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ABOUT THE COVER:

Shown on the front cover is an artist's concept of major Soviet weaponry on a compressed battlefield of the 1980's. This picture appeared in the recent DOD unclassified publication *Soviet Military Power*. The back cover portrays key materiel systems in the U.S. arsenal. *Army RDA Magazine* extends its thanks for these drawings to Mr. Jerry Nini of the Defense Intelligence Agency and Mr. Aldric Saucier, formerly with DARCOM, now with the Army Ballistic Missile Defense Program Office.

FEATURES

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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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Integrated Logistics Support

By William Kracov

While the following article deals with integrated logistics support (ILS), it should be stressed that it was written by a development manager, not by a professional logistician. The writer's objective is to inculcate, in the development community, a deep recognition that development and support are inseparable partners and to demonstrate that unless and until the developer understands and reacts to his support responsibilities the acquisition community cannot do justice to the soldier in the field.

Some years ago it dawned on the DOD that the cost of operating and supporting systems far outweighed the cost of developing and buying them. Immediately, the issues became: What are the system cost drivers? Can we do things in design to cut the O&S costs? Won't a little up-front development money pay off enormously in O&S costs?

Coupled with the cost issues, the plain fact was that some systems were being fielded with impossible logistics support gaps. Others were not fielded because the logistics support situation was so dismal. ILS then is the management system that was developed to deal with some of these problems.

What is ILS? It is not a bunch of *things* such as lube orders, provisioning lists, training devices, TMDE, etc. ILS is a *management* system that attempts to identify all support requirements needed to field a system and then to manage their planning, scheduling and execution in a cohesive way.

The cohesiveness of ILS permits the PM/major subordinate command developer, using his ILS manager for professional expertise, to:

• form a basis for and make trade-offs among ILS elements and between ILS and other system parameters.

• assure that each program decision considers logistics support impacts to the same degree and detail as other system parameters.

• assure that ILS has been planned, funded, and done adequately.

• provide evidence to decision-makers that the DT/OT has shown convincingly that the logistics system support issues have been tested so that a low-risk decision can be made from the logistics support standpoint.

• assure supportability of design.

ILS involves planning, funding, and executing many elements. ILS is an RDTE money burner that demands personal PM/subordinate command attention. It is the PM who must come to grips with the key trade-off decisions and their long term impacts. His ILS manager may not be privy to the overall system picture.

When a PM has traded RAM, he has traded ILS. While he relies on his ILS manager, only he can make the ultimate decision. For example, he should know when the Skill Performance Aids route to technical manuals may not be affordable at GS level and therefore that a compromise is in order.

ILS demands that the PM understand that he is just as responsible for ILS as he is for program and cost control, schedule control, and technical performance.

Who does ILS?

The PM/developer is responsible for system ILS. This includes responsibility for ILS for subsystems managed by other PMs or by various major subordinate commands. The ILS system manager is responsible to PM/developer for planning, scheduling, funding estimates, and overseeing execution.

Overall manager for ILS in the major subordinate command is responsible to the commander to assure him ILS is efficiently and effectively implemented throughout the command.

Actual work is done by contractors/subcontractors, by subordinate command personnel and by the user community. The work is monitored by the PM/developer ILS system manager. The contractor's product is governed by military standards and specific requirements of the contract.

How is ILS done?

The central tool for the conduct of ILS is the Logistics Support Analysis (LSA). LSA is an iterative process that grows in intensity during the development life cycle and which uses a host of analytical techniques and models to assess the logistics impacts of given or proposed system designs. As a result, design features that adversely impact on logistics support or O&S costs are surfaced so the design may be improved.

The LSA process is also used to evaluate the various features of the system design, including alternatives, e.g., alternate packaging concepts, test approaches, accessibility features, transportation, etc. Resources and costs are estimated for each alternative, leading to a preferred approach. This selection should affect the final system design.

Once a maintenance concept evolves, the LSA assists in evaluating alternative repair policies and permits selection of the one most compatible with the maintenance concept. In broad terms, the LSA is the systematic method used to select among alternatives logistics support resources.

All of the LSA effort is captured in an integrated logistics data base called the Logistics Support

Analysis Record (LSAR). LSAR data include provisioning, maintenance man-hours, allocation of maintenance tasks, repair parts, support equipment, operator and maintenance manuals, personnel and skill requirements.

The true value can be seen by translating, into practical terms, the data derived from the various LSAR data sheets. Here are several: end item maintenance requirements; how the item fails; where and who fixes the failed item; how the failed item is fixed; description and justification for special tools, TMDE and training devices; description and justification for new facilities; requirement and justification for new skills; repair parts requirements—provisioning.

It can be seen from the foregoing that much ILS execution stems from the iterative LSA process as reflected in the LSAR. The ILS process must be subjected to tailored and flexible approaches so that only the essential effort is conducted.

ILS—When and How Much?

It is useful to examine ILS as applied to each life cycle phase to perceive its contribution.

"Milestone 0"—Program initiation. At milestone 0, manpower and other logistics constraints are identified based on analysis of current systems in the same mission area.

As alternative concepts are developed, they are bounced against resource impacts. The idea is to assure that logistic support considerations are brought to bear in the decision as to the system concept to be pursued in advanced development.

The LSA process first comes into play on a limited scale with a great deal of work related to the analysis of current systems for future comparative purposes. LSA in this phase is largely done in-house. This phase is led by the combat developer with emphasis on identifying the true logistics impact that the state-of-the-art technology will place on the user.

Milestone I—Demonstration and Validation. The LSA process increases in depth and typically the LSA and LSAR are contractually required during this phase of the life cycle. Logistic and support criteria are established and directly affect the design and configuration of the system. The maintenance support concept begins to be defined from the standpoint of echelons, maintenance site locations and support effectiveness factors.

While contractor supply and maintenance is the usual mode during DT/OT I, it is required that the test be designed to provide positive proof that the proposed system support concept will be visible and cost-effective. Again, it is intended that the logistics impacts be assessed and brought to bear in the decision to select one competitive prototype over another.

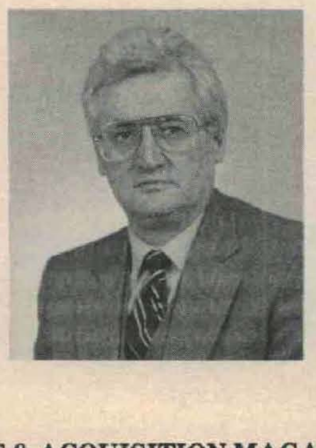
In other words, a system that shows high system technical performance coupled with inordinately high logistic support costs should lose out in the selection process to a system concept with acceptable performance coupled with much lower support costs.

Milestone II—Full-Scale Engineering Development. The LSA/LSAR process, building on the past work, reaches its most detailed level of intensity during full-scale engineering development. Specifically, the logistics support concepts are firmed up and the resource requirements become more definitive. As the system configuration becomes more "frozen," the maintenance actions, times, levels, locations, repair part requirements, facilities, personnel, training, training devices, etc., are refined and fixed.

Logistic support requirements and resources for maintenance, training, etc., are defined and physically constructed for use in assessing the adequacy of planned manpower, support concepts and resources and reliability and maintainability.

The bottom line is to prove to the decisionmakers that logistics support is well in hand, that the most cost-effective logistic support concepts have been selected, and that considering logistics, a low risk production decision can be made.

It is to be expected that certain residual logistics tasks, e.g., technical manuals, training devices, etc., may not be fully completed at DT/OT II. While this residual work must be completed and validated for production configuration before IOC, sufficient ILS must be completed to give confidence to the decisionmakers that the residual effort is achievable without inordinate risk.



WILLIAM KRACOV is chief, Support Equipment Branch, Support Systems Division, Directorate for Development, Engineering and Acquisition, HQ DARCOM. He received the Secretary of the Army Acquisition Award for significant contributions to quality assurance, procurement and logistics, and is an honorary faculty member of the Army Logistics Management Center. Additionally, he represented DARCOM in the formative stages of development of Skill Performance Aids and the current system for fielding Army materiel.

