead for provisioning as an integral part of logistics and acquisition strategy.

Provisioning technical documentation describes technical data normally obtained from the prime development contractor. Input data include identification of parts, organizational hierarchy of the item, quantities and reliability.

The product, a provisioning parts list, usually in machine processable form, must be backed by an approved technical drawing package for independent government verification.

Acquisition doctrine calls for generation and validation of provisioning technical documentation during full-scale development. The provisioning parts list should be accepted long before the formal test and evaluation period so that a preliminary stockage decision can be made, thereby facilitating parts availability for operational tests.

Since the mass of data required in the parts list, even for non-major systems, makes data errors inevitable, the project manager must not only minimize but accommodate technical documentaton errors in a way that contributes to progress.

The alternative, ultimately, is a delay in deployment of the prime system. A practical solution is to initiate follow-on tasks after the data achieved an acceptable confidence level and then to follow up all discrepancies in a disciplined manner. This technique requires dedicated manpower, access to the formal parts data base, an off-line control data base, and, most important, interdirectorate cooperation.

One other aspect of documentation is the determination of what to buy. An unfortunate tendency in acquiring provisioning technical documentation is to accept the "standard package" without reference to a provisioning plan—tailored to the peculiar needs of the materiel end item. Complicating the process is the reality that the maintenance concept and ultimate distribution of the prime system are not yet firm.

Almost anything in the way of educated guesses in tailoring the provisioning technical documentation is better than apathetic reliance on a "standard package," which probably was originally tailored to the needs of some long-forgotten end item bearing little similarity to the current object.

Determining requirements is the most technically and procedurally complex phase of provisioning. This complexity stems from the need to integrate technical documentation, maintenance concepts, and deployment data in a manner that logically predicts the quantities of each spare part needed in the field or depot supply system.

The project manager's first and supremely important task is application of the approved maintenance concept to the parts listing; second he must select a computational model.

Additionally, the project manager must establish or amend a budget long before an order can be made. The outputs of the process include a provisioning item order, which is released to the supplier, and a screened list of repair parts for use in cataloging and equipment publications.

The maintenance concept firms up during full-scale development and is translated into a maintenance allocation chart (MAC). The MAC is a critical element in translating the provisioning parts list into a complete data base suitable for modeling requirements and cataloging.

Looseness in interpretation of the MAC must be corrected before the provisioning conference, or cause significant confusion and delays. Purchase of maintenance recommendations as a part of the provisioning list may provide an effective vehicle for facilitating the conference.

At the conclusion, the project manager knows what parts may have to be stocked, but he then must determine how many of each should be stocked at the various echelons of supply.

Computer programs calculate quantitative requirements in all but the simplest cases, and once approved by the PM, translate into procurement orders and authorizations for field stockage. Use of a demand-based model is imposed unless a sparing-to-availability model is authorized.

Demand-based models are very conservative in stockage decisions and may well result in the purchase of too few of the parts unique to the end item and extremely long lead times for reorders.

This phenomenon is most common for large complex electronics assemblages (production lead times as high as 44 months). The end items fail frequently, but always for a different reason!

The sparing-to-availability modelling technique permits optimum expenditure of secondary item funds on all parts according to the contribution each makes to the availability of the prime system. The models also compute the quantity of each to buy and the appropriate stockage echelon. Models approved for use include SESAME, ACCLOGTROM, and Firefinder. The models should also be used early in the provisioning cycle to predict requirements for the spares budget. The project manager must plan early if these models are to be used, since they require more provisioning technical documentation upon which to base stockage recommendations.

Cataloging is concerned with the portion of the parts list selected for stockage by the provisioning conference. It determines which items are in use by other weapon systems and assigns each part a uniquely identifying stock number.

The output, a stock number list correlated with parts identification data, is provided to the manufacturing contractor for labeling of the parts, incorporated into technical publications and, of course, are necessary for supply managers.

Cataloging accuracy depends primarily on the quality of the parts listing as augmented with maintenance data. Minor engineering changes and high-quality technical documentation make cataloging a relatively simple process with the exception of items used in the materiel systems of other services. Items managed by the other services must be carefully coordinated to register new users and pave the way for consolidated spares acquisitions. As prime system engineering changes and data corrections increase, a cataloner may be required for consistent application on an as-needed basis.

Procurement of the selected spare and repair parts, less long lead time items bought during development, is a relatively straight-forward but time-consuming process. Once an item order is generated and funding is established, the project manager must accommodate the administrative lead time for procurement.

Processing and negotiation of the contract by program management and contracting personnel currently consumes approximately six months if a contract vehicle has not been previously established. From contract award, production times approach the times required by the end items for the more complex, high-level spares.

Long pre-contractual lead time requires early planning of the procurement strategy. Computer-driven orders for "single line items" complicate the contractual process because they require duplicate administrative actions equal to the number of line items unless management makes a special effort to coordinate batch handling of orders for system peculiar spares.

The project manager must consider several procurement approaches. These include spares contracts separate from, or integrated with, end item production contracts and initial contractor support for selected parts. For example, spares acquisition integrated with production takes advantage of price breaks for quantity buys.

High cost, critical spares bought on the initial contract for production of the end items reduce administration and start-up costs. Beyond the price break, the principal advantages are insurance of timely delivery of the correct spares even when changes occur in design. However, initial stockage of spares is not practical for all materiel systems.

Interim contractor support is a technique that makes the prime equipment contractor responsible for providing spares that cannot or should not be procured in quantity. This technique permits delayed procurement of parts that are likely to become obsolete through change or for which demands are very unpredictable. Disadvantages of this technique include increased cost and complexity for each transaction and direct dependence on commercial sources for quick response.

Parts are distributed to field or depot stockage after coordination by either a "push" process or a "call forward" process. Current doctrine dictates the latter approach which necessitates long-term coordination between the project manager, the parts stockage manager, and the ultimate field user. Management can release the end items to the field only after confirmation that the spares have been distributed to field stockage echelons. Success of the distribution process depends ultimately on rapport between the PM and the user. Vital to the process is knowing where the parts are; they must be tracked throughout production, shipment, and storage. The message here is not to relax once the parts are on contract or interdepartment order.

Making It Work

The initial provisioning process consumes a minimum of two to three years. Critical to the process is the long-term continuity of assigned personnel. The functional breakdown of these responsibilities puts a premium on coordination and planning—the responsibility of project management.

Provisioning, a lengthy, complex, interdependent process involving precise tasks, is executed in a highly decentralized manner. Decentralization of the basic process among three to five essentially independent directorates in the materiel development and readiness communities, has led to ineffective and inefficient provisioning. Maintenance technicians, coding specialists, inventory managers, procurement officers, and catalogers each report to chiefs who are not responsible for the whole process or to the PM.

The initial provisioning process has developed to the point that very few people know enough about the whole system to guide programs through it. Specialists responsible for the quality of their specific output handle pieces of the process rather than concern themselves with the ultimate success of provisioning.