A Multiplex System for Combat Vehicles

By Anthony Comito and Marquis W. Woody

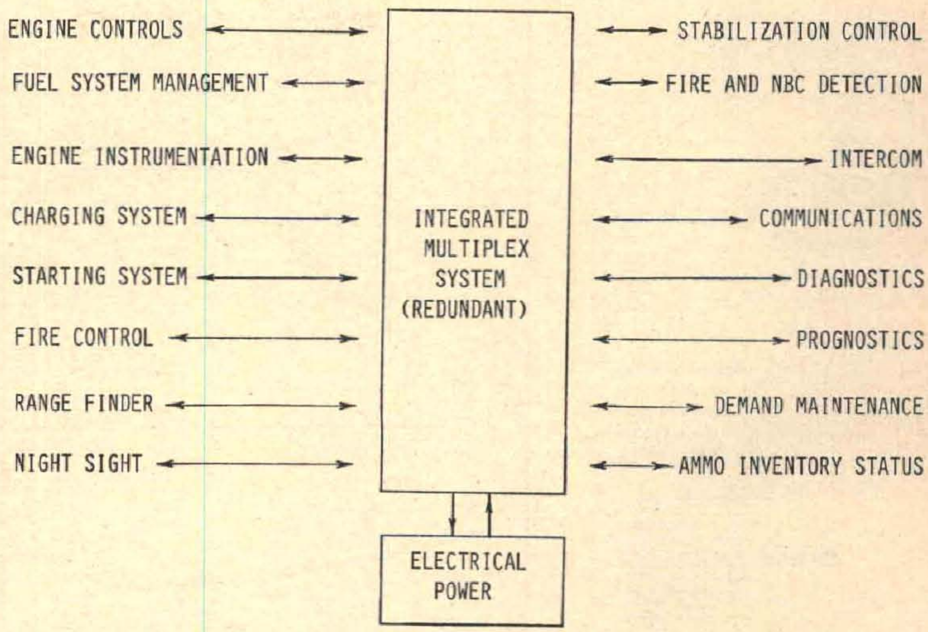


Fig. 1. Total Tank Subsystem Integration Potential

It is readily apparent that a more efficient integration of vehicle subsystems must be achieved to take full advantage of a modern combat vehicle's capabilites and potential. The current trend in combat vehicle design and development to increase information flow has greatly increased vehicle electrical system complexity.

The complexity of vehicle wiring has increased in direct proportion to the use of electrical power and controls using conventional design techniques.

The U.S. Army Tank-Automotive Command (TACOM) will soon begin the first vehicle tests of a prototype microcomputer-controlled multiplex system using a data bus designed to permit a tank crew to control and monitor all of the vehicle's electrical and electronic equipment.

Such a system would simplify many of the complex vehicle wiring harnesses now required for this purpose. It integrates many of the controls and instrument display functions and provides an on-board diagnostic capability (Figure 1). Thus, it has the potential for improved crew efficiency, better reliability and maintainability and reduced life-cycle costs.

The project to develop this new system is being conducted under a TACOM effort called ATEPS (Advanced Techniques for Electrical Power Management, Control and Distribution Systems). The objective of ATEPS is to upgrade military ground vehicle electrical wiring, controls, and instrument displays to reflect the latest advances in these areas.

The ATEPS multiplex system uses a technique known as the time-division multiplexing. This is a method of communication in which a single communication medium, such as a pair of wires, is used to carry a multitude of signals, each intended to serve a different purpose.

For years, multiplexing has been used by the telephone industry and in military aircraft, space vehicles and naval ships to reduce the large volume of internal signal wires. More recently, the automotive industry has begun applying multiplexing and electronic instrument display to its commercial products.

In January 1976, engineers in TACOM's R&D Center began work to develop a conceptual design of a multiplex system for combat vehicles, a task that was completed early in 1977. A breadboard demonstration model of the concept, fabricated for TACOM by Chrysler's Huntsville Electronics Division, proved the feasibility of the design. As a result, TACOM awarded a contract to the firm in April 1979 for fabrication of the current ATEPS prototype hardware.

The system, which has recently been installed in an M1 tank, will be evaluated during 50 hours of vehicle operation at TACOM during the first quarter of 1982. It features a shielded conduit, containing two sets of conductors that loop around the inside of the tank hull. A similar loop arrangement is situated in the turret (Figure 2). The two loop assemblies are interconnected through a simplified hull-to-turret slip ring having only 15 electrical circuits instead of the 39 normally

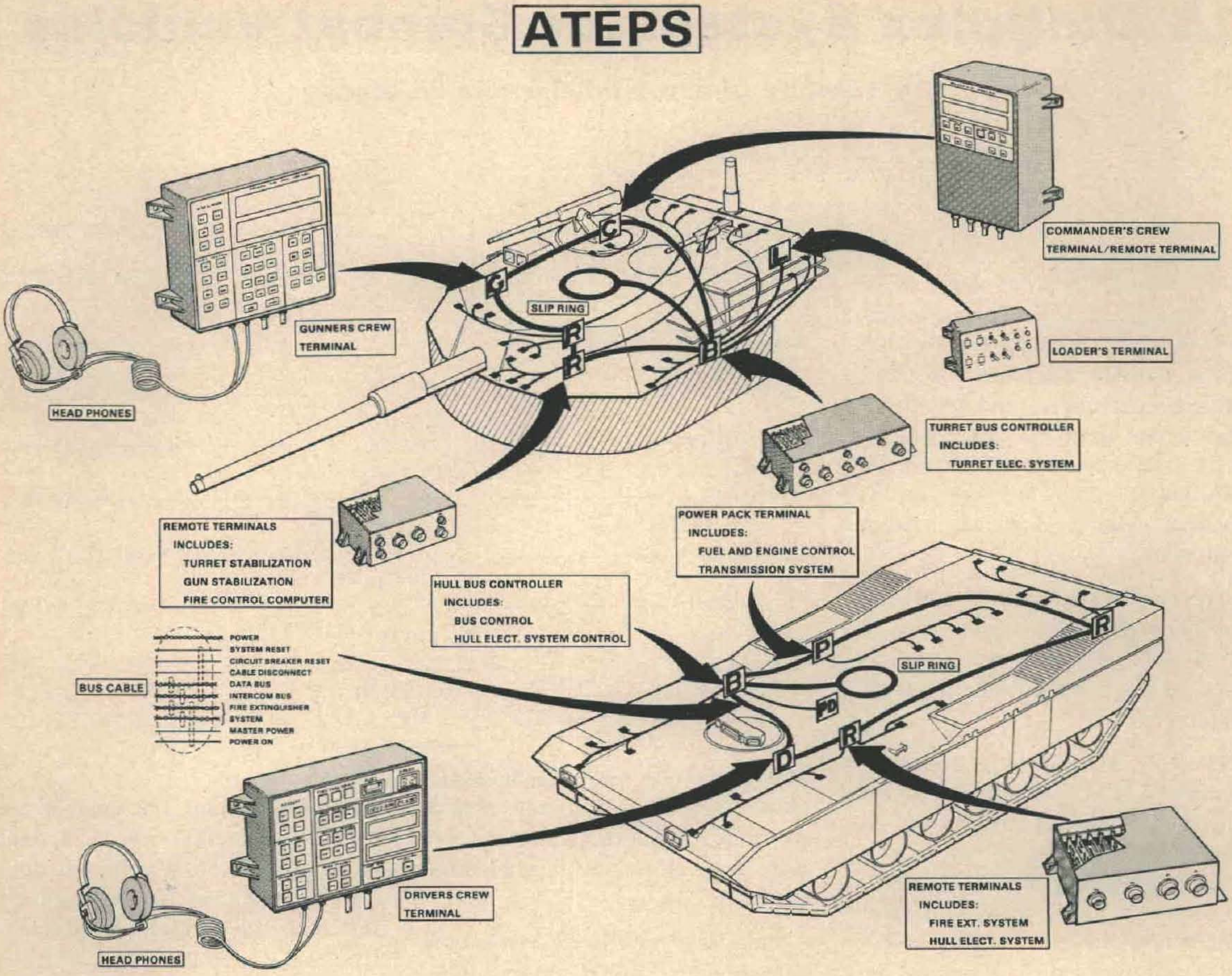


Fig. 2.

required for the M1 tank wiring system.