A major contributing factor is personnel turbulence caused by inconsistent assignment of limited personnel resources to each project. The basic provisioning system is overregulated, overcompartmentalized, and interdependent to the extent that effective provisioning is accomplished more by accident than by plan.

Problems of coordination may seem almost insurmountable since each functional activity demands perfect data before it assumes responsibility for its phase. Finger pointing or apathy become commonplace, and the result usually is either inadequate, incomplete, or late provisioning.

No one individual is to blame except the project manager. Several of the problems stem from the inherent complexity of provisioning. To combine all the pieces, someone knowledgeable of the materiel end item must be given authority and personnel resources to plan and complete the process.

Personnel limitations may preclude assignment of a complete, dedicated provisioning team per project office, but long-term of shared experts may provide a workable solution. Although careful scheduling of individuals will be a challenge, the process can be expedited with a strict schedule negotiated between project managers and readiness directors and enforced under sufficiently flexible guidelines.

Because provisioning takes so long, it may be necessary to accelerate the process to provide required spares support for test or initial deployment. Two techniques have been attempted and both are still somewhat experimental. One method saves up to five months by augmenting the provisioning conference team and providing it authority to create the provisioning item order at the meeting. Of course, this increases the risks of buying unnecessary spares or introducing errors.

Another method divides the process, expedites the most critical spares acquisition by up to four months, and allows the procurement of other parts at the normal pace.

Despite the overall complexity of provisioning, it will establish the mode for life-cycle support for a new weapon system. It must work adequately-within cost and time budgets. If the project manager does not closely monitor and direct the process, it will probably not provide satisfactory results. He must develop a plan, revise it as necessary, and follow it.

For most systems, special tailoring of the plan and the processes themselves is necessary. Spares acquisition integrated with production, sparing-to-availability, accelerated provisioning, initial contractor support, and other special processes can solve many problems.

The project manager remains the responsible official, with or without organic expertise in provisioning and he must give continual attention to every phase of the process. In order to succeed, he must understand the functional provisioning system, tap and integrate provisioning power centers, and, most important, formulate and coordinate a realistic, tailored provisioning plan well before the start of full-scale development.

MAJ BRUCE D. SWEENY is presently a student at the Air Command and Staff College, Maxwell Air Force Base, AL. He holds a BS degree from the U.S. Military Academy, an MS degree from Dartmouth College, and an MBA degree from Long Island University. His career assignments have included service as a development project officer and assistant project manager for logistics at the Army Communications Electronics Command.

Methodology Division Plays Key Role in Reviewing Test Procedures

Testing military equipment is no easy task. It requires the talents of thousands of top engineers, scientists, and technicians.

However, those skills, no matter how great, are of little use to military planners unless the results of their testing operations are standardized, reproducible, and flexible enough to meet the challenges offered by the wave of new technologies presented by new and projected hardware items.

Making certain that testing methods meet those goals is the major responsibility of the U.S. Army Test and Evaluation Command (TECOM) Methodology Improvement Division, located at Aberdeen Proving Ground, MD.

According to Mr. Grover Shelton, chief of the division, his 16 specialists have two primary missions. "We have the responsibility for methodology development and international standardization (among the Allies) of testing methods and procedures," he said.

Methodology development is concerned primarily with developing the techniques to test new systems and technology that will be coming on the scene in the next few years, and to develop guidelines on the kinds of instruments and gauges needed to collect usable data on them.

The primary methodology requirement is to develop studies which can be converted into formal papers called Test Operations Procedures (TOPS), so that there will be standard ways of testing equipment.

The aim of TOPS documents is to get reproducible results on similar tests done in the command's numerous proving grounds and test centers.

While Aberdeen Proving Ground is the largest volume test site of the TECOM installations, the command maintains eight other installations and activities ranging from the tropics to the arctic, and from the East Coast to the desert Southwest.

So far, more than 600 of the documents on test procedures have been developed, ranging from boot testing to exotic vulnerability tests on heavy armored vehicles.

Knowledge gained in field testing and in developing studies is the core, or prime ingredient, in developing a TOP.

Bub Huddleston, deputy director of the division, said that six working groups of specialists are in charge of coordinating development of testing methods. There is a Shock and Vibration Group, Electromagnetics and Electrostatics Group, a Laser Group, Nondestructive Testing Group, an Environmental-Technical Group, and a Pressure Measurement Group.

"Besides generating TOPS, the division fills testing voids, or areas for which we have no current capability. They identify the technology that needs to be developed, generally with the help of testers in the field who see a problem developing, then send funding to the field to finance the necessary studies to fill those voids.

TECOM has a total budget of nearly $400 million, but the Methodology Division spends only about $4 million.

International standards, the other major responsibility of the division, is becoming an increasingly important idea to allied governments.

"At the Army level, we have more than 600 TOPS documents. They are unique in the world. No one else has them. Our having them, and the capability to produce additional ones, is how we got this international standardization mission last year," Shelton said.

APG Addresses Weapons Testing Noise Problem

One of the unavoidable by-products of large caliber weapons testing is noise. However, experts at the U.S. Army's Aberdeen Proving Ground, MD, are developing innovative methods of dealing with the problem.

A system now in use enables APG's Materiel Testing Directorate to predict, in general, how loud firing noise will be in surrounding areas based on weather factors. However, work is underway at fine-tuning the system and developing ways of reducing noise at its source.

Mr. John Feroli, chief of the MTD Methodology and Test Management Division, said that APG never fires if there is a potential for off-post damage and that all attempts are made to minimize noise that may be annoying to APG's neighbors.

Practical concerns have been reduced to a mathematical system of predicting how and where sound will travel, and at what intensities it will be heard from various distances.

According to Mr. Dave Gross, a mathematician with MTD's Analytical Branch, APG has formulated a system for predicting noise levels based on weather data taken at least three times a day. Data are obtained from weather balloon flights and the information is sent back to a central meteorological observatory and put into a computer system.

Estimating weather and noise conditions was done by hand and often required up to two hours. Now, the automated prediction system can provide the same results in less than 40 minutes.

Gross reports that the new system can be used in two ways. First, it can be used as a warning on when not to fire, or to reduce firing operations. Additionally, it can be used to tell when conditions are ideal for firing so that noise can be minimized in surrounding areas.

TOW Trio

"Family" portrait compares the two latest versions of the U.S. Army's TOW (Tube-launched, Optically tracked, Wire-guided) antitank missile with the basic model (left) which is 45.7 in. (1.2m) in length. The center missile is ITOW (Improved TOW) that features an improved five-inch diameter warhead and an extensible probe (shown extended) to provide stand-off detonation and greater armor-piercing capacity. The missile to the right is the more advanced TOW 2. It has a heavier six-inch diameter warhead, extensible probe, and a higher impulse flight motor. TOW 2 also will have improvements in the guidance system to cope with the "dirty" battlefield environment, including smoke and countermeasures. Hughes Aircraft Co. is in production on all three TOW missile versions. Texas Instruments, Inc., is the principal subcontractor for the TOW 2 ground launcher modifications. The Army Missile Command at Redstone Arsenal, AL, has overall management responsibility for the TOW system. (Also, see p. 26).