One set of conductors contained in the conduit segments, known as the "data bus", carries signals between a central microcomputer called the "bus controller" which contains a central microcomputer and three other remote terminals located at points along the conduit which are used to connect the tank's electrically-operated subsystems to the multiplex system.

The second set of conductors, called the "power bus", supplies the electrical energy from the vehicle's main power source to the bus controller and remote terminals.

Three types of electronic units are required to form the multiplex hardware system. These are a bus controller, crew terminals/displays, and remote terminals which are interconnected to the data/power bus.

Controlling the transfer of data over the data bus and performing necessary computations and data processing is the bus controller.

Crew terminals are the human interface with the multiplex system. They accept data from the bus controller, display information to the crew member, and transfer data from the crew member to the bus controller over the data bus system.

Remote terminals contain the electronics to interface the bus assemblies with the vehicle subsystems. They convert signals for transmission to the bus controller and also decode data received from the bus controller.

Solid state switches required to connect power to the subsystems are also located in the remote terminals.

In operation, the driver controls and monitors the vehicle functions

The ATEPS multiplex system uses a technique known as the time-division multiplexing. This is a method of communication in which a single communication medium, such as a pair of wires, is used to carry a multitude of signals, each intended to serve a different purpose.

from the crew terminal. If, for example, he wishes to start the engine, he simply presses the appropriate illuminated push-button switch on the control unit which transmits signals through the data bus to the bus controller.

The bus controller interprets this message and signals a remote terminal to switch on the control unit that controls power to the starting mechanism.

As part of its normal routine, the bus controller periodically monitors data from engine sensors and other pertinent data and can display vehicle diagnostic or readiness information in the message center on the driver's panel.

The multiplexed concept features a redundant integrated system that provides the combat vehicle with a fully functional, continuously self-tested system. This, together with the similarity of circuit cards within the various remote terminals, provides the user with a high degree of system maintainability.

The system can self-test and diagnose problems to a PC card level and inform the user of the problem via the display on the crew terminal.

The M1 tank is being used as a base line for installation and evaluation of the prototype hardware. This prototype system is a generic system intended to demonstrate the feasibility of the multiplex concept in a combat vehicle.

While the prototype system is currently limited to handling those electrical and electronic functions within the vehicle hull, it will be expanded to include turret functions as well. This will be done by installing a turret system capable of communicating with the hull loop and to handle signals needed for stabilization and fire control.

The flexibility of a multiplex system allows for the addition or modification of any electrical/electronic subsystem or component by restructuring the bus controller program and adding printed circuits boards or remote terminals where necessary.

Simplification of many of the complex wiring harnesses/electrical connectors, the incorporation of solid state switches and selected redundancy features will result in dramatically improved reliability and maintainability.

Multiplex systems should be included in the initial design states of all new combat vehicles and should be considered for major product improvement program applications where it is shown to be cost effective. Multiplexing is essential if we are to provide real integration in our combat vehicles.

Former RDA Editor Dies

Former editor and founder of the *Army R&D Newsmagazine* (now *Army RDA Magazine*), Mr. Clarence T. Smith died February 7. Smith, who retired in July 1977, was the first editor of the magazine founded by former Army Chief of R&D LTG Arthur G. Trudeau in 1958. Initial publication began in December 1960.

Smith's journalism career encompassed more than 50 years of achievement, both in government and in the private sector. He began his career as a sports and city editor for a Minnesota daily newspaper in 1925.

He served on the editorial staff of *Yank*, beginning in 1943, and later co-founded the publication *Outfit* that was directed toward the Army's hospitalized, sick and wounded. Other publications with which he was associated included *Stars and Stripes* and *Task Force Times*.

During his tenure as *Army R&D Newsmagazine* editor, Smith won consistent praise for the high standards he established and maintained for the magazine, and he earned the respect of his superiors and those associated with the Army's R&D community.

He is survived by his wife Vera, and daughter Janet.

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A Young Turk's View of Improving Army Acquisition of Nonmajor Programs

By MAJ Geoffrey B. Charest

Two of the most persistent performance criticisms of Army acquisition in general are the length of time to acquire and field a system and the apparent difficulty of determining precisely what the requirement is which must be satisfied.

Field commanders become extremely agitated and frustrated when told that their equipment problems will not be solved until years after their departure from command, even with the Army's policy of increased command tour lengths. Contractors frequently proclaim amazement at volatile requirements, and while some contractors may view the engineering change proposal as profits in escrow, most are frustrated in a sincere attempt to deliver something of use. Everyone is frequently touched and annoyed by the fielded system which, on arrival in a unit, is panned as not filling the bill. . . "after all these years."

Attention for solution to these problems is centered around large, complex and expensive major system acquisitions, yet these same difficulties exist for almost all nonmajor acquisition programs as well.

Smaller, simpler, and cheaper unfortunately does not necessarily lead to the faster acquisition time or an easier job of requirement articulation and documentation that intuition might dictate. This article is intended to highlight some of the causes of delay and difficulty in these areas and propose improvements which can be made.

The Department of Defense recently began instituting 32 actions, collectively known as the "Department of Defense Acquisition Improvement Program." In his 30 April 1981 memorandum, Deputy Secretary of Defense Frank C. Carlucci outlined four major objectives of the program for improving the acquisition process. They are: reduce acquisition costs, shorten acquisition time, improve weapons support and readiness, and improve the DSARC process.

This call for action must be met. It is a call few can disagree with. The difficulty is how to respond positively.

While major systems acquisitions suffer from long development times, nonmajor system acquisitions suffer often to a greater extent, considering the complexity and cost involved. A 10- to 12-year development, or the period from initial identification of a need until initial operational capability, for a major program, is often criticized as too long. However, many nonmajor programs have an equally long development.

TABLE 1
Current Major System RDT&E Expenditures
vs.
Total RDT&E Expenditures
(Current Year $ Millions)

Service	Items	FY 81 Major Program $	Total $	%	FY 82 Major Program $	Total $	%
Army	25	931.7	3086.8	30.2	867.7	3577.2	24.3
Air Force	20	2325.8	6775.8	34.3	3548.6	8669.4	40.9
Navy	21	1007.9	4895.1	20.6	842.3	5866.3	14.4
Total	66	4265.4	14757.7	28.9	6285.6	18112.9	29.0

Source: January 81 FYDP, RDT&E Annex

Current Major Systems Procurement Expenditures
vs.
Total Procurement Expenditures
(Current Year $ Millions)

Service	Progr	FY 81 Major Program $	Total $	%	FY 82 Major Program $	Total $	%
Army	27	3647.9	8969.1	40.7	4518.1	11079.1	40.8
Air Force	30	4855.1	15818.4	30.7	4219.9	19706.2	21.4
Navy	37	11756.6	19858.9	59.2	11874.6	24324.0	48.8
Total	94	20259.6	44646.4	45.4	20612.6	55109.3	37.4

Source: January 81 FYDP, Procurement Annex

Examples of nonmajor acquisitions that have taken this long are numerous. Indeed, nonmajor acquisition is the Army's stock in trade. The Army acquires hundreds of them compared to a relative handful of major systems. Table 1 shows that roughly 70 percent of the RDTE and 60 percent of procurement funds are spent on programs not designated as major.

Part of the reason why nonmajor acquisitions take too long is that many individual nonmajor projects simply cannot command top management attention and often do not have a high powered program manager to guide the acquisition, and this is as it should be.

These nonmajor projects are managed by young turks well within the acquisition bureaucracy. What top management must do is insure that nonmajor projects which might be acquired rapidly, deep within the bureaucracy, can be. It is this point which forms the focus for improved nonmajor system acquisitions.