Federal Government Funding Support for R&D Estimated at $37.0 Billion During CY 1982

Federal Government funding support for R&D during CY 1982 is estimated to be about $37.0 billion, up 13.3 percent from 1981. This represents 47.7 percent of the total 1982 national projection of $77.6 billion for R&D.

Industrial funding for 1982 R&D is forecast at $37.7 billion (48.6 percent of total), up 11.4 percent from 1981. Funding by academic institutions is expected to be $1.7 billion (2.2 percent of total) and other nonprofit organizations will provide $1.1 billion (1.5 percent).

These estimates were prepared by Dr. Jules J. Duga, with assistance from Dr. W. Halder Fisher, of the Department of Resource Management and Economics Analysis at Battelle Columbus (OH) Laboratories. Data were drawn from many sources, including the National Science Foundation reports, and the McGraw-Hill Annual Survey of Business Plans for R&D Expenditures.

A national increase of $8.5 billion (12.4 percent) over the $69.1 billion that the NSF estimates was actually spent for R&D in 1981 is forecast.

While most of the increase will be absorbed by continued inflation, Battelle forecasts a real increase in R&D expenditures of 3.7 percent. This is slightly higher than the 8-year average rate of 3.4 percent in *real* R&D effort that has been experienced since 1973.

The Battelle report indicates industry will remain as the dominant *performer* of R&D. In 1982, performance of R&D by industry is expected to rise to $55.0 billion, or 70.8 percent of all research performed. This compares with $10.1 billion (13.0 percent) for the Federal Government, $9.7 billion (12.5 percent) for academic institutions, and $2.8 billion (3.6 percent) for other nonprofit organizations.

Battelle notes that Federal funding supports research performance in all four sectors. Currently, about one-fourth goes to support R&D conducted by the government itself; almost half goes to industry; approximately one-fifth goes to colleges and universities; and the rest, about one-twentieth, goes to other nonprofits.

Industry absorbs almost all of its own funds, either performing the R&D itself or contracting with other industrial performers. Its contracts and grants to colleges and universities slightly exceed those to other nonprofit institutions. Other nonprofits finance both themselves and the academic institutions about equally; colleges and universities use up all the funds they originate.

Four government agencies dominate the federal R&D scene and are expected to account for 87.9 percent of total federal R&D funding in 1982. These are the Department of Defense, 57.0 percent; the National Aeronautics and Space Administration, 13.6 percent; Health and Human Services, 9.9 percent; and the Department of Energy, 7.4 percent.

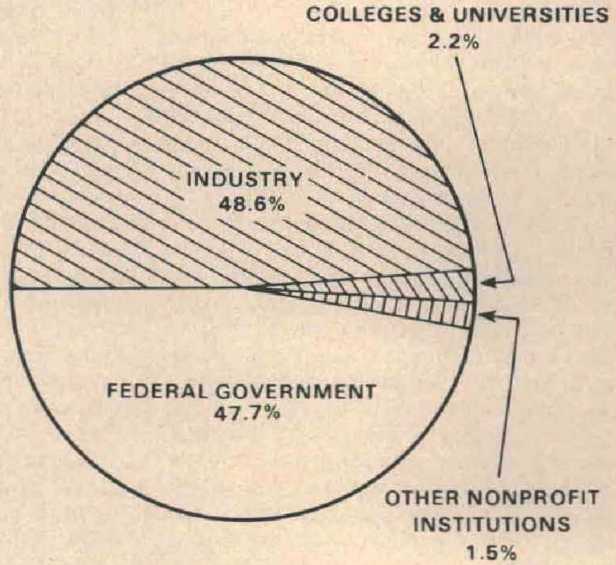
The forecast notes that national security, reflected in the Department of Defense budget, is the dominant driving force in furthering R&D spending. While increases in real spending are expected in space and health, Federal efforts in energy R&D are expected to decrease, with activity in energy research being assumed more by industry.

While the Federal Government has, in the past, been supportive of research in the so-called "soft" science areas, it is evident that such support will be significantly curtailed during the coming years. Decreases in real spending in these areas are expected to reflect the present Administration's policy of returning more program definition and decision making to lower levels of government.

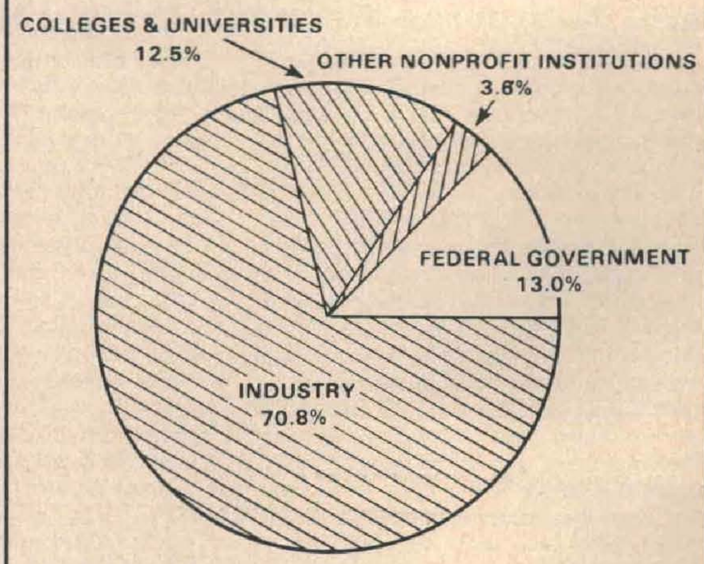
Industrial support of research is growing in fields related to electronics, communications, advanced machinery and in those fields most directly influenced by the need for more energy-efficient products and processes. R&D will be heavily self-funded in the manufacturing industries, where on the average, only 31.8 percent of the total will be supported by the Federal Government. Non-manufacturing industries do relatively little R&D, and support for this activity will be divided almost equally between Federal and industrial support.

R&D EXPENDITURES IN THE U.S., CALENDAR YEAR 1982

The total forecast by Battelle's Columbus Laboratories is $77.6 billion. Distribution shown here is by source and performance.



a. By Source of Funds



b. By Performance of R&D

Source: Battelle's Columbus Laboratories

As part of the forecast, Battelle estimated the industrial versus Federal support for the R&D performed by several broad industrial sectors. In 1982, Battelle expects aerospace to be the industrial manufacturing sector leader in total R&D, with funding of more than $12.2 billion. Of that, 26 percent will be industrially funded. The electrical machinery and communications industry is forecast to have the second largest total R&D support with nearly $11.0 billion. Of that, 58.6 percent will be industrially funded.

Other industrial sectors Battelle estimates will receive more than $1 billion in R&D funds include:

- machinery—$7.6 billion, 87.3 percent of which will be industrially funded
- autos, truck and parts, and other transportation—$6.5 billion, 86.1 percent of which will be industrially funded
- chemicals—$5.7 billion, 91.7 percent of which will be industrially funded
- professional and scientific instruments—$3.0 billion, 91.8 percent of which will be industrially funded
- petroleum products—$1.9 billion, 84.0 percent of which will be industrially funded.

The Battelle report also compares the four performing sectors in terms of their relative costs of R&D. From 1972-1982, costs of all R&D, as an average, are estimated to have risen by 105.2 percent. Increases in the individual performing sectors —over this same time period—are expected to be: Federal Government, 108.2 percent; industry, 101.0 percent; colleges and universities, 124.3 percent; and other nonprofits, 117.2 percent.

During 1982, the overall cost increase for all R&D is estimated to be 8.7 percent. By sectors, the increases are estimated as government, 11.4 percent; industry, 7.7 percent; colleges and universities, 10.3 percent; and other nonprofits 12.1 percent.

In addition, the forecast discusses the impact the 1981 Administration postures and actions are likely to have on R&D expenditures in 1982.

According to the report, it is anticipated that the Administration's posture, relative to business and industry, may continue to provide an atmosphere more conducive to industrial R&D. In particular, greater efforts will be directed toward both short-term and long-term R&D aimed at an improved competitive position vis-a-vis foreign competition.

The move toward the so-called "reindustrialization"—including the R&D necessary to adapt new processes to old product lines—will require continued investment in advanced technology. In addition, new tax credits for increases in industrial R&D are expected to have some small impact.

This positive attitude toward industrial R&D is partially tempered, however, by general business slowdowns, increased unemployment, decreased profitability, and high interest rates.

Microclimate System Controls Temperatures Inside Protective Suits

Development of a new system for controlling temperatures inside the protective suits of tank crewmen has been reported by the Materiel Testing Directorate, Aberdeen Proving Ground, MD.

According to Ms. Pam Jubic, director of an Aberdeen Proving Ground Materiel Testing Directorate, feasibility test of microclimate cooling-heating systems, the Army's Natick R&D Laboratory and the Mobility Equipment R&D Command have developed a new system for controlling temperatures inside the tanker's protective suit.

"They have developed two kinds of vests that fit under the protective suit. The vest is worn over the T-shirt and pumps a coolant over the torso," she said.

The Ambient Air Ventilation Microclimate System (AVMCS) is composed of a fire-resistant vest with open-ended air lines runing along rigid supports in the vest structure.

According to Jubic, air is drawn into a central pump unit, and fed to the vest through air lines. "The air hoses are fairly bulky, and the system won't do a whole lot if the outside temperature is extremely high," she said.

The other air-based system, the Air Conditioned Microclimate System (ACMS), incorporates an external refrigerator unit which fits on the rear of the tank turret, pump-regulator box inside the turret, (a control unit), and uses the same vest as the ambient air system.

Refrigerated air is fed from the cooler to the soldier through the same air lines used for the AVMCS.

A third item being tested is the Liquid Conditioned Microclimate System (LCMCS). In this system, according to Jubic, an external refrigerator is attached to the rear of the turret, with lines running through an antenna hole to a central control inside the turret.

Basic temperature and water flow may be set on the control, but each crew member may also control temperature by regulating coolant flow through the vest's internal lines. Earlier prototype development testing had been done at the Yuma Proving Ground which showed that such systems could work.

The test at APG is a human factors feasibility study, designed to show whether tank crews can work inside the already cramped turret with the additional gear. The vests, all made of lightweight materials, are form-fitting and weigh less than two pounds.

One of the systems, or a modification of it, may be in soldiers hands in the next few years if design and installation problems can be worked out so that units can be fitted into the tank. (In the test, cooling and pumping units, as well as transfer lines are not built directly into the M60A1 test tanks).

"What we're doing with the test, basically, is looking at what effects wearing the vests has on a crew's ability to perform its task," she explained.

During one set of tests, crews will perform firing and maneuver tasks while wearing protective clothing, and no mircoclimate control system. Subsequent tests will have the crewman doing the same tasks, but wearing the experimental control systems.

The idea behind the vests is that if body heat is carried away from the torso, body temperatures can be kept low enough to prevent serious injury even in the most extreme of climates U.S. soldiers would be expected to face.

Other elements of the test include looking at hose placement on the vest, connection of hoses to vest, the connecting-releasing arrangement, and whether the hoses impair the soldier's ability to work within turret confines as well as ease of donning and removing the vest.

Jubic said she doesn't know what the final system will cost, if adopted by the Army, but the cost probably isn't a major factor in the Army's decision to cool soldiers rather than the tank interior.

The idea behind protecting the soldier, rather than cooling the tank's interior, is that if the tank has to operate in a "dirty" environment, and soldiers are forced to open the hatches for some reason, then the interior would be just as contaminated as the area. "This way, soldiers can remain in their protective suits until the tank can be decontaminated," she said. It is also much more efficient to provide individual climates than to try to protect a whole tank.

APG Ammunition Processing Section Performs Many Roles

Managing the vast flow of ammunition of all calibers used at Aberdeen Proving Ground, MD, is a massive undertaking. However, as big a job as it is, each round gets special treatment from a band of experts who build that ammunition as carefully as the gunsmithing craftsmen of the 19th century did.

Those experts belong to the Ammunition Processing Section of the Materiel Testing Directorate (MTD). They perform a myriad of jobs from assembling artillery projectiles to clearing duds from impact areas, according to Mr. Bob Bourn, chief of the section.

"Ours is the kind of work where you're only allowed one mistake . . . you can't erase your errors in this job, then go back and write it over," he said.

The section is divided into two major units . . . a High Explosive Load-Destruction and Recovery Unit, and the Assembly Plant, Load, and Environmental Unit.

The High Explosive Loading Unit, the senior of the two units, is responsible for most of the sensitive, or potentially dangerous work in the section. They cast load, assemble, disassemble, and modify ammunition for tests, and record test data. They also remove dud, and inert ammunition components from range areas, disassemble and destroy duds, and demilitarize ammo components.

Other jobs done by the high explosive unit include static test firing of major weapons; spot check assembly plants and test areas when required, to make sure ammunition is used according to test specifications; safety; and, operating requirements.

Bourn said the unit also inspects ammunition during and after handling to make sure it hasn't been damaged. They look for hazards to testers and equipment which might be caused by defective ammunition, and demilitarize some ammunition for training purposes.

One of their biggest jobs is recovering inert or explosive components from the ranges for evaluation. Along with that, they destroy dud or left-over ammunition found on all APG ranges, and perform demolition work for the post and tenant activities.

The Assembly Plant Unit, though generally not involved in such tricky work, is busy too. They do a lot of the same things the other unit does, but they're more concerned with actually assembling the ammunition used for training and for testing here. They also do a great number of inspections, and checks to make sure all safety requirements are met.

The environmental unit sets up and operates portable or fixed environment chambers at the test sites to "condition" ammunition so that it meets requirements of the test.

According to Bourn, the section can simulate conditions such as heat, cold, sand, dust, and other extremes of nature, which U.S. weapons may be expected to perform in during some future hostility. This makes test results more realistic and reliable.