While some nonmajor systems respond directly to a threat such as intelligence/electronic warfare systems, most nonmajor systems do not. A need may be cloaked in a variety of disguises such as improved force readiness provided by a new test set, improved force efficiency provided by a new automatic data processor, improved performance of a radio system provided by a new antenna, improved force deployability provided by a light weight mortar or improved skill development provided by a new training aid. Simple replacement of obsolete equipment is another major source of needs.

In almost all cases, the need is today, not in some future window of vulnerability to which many major programs respond. Many nonmajor acquisitions are low technical risk. The impact of successfully fielding many of these nonmajor acquisitions on the fighting forces, however, can be surprisingly significant. The nonmajor definition stems principally from the dollars involved, not the nonimportance.

Increasing interest and emphasis seems to be placed on a wide variety of contingency missions where U.S. Forces may be deployed. Rapid equipment acquisition is essential once contingency planning points up deficiencies in traditional weapons systems, and needs are

"Within the Army, the highest order policy is Army Regulation 1000-1, *Basic Policies for Systems Acquisition*. Except for a definition of what a major system is and outline of lower authority levels, there are only vague distinctions between major and nonmajor acquisition policy."

identified for small or special purpose systems which are not needed in the traditional scenarios of Central Europe.

One need only visit the XVIII Airborne Corps planners or read after action reports from exercises such as Bright Star in Egypt to find many needs which can be satisfied by rapid nonmajor acquisition projects.

Key to accomplishing timely development and fielding of equipment of any size is the recognition that prompt and effective systems acquisition can only occur if system requirements are identified, and documented rapidly and effectively; viable and flexibile acquisition strategies are available; and if funding is provided.

In order for these actions to occur, DOD and the Army have established an acquisition process governed by policy in the form of DOD directive and instructions, army regulations, policy letters, etc. These policies, also perform a controlling function. This controlling aspect often results in longer acquisition times.

Several attempts to solve the excessive acquisition time problem for nonmajor acquisitions have been tried. A few of these attempts have met with limited success, but they are chronically short lived. In general, they have failed for several reasons; among them are failure to recognize inherent risks in accelerated acquisition and programs viewed as exceptions or external to the acquisition process. Accelerated acquisition programs have been successful only when they are very limited in scope and when there was some overriding urgency for fast acquisition.

An excellent example of a moderately successful accelerated acquisition program is the Navy Quick Reaction Capability Program for Navy Airborne Self Protection Electronic Counter Measure (ECM) Equipments during the Vietnam era. Response time in acquiring and installing ALQ-100, and ALQ-126 ECM devices was extremely rapid and the survivability improvements for aircraft has been well documented. However, the program was of limited scope and after Vietnam, there was no conflict, no urgency, and therefore no continued rapid acquisition program.

The Army has attempted in the past, and continues to attempt, development of a Quick Reaction Capability (QRC) for Intel/EW systems, somewhat patterned after the Navy program. Even with an Army regulation, titled "Quick Reaction Capability for Electronic Warfare," the entire effort continues to be viewed as external to the acquisition process with no significant motivation for such a program.

The only apparent reason for success of accelerated acquisition programs is overriding urgency. With the urgency, also comes visibility which helps and facilitates an acquisition program to proceed outside the normal process of doing business. Field units, frustrated by a lack of acquisition community response, have attempted to use programs, such as the so called Quick Return on Investment Program—basically a low-level funding source for field units, to solve their problems through their own acquisition of equipment, again outside the normal acquisition process. This approach is almost always doomed to failure.

Frequently, the acquisition community will argue that field problems go unsolved because the field fails to articulate their needs. The reason for the lack of timely acquisition community response really does not matter. It often is not responsive and it is incumbent upon the acquisition community to make itself more responsive.

Examination of the acquisition process can lead to clues to why it takes so long to acquire many nonmajor systems. With this understanding, the causes of the problems can be attacked within the acquisition process itself. The first place to look is the acquisition policy which guides the process, the second at how acquisition requirements are identified and documented, and, finally, the funding which turns ideas into reality.

The centerpiece of acquisition policy is the Office of Management and Budget Circular A-109, *Major System Acquisitions*. This circular deals exclusively with major system acquisitions. Another source is DOD Directive 5000.1, *Major Systems Acquisitions*, intended to implement the concepts and provisions of OMB Circular A-109. Somewhat more detailed than A-109, this directive contains the first reference to nonmajor systems, "The principles in this Directive should also be applied, where appropriate, to the acquisition of systems not designated as major."

Within the Army, the highest order policy is Army Regulation 1000-1, *Basic Policies for Systems Acquisition*. Except for a definition of what a major system is and outline of lower authority levels, there are only vague distinctions between major and nonmajor acquisition policy.

Much of the top levels of policy place heavy reliance on the word "tailoring." While it all sounds good, it is in general not possible for many nonmajor programs which need it most. The young Turks, captains and GS-11s, who manage many nonmajor system acquisitions simply cannot tailor the many untailorable words like "will" and "shall" which abound throughout the policy pile and certainly not letters signed by generals. Tailoring of acquisition policy designed for major systems to suit nonmajor system acquisition is simply no substitute for viable nonmajor system acquisition policy. The Army does not have one for its stock in trade.

Requirements documentation appears on the surface to be a relatively simple and straightforward procedure. The joint DARCOM/TRADOC Pamphlet 70-2, *Material Acquisition Handbook*, neatly lays out time schedules, flow charts, sample forwarding letters, and states that letters of agreement (LOA), required operational capability (ROC), letter requirements (LR), etc. can be completed in 180 days. As a practical matter, this is not possible for a variety of reasons. Among them, are cumbersome and unreasonable staffing procedures, conflicting policies, and confusion as to exactly which requirement document is needed when, what is in the document, and the perishability of the information in it. Staffing is excessive.

The development side of the house is not alone in its cumbersome staffing. TRADOC also is guilty of excessive staffing. A check of the coordination annex to an early draft letter requirement for a small ½-rhombic antenna for the Army's AN/VRC-12 FM radio system indicated that it had been staffed to all 26 TRADOC centers and schools.

It is hard to understand what possible interest the Administration Center at Fort Benjamin Harrison could have in an Army antenna. Why it was staffed there can be summed up in one word—rules—which young Turks cannot tailor even though they may be inane.

A problem caused by the lengthy time to prepare a requirement document is the perishability of the information in it. One of the inputs to the ROC and LR is a validated cost estimate. It remains "valid" for one year from the date of validation. Many requirement documents take over a year to staff and approve. The result is the validated cost estimate is done twice. The cost in time is another month.

The requirement documentation process is out of control. It is by its nature an undisciplined process. Many of the policies surrounding the process are shortsighted attempts to structure it in a piecemeal fashion.

The requirement documentation process is overlooked in the larger acquisition process and policy view in that almost every representation and discussion of acquisition strategy starts with the existence of an approved requirement document. While the process cannot be ridigly structured, it certainly can and must be structured so that requirements can be efficiently developed and documented.

Fund programming is a third major cause of delay in the acquisition of many nonmajor systems. The reason lies principally in that funds are usually not programmed in the POM process until a requirement document is approved. This includes both RDTE and procurement funds. This often forces a few urgent nonmajor programs to be supported through reprogramming efforts which have a very destabilizing effect on many programs.

An example of this type of delay is illustrated in a product improvement program for the AN/GRA-39 FM radio remote set. This minor effort was to provide an attachable power supply so that the AN/GRA-39 could be plugged into local power outlets and eliminate using as many as 12 "D" cell batteries per day. The effort was proposed in 1978 and a product improvement program (PIP) initiated.

In 1979, the PIP was rejected after a DARCOM determination was made that this PIP increased the performance envelop of the AN/GRA-39 and thus required a requirement document. In 1980, the PIP was approved and RDTE funds to support a drawing package, etc. were scheduled for FY 83 and 84 with procurement funds scheduled for FY 85, 86 and 87.

The previously mentioned requirement for a ½-rhombic antenna document ultimately resulted in the procurement funds programmed to be available starting in FY 82. It should not be this difficult to procure an extremely simple antenna which was first proposed in 1978 with prototypes developed and delivered in that same year with reprogrammed funds.