During a typical month the crews process, build, or dismantle more than 140,000 separate pieces of ammunition, ranging from small arms to the largest caliber weapons in the Army inventory.

SPARC Aids in Critical Combat Systems Support

In Napoleon's time, an army may have traveled on its stomach, but with today's high technology warfare, an army's progress is largely dependent on its equipment and the means to keep that equipment operational. Consequently, the Army has devised SPARC.

SPARC (Sustainability Predictions For Army Spare Component Requirements For Combat) was established in 1977 and has been under development by the Army Materiel Systems Analysis Activity (AMSAA) at Aberdeen Proving Ground.

According to Mr. Wilson Heaps, SPARC program coordinator, SPARC has three objectives designed to sustain critical combat systems. They are to predict which parts will be damaged in combat, to create product improvement programs to increase survivability where feasible, and to develop combat damage repair programs for the field to extend a system's availability for critical periods of time.

"AMSAA's role has been to develop the methodology and do the initial analyses. We have done the majority of studies to date," Heaps said.

In the past, studies for spare parts requirements were based on peacetime reliability and wear-out rates. "However, it became apparent that there were other things that had to be considered," he said. "First, since the systems are used more intensely in combat, the wear-out rate increases. Also, parts of systems sustain damage in combat."

The Department of the Army recognized the need to develop and implement programs for determining spare parts requirements for combat. The U.S. Army Materiel Development and Readiness Command assigned AMSAA to develop a pilot SPARC program for the Cobra helicopter in 1978.

The study was completed in 1980. Since then, SPARC programs have been developed, or are under development for several other pieces of equipment, including the Blackhawk helicopter, M60 and M1 tanks, M113 personnel carrier, M109 howitzer and the M163 Vulcan carrier.

Methodology for the SPARC program consists of identifying and describing components of equipment likely to be damaged in combat, determining the most likely threats to those components, and the vulnerability of those components. Results are then stored in a data bin for use by Army agencies.

Not all necessary data to develop the methodology is always available, so AMSAA must sometimes generate it. Heaps pointed to the SPARC program for the M60 tank as an example. "When we started we didn't have adequate target description by components, so we developed the descriptions in-house, working from engineering drawings," he said.

Army studies were used to determine the most likely threats to the M60 and its vulnerability to those threats. "We determined the most likely points the tank would be hit from shotlines (lines tracing the path of direct fire projectiles), the probability of occurrence and the individual parts that could be damaged by each shotline," Heaps explained.

Results of the study included information on the probability of a particular shotline occurring, the number of parts that would be damaged, and where replacement parts can be obtained.

Heaps said AMSAA's role in SPARC is changing since the Ballistics Research Laboratory is now doing the bulk of the analysis studies. "We now want to emphasize the role of program management and to see to it that SPARC information and data is made known to the appropriate activities," he explained.

HEL Examines Effectiveness of Battle Tank Fire Control Systems

How effective are current battle tank fire control systems and what can be done to improve them? These questions will hopefully be answered by researchers at the U.S. Army Human Engineering Laboratory, who are conducting tests using live rounds in a 50-caliber spotting rifle mounted on the gun tube of a battle tank.

One of the main problems with current fire control systems in battle tanks, according to HEL researchers, is that they are designed to perform well under training conditions, rather than simulated battlefield conditions.

"However," Mr. Andrew Eckles, chief of HEL's Combat Vehicle Systems team said, "those conditions are not what a person would expect to find on a battlefield. In 1973, we ran a study to try to look at what those battlefield conditions might be."

Currently, when soldiers go out on the range to fire a battle tank weapon for training, they shoot at targets that are relatively predictable. That is, the targets are a specified distance away. They travel on railroad tracks at a constant rate of speed in a specified direction. In essence, during training, there are few variables which challenge the fire control system. The HEL study has changed that.

"In 1973, we argued that targets would appear at shorter ranges, intermittently, with short target exposures, in a modern combat encounter," Eckles said. "The gunner would not have any idea from which direction the target is coming, where it is going, or in which direction he will have to fire next.

This situation has posed some tricky problems for HEL testers. Researchers considered using a remote control target, but Eckles said there were too many problems. Actually, the only way to make testing of the fire control system as realistic as possible is to put a crew inside a tank and perform evasive maneuvers while being fired on, Eckles said.

HEL elected to use 50-caliber rounds fired from a spotting rifle at a manned target, which had been equipped with the most stringent safety features. These features include everything from complete armor plating on the outside to nylon ballistic blankets on the inside compartments.

The armor plating can withstand the impact of the 50-caliber round at point blank range. Ballistic blankets inside are not to protect the crew against rounds that might find their way in, but "just in case something got knocked loose inside the tank," Eckles said.

The target, originally an M114 Reconnaissance Vehicle, was scaled down to a 6/10ths version of a main battle tank. HEL picked the M114 because it is no longer used by the Army, and there is a surplus of the vehicles. The former recon vehicle has been dubbed, the "Scaled Tactical Target" vehicle, or mini-tank.

The M60 normally fires a 105mm cannon. By modifying the fire control computer to the ballistics of the 50-caliber round, the gunner must still do everything he would have to do to fire the 105.

The researchers don't expect the same results as from the 105, but would expect the same relative differences in performance between the fire control systems as we would get when firing the main gun. Testing has been in progress for about a month.

An unforeseen product of this research is its inherent possibilities for training soldiers.

"For training, this will bridge the gap between range firing and combat," Eckles said. "It will give the soldier a better idea of what battlefield conditions are like. No one is shooting back at him, but at least the target is evasive, which it will be on the battlefield."

Near-combat realism is not the only beneficial factor in using the mini-tank for training. The cost of ammunition for the 105mm cannon can run anywhere from $300 to $800 per round. Fifty-caliber rounds go for about $3 a piece.

The cost of ammunition is getting very prohibitive. Also, with modern tank gun ammunition, there are few places left in the country where you can shoot it.

The 105mm cannon must be shot at a target on a range, and can't really be used the way HEL is using the 50-caliber, because the rounds simply go too far. There is too great a chance for the rounds to go out of the range area. "With the 50-caliber gun, you don't have that problem," Eckles said.

Plans are being made to extend the testing to include a 3-day field maneuver. Several locations are being considered. Fort Knox, KY, is one of them.

DIVAD Slated for Extensive Testing at APG

A developmental model of the Army's new Division Air Defense Gun System (DIVAD) has arrived at Aberdeen Proving Ground for extensive testing that may last a year.

The system, an advanced computer-controlled front-line weapon, was designed to be effective against helicopters and high-performance fixed wing aircraft, as well as ground targets.

According to Mr. Larry Miller, DIVAD test director from APG's Materiel Testing Directorate (MTD), the system has completed exhaustive performance testing at the Army's Air Defense Center ranges at Fort Bliss, TX. At APG, it will be subjected to strenuous automotive, endurance, firing, and reliability tests.

The DIVAD vehicle uses a modified M48A5 tank chassis M60 tank drive train, and a specially-designed, advanced firing unit and fire control system mounted in a hardened turret.