The difficulties described are certainly not new. They have existed ever since large bureaucracies were formed, and they will continue to exist. This is no reason to ignore them. Among the ongoing actions in the Department of Defense and the Army is the previously mentioned acquisition improvement program aimed at solving some of DOD's long standing acquisition problems. The discussion in recent months surrounding this program has set a tone throughout DOD to start solving these problems, particularly the self-inflicted ones.

Another Army project, the High Technology Test Bed (HTTB), offers a framework for solving many of the requirements documentation, acquisition policy, and funding policy bottlenecks in a developmental way. The intent of the High Technology Test Bed is to develop new and improved concepts using off-the-shelf or otherwise available equipment.

Keyed to the 9th Infantry Division, the HTTB efforts have centered on concepts for improving mobility, survivability and effectiveness for a rapidly deployable force. A further goal is that equipment fielded in the 9th Infantry Division to support concept development should remain leaving a uniquely high technology division.

Special emphasis is placed on concept development in the HTTB as opposed to equipment testing. The HTTB is not an organization to perform operational and developmental type testing. Surprisingly, little about the High Technology Test Bed has been written, however. This may be due largely because the effort has not yielded any impressive results.

A big reason for few results may be the inability to acquire nonmajor systems quickly and efficiently to support newly developed concepts. The High Technology Test Bed is, however, a new approach which deserves attention and study in its relation with the acquisition process.

Finally, there is growing interest and emphasis for insuring U.S. Forces readiness and ability for deployment on contingency missions. This is certainly one of the reasons for establishment of the High Technology Test Bed.

Deployment exercises, such as Bright Star in Egypt and contingency planning in units like the XVIII Airborne Corps at Fort Bragg, and pointing out problems which need to be fixed now. This change of emphasis from the standard forward deployed corps in Europe to light and mobile contingency forces provides a new motivation to acquire the equipment to fill identified voids quickly.

This new motivation, coupled with the acquisition improvement program initiative started by DOD and the High Technology Test Bed as a framework for acquisition process improvement, should provide the ingredients necessary to facilitate nonmajor systems acquisition. A lot of work is left to be done however.

The first step towards a solution for nonmajor systems acquisition is to establish acquisition strategy alternatives to the concept development, validation and demonstration, full-scale development and production life cycle management model strategy. Several examples of alternatives are shown in Table 2.

TABLE 2
Alternate Acquisition Strategies For Nonmajor Programs

Problem Identification and Articulation	*Prototype Acquisition*	*Concept Evaluation*	*6.2 RDTE Study*	*LOA*	*Advanced Development (6.3)*	*ROC/LR*	*Full-Scale Development (6.4)*	*Production*
X	X	X				X		X
X	X	X				X	X	X
X	X	X		X	X	X	X	X
X			X	X	X	X	X	X
X		X	X			X	X	X
X				X	X	X	X	X

In Process Review *In Process Review* *In Process Review*

"Program risks will always increase with a shorter acquisition strategy. It is a management function to assess risks and find acceptable ways to reduce risk. Timeliness in acquisition is also important and appears to be forgotten when a low-risk, long and time consuming strategy is followed for all programs whether risk exists or not."

A key part of each acquisition strategy is the requirement documentation process and should be considered in the strategy itself. Funding, both RDTE and procurement, can be accommodated within the PPBS structure if out-year procurement funding is identified concurrent with the requirement documentation process.

RDTE funding must be approached as a funding level provided to support a class of projects with fund expenditures made in advance of the requirement document to support the prototyping essential to developing a sound requirement document.

Finally, acquisition policy changes must be made which support a nonmajor acquisition process. A great bulk of current policy which simply adapts major systems acquisition policy to nonmajor systems acquisition in a cumbersome way can be eliminated. The result will be a nonmajor acquisition policy which does not exist today.

The second step for improved acquisition of nonmajor systems is a more structured organization to facilitate the requirement/articulation and documentation process. The High Technology Test Bed is an activity which should serve this purpose though it is not the only means to do so. Within this activity, supported by TRADOC, DARCOM and DA, a systematic approach for production of concepts and requirements generation can follow a pattern to:

- Conduct of comprehensive system engineering teams to identify, define, and articulate near term problems for solution.
- Propose initial solutions and acquire prototype equipment solutions.
- The prototype solutions undergo a Concept Evaluation Program with a purpose to define and document the requirement, BOIP development, and QQPRI development; document the operational concept; define the essential design requirements performance parameters and prototype changes necessary for production; and identify funding for procurement.
- An assessment of the development risk is made and a suitable acquisition strategy is selected.

Finally, the acquisition policy pile is huge and multilayered. It requires a comprehensive overhaul at all levels. A method often used to guide the efforts of many agencies within the Army towards a complex goal is the special program review (SPR). Such an effort must be made in the Army to solve this policy problem.

An acquisition policy SPR is needed to initiate an acquisition policy system review and monitor the progress made in eliminating the complex policy issues.

This paper has only scratched the surface of the many reasons for delay which exist within policy and procedures themselves. Solutions need to be found so that Basis of Issue Plans (BOIP) can be handled more efficiently. More than a thousand BOIP's are in the process of development today and forms a major bottleneck. Another major bottleneck is the assignment of a standard line item number for an item. This number is required so that an item of equipment can be authorized on a unit Table of Organization and Equipment (TO&E).

The process to assign a standard line item number now takes two years. Other bottlenecks exist and only through a coordinated action can bottlenecks be eliminated instead of shifted from one activity to another.

Program risks will always increase with a shorter acquisition strategy. It is a management function to assess risks and find acceptable ways to reduce risk. Timeliness in acquisition is also important and appears to be forgotten when a low risk, long and time consuming strategy is followed for all programs whether risk exists or not.

An implicit assumption in a shorter acquisition strategy is that competent managers are on hand to properly assess risk. If acquisition is permitted to occur as quickly as it is possible to occur, some mistakes will be made. Some great successes will also be made. The problem will be to guard against these mistakes without slowing the process down to the zero defect stall.

The acquisition process is too slow. While this is a problem for major system acquisition it is a significant problem for nonmajor projects as well. Causes for delay are rooted in the awkward manner in which requirements are documented, the tardiness in which funding requirements are identified and planned for, and the complex adaptation for nonmajor systems acquisition of policy originally written for major systems acquisition.

An opportunity exists today to solve these acquisition problems. The key is the Acquisition Improvement Program, initiated by the Deputy Secretary of Defense, but there are many skeptics who view this program as an excellent statement of goals but contain little on how they are to be achieved.

Support for improved acquisition programs is the important part. With this support, activities like the High Technology Test Bed can be used to not only develop better concepts, but improve the acquisition process itself.

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The Dangers of Relying on Industry as a Partner in Materiel Development

By Delaney A. Dobbins

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* * *

The labyrinth of a single materiel system development, today, winds through perhaps a half dozen significant commands and several private companies. Sometimes there is division and by the time participants agree on design and quality, if indeed they ever do, the item may have cost more than it should.

The U.S. Army has concluded that the time from concept to final deployment must be cut. In the early 1970's, the Army began to look for a better approach and came up with the Single Integrated Development Test Cycle (SIDTC). A main focus has been on testing, which traditionally was viewed as gatekeeping: before an item could move into the next development phase it had to "pass" the current phase's test. The government controlled the gates because it did most of the testing.

With the advent of SIDTC, a new trend evolved: less government testing and more reliance on private industry testing. Furthermore, much of the sequential, "heel to toe" concept was abandoned for simultaneous testing of some phases in which various interests coordinate efforts to reduce redundancy, SIDTC, with alterations, survives but has it contributed to better quality and economy? Will it be suitable for the 1980's?

In seeking answers, one should look at the central factor in SIDTC, industry or contractor testing. The Army's expectations, as SIDTC began to be exercised in the 1970's and since, have been that contactor test data would be both valid and interchangeable with Army data and that a new Army-industry partnership could use common test standards for test design, reliability-availability-maintainability (RAM) criteria, and failure definitions.

In the second phase (DT-II) of materiel acquisiton, as a new system moves toward a production decision, reliability and maintainability testing assumes paramount concern. The performance envelope has been validated by this time and attention turns, usually with some apprehension, to the availability for the future system to the field commander when the mission requires it.

Before looking at the Army experience, consider some studies by the Navy and Air Force. These services have been more articulate on contractor reliability and have invested more funds in systematic, large-scale studies.

This emphasis perhaps is caused by their traditionally greater dependence on contractor development and testing. Writing in the *Defense Management Journal*, the deputy chief of Naval Material for RAM, Willis J. Willoughby, stated that the Navy's new equipment has been far worse than expected and this has over-burdened the logistic procurement system.

Industry consistently meets the Navy's performance standards; reliability is the major problem. He identifies poor contractor testing as the single most important factor in the poor reliability of military procurement-largely responsible for the Navy's one-half billion dollar annual expenditures for spare parts alone!

Contractor tests are also held responsible for the 10 to 1 difference sometimes found between factory and fleet reliability. Willoughby holds that the weak link in Navy testing is the contractor's practice of reliability testing in a benign environment bearing little or no relationship to the field. Another Navy spokesman, Rear Admiral George E. Jessen, speaking before the Institute of Environmental Sciences (IES) in 1978, noted that Navy reliabilities drop from 85 percent in industrial laboratories to about 25 percent when measured in the fleet.

The Navy places much hope in the recent revision of Military Standard-781 (one of several universal, engineering specifications for materiel) to provide more realistic environmental qualification tests. The Navy also has developed a massive data base that will provide continuing surveillance of fleet equipment reliabilities and early detection of trouble areas.

The vice commander of the Air Force Systems Command noted that the Air Force reduced laboratory reliability predictions by as much as 10 to 1-to estimated field reliability for avionics. A histogram from the *Defense Management Journal*, April 1976, shows that in about 13 percent of the cases, laboratory reliability estimates exceeded field reliabilities from 16 to 64 times). In common with the Navy's explanation, LTG Robert T. Marsh stated, "The final major cause of the large disparity between laboratory and field reliability lies in the inadequacy of the physical environment used during laboratory testing."

The Air Force copes with the reliability dilemma in part by the Combined Environment Reliability Testing (CERT) program, which emphasizes the test chamber cycling of several environmental factors simultaneously (e.g., moisture, vibration, and temperature) for more realistic simulation of field conditions.

CERT has found its way into the recently-revised MIL-STD-781, which possibly will help solve some of DOD's environmental problems of the future.

The Army's principal tester of materiel development is the Test and Evaluation Command with headquarters at Aberdeen Proving Ground, MD. Not only does TECOM have a ringside seat for the unveiling of future materiel but the Command also is diligently trying to make SIDTC work. The TECOM experience with contractor testing reflects many unresolved problems:

• Many contractor tests are done on a component rather than a system basis. Government-furnished equipment (GFE) may not be included in the contractor test. For example, commercial power may be used instead of the appropriate Army generator. Some contractor tests are conducted in a sterile laboratory instead of in an operational environment.

• Some contractor facilities, primarily environmental ones, are inadequate. Test procedures followed during some of these tests are inadequate.

• Contractors often go through a find and fix mode during a test. Once a fix has been established, retest of previous tests may not be conducted.

• Reliability criteria in the contract are used by the contractor to assess the item's reliability. However, the failure definition, scoring criteria and mission profiles usually are developed subsequent to the award of a contract. Thus, reliability is assessed by the contractor with one set of criteria and by the government tester with another set.

• Reliability tests by contractors are incomplete. They often consist of continuous operations rather than an "on-off" procedure under which the system will actually operate. The tests often do not exercise all of the system functions. Some reliability tests are merely a "burn-in" type of short duration.

An example of these problems is a radio data link. One contractor used commercial power instead of system batteries and reported the item passed all tests. However, the item failed immersion shock and vibration, and reliability tests during

TEST TYPE	POOR TEST METHODOLOGY	UNQUALIFIED TEST PERSONNEL	UNRELIABLE HARDWARE	UNSTABLE CHAMBER CONTROL	INCORRECT SENSOR PLACEMENT	LACK OF CALIBRATION	TOTAL	%
FUNGUS	17	5	6	11	1	5	45	26
HUMIDITY	6		7	2	6	2	23	13
SAND & DUST	2	5	3	2	1	1	14	8
SALT FOG	1	8	2	3			14	8
TEMP/ALT	1	2	3	2	2	3	13	8
HIGH TEMP	2	1	2	2	3	2	12	7
LOW TEMP	2	1	2	2	3	2	12	7
VIBRATION	1	9			1		11	6
RAIN	3	3	3	1			10	6
BOUNCE (LC)	3	6					9	5
SHOCK (DROP)	3	1				1	5	3
IMMERSION	1			1			2	1
CRASH SAFETY		1					1	1
SUNSHINE	1						1	1
TOTAL	43	42	28	26	17	16	172	100
%	25	25	16	15	10	9	100	

Fig. 1. Deficiencies found in 222 test facilities of 58 separate contractors failing to comply with Government environmental test standards.

DTII (development or engineering design test) and OT II (operational or troop user test). Fixes were made and DT IIA was conducted.

Another case is an electronic message device. A fungus test was conducted for 28 days without inspecting the item. The fungus test chamber was more like a rain facility and all spores had been inadvertently washed off the item.

Still another case was a specialized radar. The contractor environmental test chambers were too small. The antenna could not be raised or rotated during the test, so effects of these environments were not determined. Later, the system failed low temperature tests conducted during DT II. Failure was associated with stiffness of azimuth drive assembly at low temperatures.

Perhaps a more systematic source for contractor test problems is a recently completed survey of contractor environmental test facilities by TECOM's Electronic Proving Ground. Experienced TECOM personnel visited 58 contractor sites over a 3-year period. At these sites, 222 separate environmental test facilities were inspected to determine their compliance with government standards. Figure 1 shows the results.

The facilities inspected included the full range under MIL-STD-801C and other specifications, to include

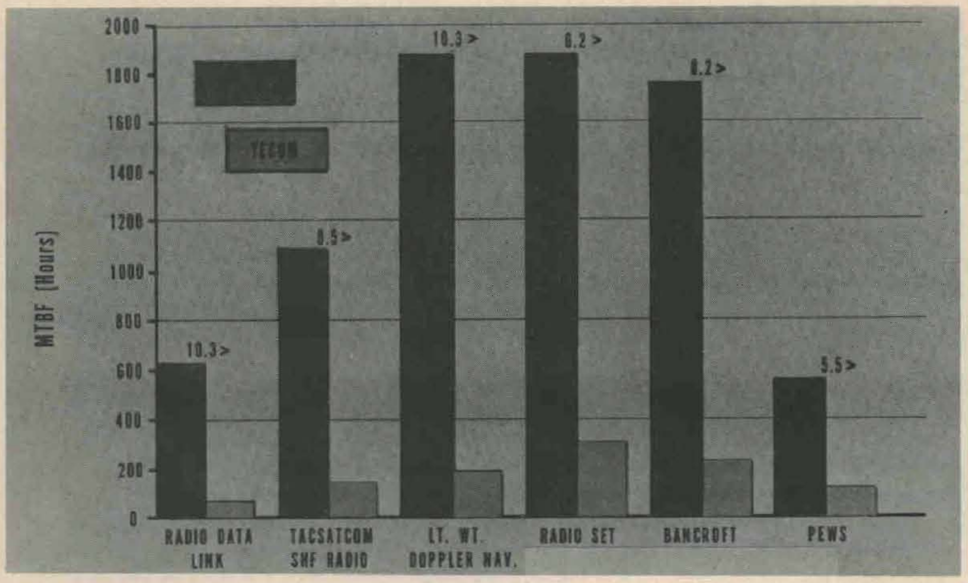

Fig. 2. Contractor Reliability vs. TECOM Reliability

shock, rain, wind, salt, fog, humidity, vibration, sand and dust, altitude, shock acceleration, fungus, bounce, drop temperature, immersion, explosion and bench handling. For those considered unacceptable, the major reasons are:

• The test facility generated conditions that either were out of tolerance with standards, out of repair, or lacked capability to measure the specific environmental trait it was intended to generate (e.g., humidity chambers with no humidity sensors).