Armament includes two Bofors 40mm linkless guns, coupled to a sophisticated radar system and a laser range finding device. Gunners may use either a day-night optical system, a computerized fire control aiming system, or a combination of the two, according to literature provided by Ford Aerospace and Communications Corp., which produces the weapon.

The system is said to be very effective against hostile low-flying aircraft, and can survive in a combat environment, according to manufacturer literature.

The recently-completed tests at Fort Bliss studied gun and fire control performance against aerial targets, using soldiers as crewmen-operators, Miller said.

During tests at APG, the system will be subjected to some 4,000 miles of automotive tests on various types of terrain and road surfaces. It will also undergo extensive reliability, availability, maintainability, and durability (RAM-D) tests. Crew-level maintenance procedures will also be evaluated.

Other aspects of the test program include environmental conditioning tests, in which the vehicle will be exposed to temperature extremes, and excessive humidity, as well as human factors engineering features of the vehicle.

Capsules . . .

DA Establishes Science and Technology Board

Establishment of a new Board on Army Science and Technology has been announced by the Department of the Army. Creation of the Board was initiated at the request of Under Secretary of the Army James R. Ambrose.

The National Research Council, through its Assembly of Engineering, is setting up the Board to provide assistance to the Army in engineering, science, research, and technology.

The Board will be comprised of about 12 members with experience and expertise in industrial, governmental, and academic areas. Officials say Board members will be selected in the near future and membership will reflect the knowledge and experience necessary to provide an effective response to a board range of army missions and responsibilities.

During its initial meetings, the Board will be briefed on the Army's needs for science and technology, plans, existing methods and approaches for managing the Army's R&D program, and other Army operational requirements. Based on these briefings, the Board will identify research gaps, major issues, and suggest high priority topics for Army R&D.

Australians Test Position/Azimuth System

The U.S. Army's Position and Azimuth Determining System (PADS) was tested recently by the Australian Army's 131st Division Location Battery. In its first appearance in the Southern Hemisphere, the PADS was able to take advantage of the on-board portion of a software program for the use of the Australian National Spheroid.

Under strict Australian field-trial monitoring, the PADS was sent on a rough 50-kilometer course, a 6-hour cross-country trek, and underwent a 7-kilometer sound-ranging, base test course over undeveloped terrain. Ten-minute zero velocity updates were used in the 50-kilometer and 6-hour test courses. The 3-minute updates considerably increased the accuracy of the system.

The 50-kilometer survey mission lasted approximately 2½ hours with position accuracies of four meters, elevation accuracies of seven meters and azimuthal accuracies of 0.2 mil. All azimuths were determined optically using a theodolite. The 6-hour mission data revealed position and elevation accuracies of better than 10 meters.

Army's MLRS Achieves Major Milestone

White Sands (NM) Missile Range was the site of a recent major milestone in development of the Army's new Multiple Launch Rocket System (MLRS).

Twelve MLRS rockets were successfully fired in series in less than a minute. The 12 rounds, each carrying a live tactical warhead, hurled thousands of submunitions onto a prepared target area nearly 10 miles from the launcher. Each submunition is similar to a grenade in explosive power.

The MLRS is a new artillery system being developed for the U.S., French, German and British Armies. It is designed to deliver a massive volume of defensive firepower against troops and materiel such as would be encountered in an enemy artillery battalion.

This first firing of a full load of 12 rounds capped several previous flight tests of single, double, triple, six and eight round firings. It demonstrated the capability of the MLRS "12-pack" to put over 7,700 live submunitions on a target.

The rockets are fired at about 5-second intervals from a self-propelled, highly mobile launcher. The MLRS system is operated by a crew of three soldiers who can fire 12 rounds, then quickly reload to fire again.

Vought Corp., the aerospace subsidiary of LTV Corp., was selected as prime contractor for MLRS in April 1980 after a 30-month competition with other potential contractors. The MLRS concept has been under study at WSMR since 1977.

Tests Verify Meterological System Accuracy

Preliminary tests on the U.S. Army Electronics R&D Command's new Meteorological Data System (AN-TMQ-31) were conducted recently at Wallops Island, VA. The purpose was to verify wind tracking accuracy of the system and to validate the operator's manual setup instructions.

Bendix Corp. developed the system according to specifications from ERADCOM's Combat Surveillance and Target Acquisition Laboratory. The Army's current system has been in the field for more than 30 years, and it is often very difficult to obtain repair parts for it.

The new system is considered highly mobile. It is housed in an S-280 shelter, rides on a standard 2½ or 5-ton truck, and cannot be detected by enemy radar.

The Army's older ground station received raw data that several soldiers had to process before the data were of any use to artillery batteries. Now, with one soldier at the controls, the new ground station automatically converts the data into meteorological messages and transmits them to the fire direction center.

Additional testing of the meteorological system is planned later this year for Fort Huachuca, AZ, and Fort Sill, OK.

Graphics Display Eases Analyses Capabilities

The 29th Engineer Battalion (Topo), Fort Shafter, HI, is field testing a graphics display system that was developed to improve capabilities for analyses.

Dubbed the Terrain Analyst's Synthesizer Station (TASS) by developers at the U.S. Army Engineer Topographic Laboratories (USAETL), the TASS enables the analyst to take advantage of photo-optical methods and eliminate the need to stack cumbersome 24- by 30-inch film overlays.

Military terrain analysts at the 29th Engineer Battalion will use from one to four 70mm factor map film chips of critical factors (slope, drainage, vegetation, soil, etc.) to quickly produce relevant military geographic information (MGI) such as cross-country movement and lines of communication.

By using film factor chips as input, TASS is able to bring together and project up to four map overlays into a screen for easy "reading" and updating of MGI data required by tactical commanders.

MICOM Awards $23 Million for TOW 2 Improvement

The U.S. Army Missile Command (MICOM) has awarded approximately $23 million to Hughes Aircraft, Co., for full-scale engineering development to adapt TOW 2 to the Bradley Fighting Vehicle System. Hughes will perform most of the work under the 28-month, cost plus incentive fee contract at company facilities in El Segundo, CA. Total potential value of the contract is approximately $53 million.

TOW 2 is a major improvement program to MICOM's basic TOW, deployed with the U.S. Army since 1970 and currently in the arsenal of some 36 countries. TOW 2 will counter more sophisticated enemy armor with its new 6-inch warhead, new flight motor and improved guidance system. TOW 2 will be used in a variety of applications.

Meanwhile, MICOM has another major program underway to counter near-term enemy threats, called Improved TOW. Improved TOW features a redesigned 5-inch warhead that will penetrate heavier armor than the basic TOW. Both programs will utilize, to the fullest extent possible, existing TOW equipment, thereby protecting the Army's investment in fielding missiles and launchers.

The Bradley Fighting Vehicle is a full-tracked, lightly-armored vehicle that will mount a 25mm automatic stabilized cannon, a 7.62mm machinegun and TOW 2 subsystem.