• Test methodology was unstandard or erroneous.

• Test facility personnel were unqualified to operate or interpret equipment and results (a particularly frequent finding for fungus test).

Comparative data also exist for one specific method (508) of MIL-STD-810C. This is the fungus test, designed to test the susceptibility of new equipment to supporting the growth of (and hypothetically damage by) microorganisms. Items are innoculated by fungi in spore suspension and subjected to high heat and humidity for 28 days.

The U.S. Army Electronics Research and Development Command (USAERADCOM) (Lascaro, 1973) collected data on fungus tests over a 4-year period. Data involved three testers: the developing contractors, the proponent Army developer (ERADCOM), and the Army tester (TECOM).

It is important to understand that all three parties were supposedly bound to test in exactly the same chamber environment using exactly the same procedures set forth in some detail by the standard.

TECOM's visits to contractor facilities show that some contractors conducted sterile tests while TECOM does normal "handling" tests as would happen in the real world. (The old MIL-STD-810B did not require sterile tests, but on the other hand, did not prohibit them.)

Why the discrepancy between ERADCOM and TECOM? Perhaps it is because of a subjective bias to waive slight growth patterns or a deliberate leniency bias by the proponent. Another possibility is overly severe judgements by TECOM. Whatever the reasons, it is obvious that the Army sometimes gets nonstandard results from highly standardized tests, depending on who does the testing. Inconsistencies such as these serve only to create or confirm doubts in the minds of project managers and other high-level decision makers as to the usefulness of testing.

TECOM has recently revised the fungus test method and the new 810D will issue explicit constraints to the sterlization of test chambers.

Now, consider six Army systems that have received both a contractor and a development test. But these allow comparison of the results of the two reliability estimates, shown in figure 2. They show a familiar pattern. However, it is important to note that these data, unlike those from the Air Force and Navy, are not a comparison of factory versus tactical settings. Both are engineering and developmental test data—thus they are factory vs. proving ground.

The TECOM data were not generated by "representative users" drawn from tactical units who are usually regarded as culprits in decreased reliability when a system is fielded. Even so, the contract reliability estimates exceed TECOM's on the order of 5 to 10 times. The most probable reason is that the TECOM test was more stressful, intentionally challenging, and more representative of the user environment. However, the U.S. Army Materiel Systems Analysis Activity (AMSAA) (Kniss) offers an alternative to the environmental explanation.

A fire control system required a Research and Development Acceptance Test (RDAT). A minimum mean time between failure (MTBF) of 150 hours at the 90 percent lower confidence level was required. Forty-five "failure events" occurred which, if allowed, would not have met the minimum MTBF. However, the Army told the contractor to disallow all but four failures.

The Army bought the system and conducted engineering service tests that resulted in a MTBF of 20 to 50 hours. Analysis showed that 25 of the disallowed RDAT failures were termed "subsystem relevant/correctible by design change." Simply

"Contractor tests have not cut the development cycle and generally have not fulfilled the early hope for SIDTC. In fact, contractor test data are sometimes disregarded by Army evaluators on the basis of suspect test environments, testing and questionable design fixes."

stated, the Army accepted the contractor promises of "design fixes." If these 25 failures had been counted, the RDAT MTBF would have been 54 hours and the system would have failed.

AMSAA had a similar experience with turbojet engines. The contractor early estimated an MTBF of 600 hours using an inhouse RAM model that purged failures already judged to be "eliminated" through redesign. AMSAA estimated 198 hours of MTBF with its own model—which refuses to purge "fixes." As of July 1978, the engine was demonstrating an MTBF of 91 hours. The AMSAA model predicted 336 hours in 1978 after certain improvements were made. Amazingly, in February 1980, the actual operating MTBF was 335 hours.

AMSAA urges wider adoption of its tough-minded reliability growth model and questions the use of the contractor reliability demonstration test. In the AMSAA view, the failure-scoring problem may be of greater significance than the physical environment in explaning contractor and the Army reliability discrepancies.

Conclusions

Contractor testing is spotty and must be improved. Common test designs, RAM criteria and failure definitions have not been consistently used and test results are frequently contradictory. Contractor tests have not cut the development cycle and generally have not fulfilled the early hope for SIDTC. In fact, contractor test data are sometimes disregarded by Army evaluators on the basis of suspect test environments, overly lenient testing and questionable design fixes.

Some Remedies

First, contracts should require the Army to perform the reliability demonstration, using soldiers to operate and maintain the equipment. This would relieve industry of trying to duplicate the Army's proving grounds. A compromise would be to award contracts that require industry to use Army facilities for reliability tests. Preferably, this would occur under close technical surveillance by Army testers.

Further, no reliability test should be conducted by a proponent of the weapon system being developed. The new DOD directive (5000.xx) on RAM specifically addresses this philosophy; "Insofar as possible, reliability acceptance tests will be conducted by an agency independent of the agency whose compliance is being determined.

The independent test agency may be a higher tier contractor, or a government or commercial test laboratory. Exceptions in which the supplier tests his own product on behalf of the government may be granted by the head of the DOD component in situations of technical or financial necessity."

Second, the Army should standardize a single failure definition and scoring system along the lines of AMSAA's Reliability Growth Model. The system must judge new equipment failures harshly and produce conservative MTBF estimates.

Third, DOD and the services must continue to improve standardization of test methods and test instruments and to demand that contractor facilities meet standards. New equipment that performs poorly in environmental test chambers and are subsequently "fixed" should be proved at TECOM's Cold Regions, Desert, and Tropic climatic centers before full-scale production decisions or major foreign military sales (FMS) commitments are made.

The recent revisions to MIL-STDS 781 and 810 are helpful, but they must continue to improve via research validation and must be made explicit in requests for procurement and related contract documents.

There should be better enforcement of DA Pam 70-21, which requires that request for procurement involving contractor tests be evaluated by the DT tester, TECOM. It write the contractual specifications for contractor-conducted tests.

Fourth, the Army needs to invest

Fourth, the Army needs to invest in systematic and larger scale research and development studies of tactical field reliabilities. They are the ultimate criteria of the worth of the Army's development and operational testing programs. If reliabilities are not being accurately predicted, then the Army's test and evaluation systems are faulty and these studies could provide the wherewithal for improvement.

It should be clear that although contractor tests are the focus of our scrutiny, there has been no general indictment of industry. There can be no doubt that contractor tests will be increased in the future. There is also no turning away from the fact that they must be improved. Every preceding recommendation involves the Army's getting its test house in order. SIDTC's early promise cannot be fulfilled until this is done.

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Key DA Staff & HQ DARC

Because of significant changes of RDA personnel at DA and HQ DARCOM, the listings below are being provided to the RDA community.

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Assistant Deputy Chief of Staff, RDA & Assistant DCSRDA (International Programs)	MG Stan R. Sheridan	697-8187	3E412
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Assistant Executive Officer	LTC Edward G. Anderson III	697-8188	3E412
RDA Analysis Office	Mr. Hunter M. Woodhall Jr.	695-9720	3E411
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Management Support Office	COL James D. Stanton	697-4016	3D463
Director of Army Research	Dr. Marvin E. Lasser	695-1447	3E360
Advanced Concepts Team	Dr. Charles H. Church	695-3718	3E363
Director of Combat Support Systems	MG Lawrence F. Skibbie	697-0387	3E432
Deputy Director of Combat Support Systems	BG Phillip H. Mason	697-0387	3E432
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Munitions Division	COL William S. Chen	694-4287	3D433
Support Systems Division	COL J. Paul Goncz	697-7752	3D422
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Ground Combat Systems Division	COL Stephen E. Rash	697-0046	3D455
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Deputy Director of Materiel Plans & Programs	BG Joe J. Breedlove	697-4944	3E374
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Procurement Programs & Budget Division	COL Donald C. Mullenay	697-0416	3D366
RDTE Programs & Budget Division	COL Benjamin A. Huggin	695-3098	3D375
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M Materiel RDA Personnel