Hughes Missile Systems Group is prime contractor for the TOW 2 and Improved TOW Missile Systems, and FMC Corp. of San Jose, CA, is the prime for the Bradley Fighting Vehicle. Texas Instruments of Dallas, TX, is the major subcontractor to Hughes on the TOW 2 guidance subsystem.

Personnel Actions . . .

Lovelace Named MERADCOM Tech Director

Mr. Thomas W. Lovelace has become the highest ranking civilian at the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, with his recent selection as technical director.

Thomas W. Lovelace

A charter member of the Federal Senior Executive Service in his previous position as MERADCOM's associate technical director for Engineering and Acquisition, Lovelace had served as acting technical director for five months prior to his new assignment.

He holds a BS degree in mechanical engineering from Virginia Polytechnic Institute and is a 1981 graduate of the Industrial College of the Armed Forces. He has received numerous awards during his federal career including the Meritorious Civilian Service Award in 1979.

Lovelace began his civil service career in 1961 at MERADCOM, then the Engineer R&D Laboratories. During six years with the Command, he gained recognition as a leading authority on small military-design gasoline engines. In 1968, after a year with industry as manager of International Engineering for Cummins Diesel Engine Co., he joined the Office of Project Manager, Mobile Electric Power, where he was chief of the Turbine/Advanced Power Systems Branch.

Lovelace returned to MERADCOM in June 1972 as associate technical director for Engineering. In 1976, this position was expanded to encompass acquisition, and in July 1979 was converted SES (ES-04). He served in this position until being designated acting technical director.

Kunde Follows Holtom as RD&S (UK) Commander

COL Gerald R. Kunde has succeeded COL Stanley E. Holtom as commander of the U.S. Army Research, Development and Standardization Group (United Kingdom).

A dual rated master aviator, COL Kunde began his Army career in 1961. Assignments have included command of an infantry company, armored cavalry troop, combat aviation battalion, and deputy commander of an air cavalry brigade.

He holds a BS degree in business administration from the University of Wisconsin, an MBA from the University of Miami, and an MS degree from George Washington University. Additionally, he has completed the Infantry Basic and Advanced Courses, the Army Command and General Staff College, and the Industrial College of the Armed Forces.

COL Kunde is a recipient of the Silver Star, Distinguished Flying Cross with four Oak leaf Clusters, Air Medal with "V" device and 53 OLC, and the Purple Heart with 10 OLC.

Thresher Becomes CSL Engineering Associates

Mr. Richard G. Thresher, a veteran Army civilian engineer and technical administrator, has been named associate for Engineering at the Chemical Systems Laboratory (CSL).

Richard G. Thresher

Prior to his selection for the top engineering spot at CSL, Thresher was chief of the Producibility Engineering Branch in CSL's Physical Protection Division.

Thresher was awarded a bachelor's degree in physics from Syracuse University in 1951 and a bachelor of science degree in electrical engineering from the Newark College of Engineering in 1962. He was awarded an MS degree in administration from George Washington University in 1978.

His Federal career began in 1951 at Picatinny Arsenal, Dover, NJ. In 1962, he transferred to the Land Warfare Laboratory (LWL) at APG where he served as a project engineer in the Munitions Branch and as chief of the Material Readiness Branch and then as chief of the Advance Development Division.

At Edgewood since 1974, he has held previous assignments as chief of Mechanical Processes Technology and was chief of the CSL Smoke Branch until 1977 when he was named to head producibility engineering.

Career Programs . . .

Barr To Represent CSL in ORTA Program

Mr. William Barr, a civilian physical scientist, has been selected to head up the new "Office of Research and Technology Applications" (ORTA) at the Chemical Systems Laboratory. The ORTA established at the Lab is the first full-time office of this type to be set up in ARRADCOM and DARCOM.

William Barr

In addition, Barr will continue to function as the technical industrial liaison officer (TILO) in CSL's Systems Development Division. ORTA is designed to implement section 11 of the 1980 Stevenson-Wydler Technology Innovation Act (Public Law 96-480), requiring federal laboratories to establish offices of research and technology applications to assist in the transfer of federal technology to local governments and the private sector.

A physical scientist who started his Federal career at Edgewood in 1974, Barr was awarded a bachelor of science degree in chemistry by the Carnegie-Melon University, in Pittsburgh. He has been serving as CSL's technical industrial liaison officer since 1977.

Awards . . .

Air Florida Flight 90 Aftermath . . .

CRREL Rewards Researchers' Assistance

Arnold M. Dean Jr. (right) and Carl R. Martinson (left), U.S. Army Cold Regions Research and Engineering Laboratory, have received the Commander's Award for Civilian Service for contributions that led to the successful accomplishment of an urgent mission in the aftermath of the crash of Air Florida Flight 90 earlier this year in Washington, DC. Guenther Frankenstein (center), chief, Ice Engineering Research Branch, is shown tracings made by a broad-band impulse radar system, developed at USACRREL for under-ice profiling, used in the salvage and recovery operations. Dean and Martinson were able to pinpoint spots where portions of the aircraft, cargo and even bodies were located beneath the Potomac River. This information enabled divers to recover much of the aircraft wreckage, including the crucial "black boxes" containing the flight data recorder and cockpit voice recorder—items considered essential in determining the cause of the crash.

Army Missile Lab Named 'Best' of the Year

Scientific and technological achievements in missile research and development have earned the Army Missile Laboratory (AML), Redstone Arsenal, AL, the 1981 Department of the Army "Best Laboratory of the Year" Award.

The U.S. Army Engineer Topographic Laboratories, Fort Belvoir, VA, earned top honors as the 1981 "Most Improved Laboratory" for accomplishments in mapping, military geographical information, and geographical intelligence systems.

Other awards for excellence will be presented to the Walter Reed Army Institute of Research; the Electronics Technology and Devices Laboratory; the Engineer Waterways Experiment Station; the Army Research Institute for Behavioral and Social Sciences; and the Ballistic Research Laboratory.

The annual laboratory awards program was initiated in 1974. The purpose of the program is to recognize quality performance, to provide a means of routinely critiquing and ranking each Army in-house laboratory, and to create an atmosphere in which the Army's scientific and technical capabilities can be continuously upgraded. A total of 36 laboratories compete for these awards.

Winners are selected by a special awards committee appointed by the Assistant Secretary of the Army (Research, Development and Acquisition) the Honorable Jay R. Sculley. Those comprising this year's selection committee were: Dr. James G. Prather, deputy for Science and Technology; Dr. Robert L. Norwood, deputy for Air and Missile Defense; and Dr. Mark R. Epstein, deputy for Command, Control, Communications and Intelligence Systems; all are from the Office of the Assistant Secretary of the Army (Research, Development and Acquisition).

Selection of the Army Missile Laboratory as the 1981 "Best Laboratory of the Year" was based on a number of key accomplishments, including a new minimum-smoke rocket motor, new technology for defeating heavily armored tanks, improvements in the accuracy of unguided rockets, fiber optic guidance link technology, and major improvements in the effectiveness of an existing radar guided air defense missile system.

ETDL Employee Receives Special Act Award

Dr. Roger J. Malik, an employee at the U.S. Army Electronics R&D Command's Electronics Technology and Devices Laboratory (ETDL), Fort Monmouth, NJ, is a recent recipient of a $5,000 Special Act Award.

Believed to be the highest award given at ETDL during the past 25 years, it was presented for Malik's invention of a new generic class of semiconductor junctions called planar doped barriers, fabricated by molecular beam epitaxy.

Ulta-thin doped layers of semiconductors are grown between undoped regions to create a structure with wide application in very high speed digital and analog integrated circits.

Malik's citation reads, in part, "His concept is being incorporated into a variety of solid-state devices . . . by scientists in a number of industrial, university, and government laboratories . . . Its impact will be widely felt in enhanced performance of a wide variety of devices in critical intelligence and target acquisition and communications systems by the Department of Defense."

Malik had the layering idea long before he had the equipment to prove his theory. However, ETDL had the equipment necessary for his research and also sent him back to Cornell University to earn his doctorate in electrical engineering which he received last August. He also holds MS and BS degrees in electrical engineering.

Conferences & Symposia . . .

MRC Schedules Meeting on Fluid Interfaces

The Mathematics Research Center at the University of Wisconsin-Madison will hold a conference on recent developments and trends in the study of the macroscopic structure and stability of fluid interfaces. The main program will consist of about 14 lectures.

A detailed program will be available in June and further information may be obtained from Mrs. Gladys Moran, Mathematics Research Center, University of Wisconsin, 610 Walnut Street, Madison, WI 53706.

Bureau of Mines Praises ARRADCOM Engineer For Safer/Faster Method of Clearing Rock

Mainly through the effort of an Army engineer, Mr. Michael Stroukoff, the U.S. Bureau of Mines reportedly now has a safer, faster way to clear hang-ups in the ore passes and chutes of underground mines.

A hang-up is fragmented rock that blocks a mine chute, preventing miners from extracting ore.

The previous method for removing the hang-up involved sending miners up clogged chutes to place charges near the hang-up. This is a dangerous procedure, according to Stroukoff, resulting in a minimum of four deaths a year nationwide.

In 1977, the Bureau of Mines asked Stroukoff's employer, the U.S. Army Armament Research and Development Command (ARRADCOM), to lend some of its expertise in explosives and propellants to help solve this problem. Stroukoff was picked to help solve the problem.

"I had to distinguish penetration dynamics of rocks versus armor," said Stroukoff. "There is a difference in the explosives technology in the mining industry versus the military industry." He said that industry either wants to heave or shatter rock while the military wants to use explosive energy for penetration or blast.

Stroukoff had to survey all available concepts of explosives and warhead technology for possible application. His search took him to several locations throughout the country.

He eventually found that the best way to fragment rock was to launch a spherically-shaped, malleable 8-inch steel disc at the rock barrier using composition B propellant. The disc, when launched, would assume an aerodynamic shape and travel between 8,000 and 10,000-feet per second.

The aerodynamic shape was the best for transmitting the maximum amount of blast energy, hitting the rock with a force of 3.5 million foot-pounds per square inch. This, said Stroukoff, is roughly equivalent to the force generated by dropping a one ton steel "headache" ball 50 feet. (Among the applications for such a ball is demolition of buildings.)

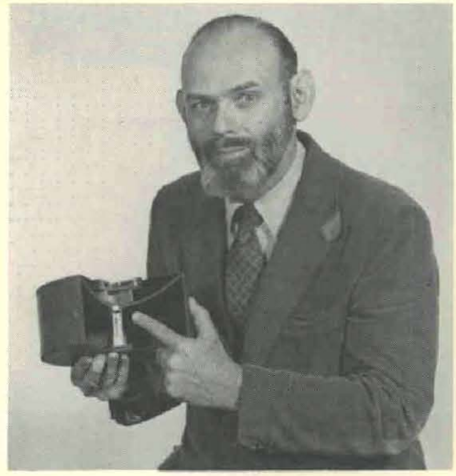
Tests conducted at Picatinny and elsewhere showed that the shock of the slug initiates cracks throughout the rock. The focused blast energy from the explosive device hits the fragmenting rock miliseconds later, further breaking up the rock.

Stroukoff said: "The effectiveness of this device was found to be such that at a range of 50 feet it can break up a 6-foot cube of limestone into pieces no more than 1,300 the original size;"

To solve the safety problem, the device, which rests on a tripod stand, is pre-aimed at the target from as much as 60 feet away, using an attached spotlight on the front of the disc that aims a narrow beam of light in the same direction that the disc is aimed. After the light is beamed on the target the spotlight is removed and the disc remotely launched, using a standard blasting cap.

Stroukoff demonstrated the device for the Bureau of Mines in July 1977 and then didn't get any feedback for three years. Finally, last year the bureau sent him a technical report to edit.

A follow-up letter recently sent by the bureau to the ARRADCOM commander summarized in part: "We would like to thank your command and Mr. Mike Stroukoff in particular for the cooperative work performed for the Bureau of Mines . . . that has resulted in a Bureau of Mines developed device for the clearance of chutes and raises in underground mines . . . Your command helped establish the basis for the transfer of military technology to the Bureau of Mines that materially contributed to our research effort to solve a definity problem existing in the mining industry . . . The entire country benefits from this type of cooperative work."



Michael Stroukoff

DOD Establishes Office of Management Policy

Secretary of Defense Caspar W. Weinberger has announced that he has established, within the Department of Defense, an Office of Management Policy, which reports directly to Deputy Secretary of Defense Frank C. Carlucci. The director of this office is Mr. Vincent Puritano, who will continue to serve as the executive assistant to the deputy secretary.

Mr. Puritano said, "The Office of Management Policy will concentrate on maintaining the momentum of the management actions that Secretaries Weinberger and Carlucci have already taken in the Defense Department. By focusing on the critical problems in implementing the principles and policies of our management initiatives, the Office of Management Policy will enhance the develoment of new efforts and reinvigorate existing actions. It will work with the Services and the central staffs to produce real and visible results."

The Office of Management Policy will closely track the continued development of the major management initiatives undertaken in the DOD in the past year. These initiatives include:

- improvements in the planning, programming and budgeting process, with emphasis on long-range planning and better strategy development.
- the development of a stronger, more effective Defense Resources Board to play a major role in that budget process.
- the 32-point program to streamline and strengthen the weapons acquisition process.
- the establishment of the Review and Oversight Office to focus the Department's audit, inspection and investigation efforts against fraud, waste and inefficient management.
- the efficiencies and economies resulting from actions of the DOD Council on Integrity and Management Improvement.

In addition to serving as the director of the Office of Management Policy, Mr. Puritano is the executive secretary to both the Defense Resources Board and the DOD Council on Integrity and Management Improvement. His wide government management experience includes more than 20 years of service in the DOD, the CIA, the office of Management and Budget, and the State Department. He recently led two task forces in reviewing and revising the Defense Planning, Programming and Budgeting Process and the Defense Acquisition Policy and Process.

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