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Commanding General	GEN Donald R. Keith	274-9625	10E08
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Assistant Deputy for Science & Technology	Dr. Richard L. Haley	274-9560	10N12
Assistant Deputy for International RD&S	Mr. Bryant R. Dunetz	274-8252	10N12
Executive Officer	COL G.B. Reed Jr.	274-9710	10N06
Special Assistant for Minority Programs	Mr. J. Stolarik	274-9559	10W12
Director for Development, Engineering & Acquisition	MG Orlando B. Gonzales	274-9490	8E08
Deputy Director for Development, E&A	Mr. D.L. Griffin	274-9493	8E08
Executive Officer	COL J. Richards	274-9404	8E08
Deputy Director for Systems Management	COL George S. Kourakos (Actg.)	274-9850	8N54
Aviation Systems Division	COL William Maloney	274-8392	8N28
Missiles & Air Defense Systems Division	COL W.V. Murry	274-9651	8N31
Ground Combat Systems Division	COL F.W. McDonald	274-9870	8N48
Support Systems Division	COL P.N. Kane	274-8605	8N48
Munitions Systems Division	COL Joseph F. Salmon	274-9870	8N48
Command, Control, Communications & Surveillance Division	COL D.W. Odiorne	274-8698	8N28
Battlefield Automation Management Division	COL J.F. Campbell	274-9144	4S38
Deputy Director for Program Management	Mr. R.D. Greene (Actg.)	274-9815	8N22
R&D Program Budget/Control Division	COL D.P. Park (Actg.)	274-9849	8E14
Automated Information Division	VACANT	274-9855	8E14
Program Integration Division	COL G. Rostine	274-9200	3N14
Policy & Project Management Division	COL W.J. Walton	274-9571	10N18
Operations & Support Division	COL G.W. Hehemann	274-8977	8S57
Foreign Science & Technology Division	Mr. B.G. Pales	274-8853	8N47
Acquisition Assessment Division	COL O. Smith	274-9811	8N22
International RD & Standardization Division	COL G.S. Glock	274-9463	10S11
Director for Technology Planning & Management	Mr. J. Bender	274-9561	10N24
ARRADCOM/MICOM	Mr. T. Shirata	274-9561	10N24
MERADCOM/NLABS/AMMRC/HEL & PM TRADE	VACANT	274-9561	10N24
ARO/ILIR/ERADCOM/CECOM	Dr. G. Bushey	274-9565	10N24
AVRADCOM/TACOM	Mr. R.A. Langworthy	274-9561	10N24
Long-Range Planning	Dr. G. Andersen	274-9561	10N24
IR&D Manager	Mr. R. Mlinarchik	274-9147	4S30
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HOW MUCH DO YOU KNOW?

Recognizing that the readership of this magazine extends from "Old China hands" in the RDA business, to relative newcomers, the editors thought it might be helpful to newcomers and interesting to old timers to see how much they know in general terms, of basic RDA terminology and processes. The following questions then, were compiled by members of the HQ DARCOM Directorate of Development, Engineering and Acquisition Staff. Answers are given on page 24.

1. *What does the term PPBS stand for?*
2. *What does the term FYDP stand for?*
3. *One hears the term "CG" in program and budget talk. What does this term mean when used in this context?*
4. *What is the "POM"?*
5. *What is the PDM?*
6. *What are the Selected Acquisition Report (SARs)?*
7. *What type of a document are MENs, ROCs, LOAs?*
8. *What is an IPR?*
9. *What is an ASARC?*
10. *What is a DSARC?*
11. *What is the basic difference between "OT" and "DT" tests?*
12. *The basic Army Regulation dealing with RDA is ________.*
13. *What briefly is a TDP?*
14. *Training manuals and associated literature (are) (are not) part of the R&D managers responsibility.*
15. *A COEA is a cost and operational effectiveness analysis performed by the project manager in conjunction with TRADOC. True or False?*
16. *What is the basic difference between a 6.3a and a 6.3b program?*
17. *What is a Determination and Finding (D&F) action?*
18. *What is the Source Selection Evaluation Board (SSEB) and what is its purpose?*
19. *What is the Source Selection Authority (SSA) and its purpose?*
20. *What is the Source Selection Advisory Council (SSAC) and its purpose?*
21. *What does the term "obligation of funds" mean?*
22. *What is the time limitation on obligation of RDTE funds?*
23. *When can funds be considered available to OSD and the service for obligation?*
24. *What are TRACE funds and their purpose?*
25. *A program manager (can) (cannot) alter the scope of contractual agreement other than through a contracting officer or his representative.*
26. *What is a DASC and in what agency will the DASC be found?*
27. *What is meant by "the budget year"?*
28. *Baseline cost estimates and independent parametric cost estimates are performed by the project manager prior to ASARC/DSARC meetings. True or False?*
29. *Reprogramming in RDTE means the movement of RDTE funds and resources between programs and projects, and authority to do this is dollar limited by Congress. True or False?*
30. *What does PEP stand for?*
31. *What is the DCP?*
32. *What do the new acronyms WSM and WSSO stand for and what is their general function?*

Mobility Fuels: Fuel Quality Versus Engine Performance

By Maurice E. LePera

TABLE 1

PROPERTY/ CHARACTERISTIC REQUIRED	CONTROLLED BY: FOR DIESEL FUEL	FOR AUTOMOTIVE GASOLINE	FOR TURBINE FUEL
Handling & Storage	Flash Point Viscosity Cloud & Pour Point Contamination (Water & Sediment) Copper Corrosion	Volatility Vapor Pressure Contamination (Water & Sediment) Copper Corrosion	Flash Point Viscosity Contamination (Water & Surfactants) Particulates Microbiological Growth
Combustion Quality	Cetane No. Distillation Range Gravity Heat of Combustion	Octane No. Distillation Range Gravity Hydrocarbon Composition	Luminosity Hydrocarbon Composition Thermal Stability Heat of Combustion
Cleanliness During Use	Carbon Residue on 10% BTMS Ash Sulfur Stability	Sulfur Existent Gum Stability	Trace Metals Distillation Sulfur Existent Gum Stability

Fuel Properties Needed for Acceptable Mobility Fuels

Quality of mobility fuels is a major factor for assuring satisfactory performance of tactical and administrative equipment. Important requirements for mobility fuels include proper control of volatility to insure startability and driveability, minimal emissions generated during use, cleanliness, combustion quality, heat content and fuel economy, and improved reliability-maintainability and-durability by reducing component wear and corrosion.

Volatility control is a major consideration for both spark-ignition and turbine engines, but not a critical factor for compression-ignition engines. Volatility control of automotive gasolines is the major factor which provides for good start-up and engine driveability regardless of the geographical area of operation.

With gas turbine engines, the volatility factor assures delivery of fuel to the turbine nozzle with satisfactory ignition and flame propagation characteristics. Diesel engines, however, are more limited by low temperature fluidity (i.e., the ability of a fuel to be pumped through fuel filter systems without restriction due to waxing tendencies) which is indirectly related to the distillation range and directly related to composition of the blending stocks.

If one were to cite the major difference in combustion quality between compression and spark-ignition engine systems, compression-ignition combustion can be characterized by diffusion of fuel through air, whereas spark-ignition combustion allows propagation of a flame front through a homogenous mixture.

The assurance of proper fuel quality is maintained by limiting and controlling specification characteristics. The fuel properties for diesel fuels, turbine fuels, and automotive gasolines that control product quality are listed on Table 1. Properties for all three types of fuel essentially control particular characteristics. The "combustion quality" characteristic relates those properties which directly affect the ability of a fuel to be used. Combustion quality could also be identified as the primary performance indicator.

The "handling and storage" characteristic is a function of volatility, fluidity, contamination during refinement and product shipment or movement. Cleanliness during use is related to composition, trace contamination, and the degree of inherent stability of the particular fuel. This governs how the fuel is consumed and whether it creates any operational problems during its use.

TABLE 2
Quality Effects on Performance Of Spark-Ignition Engines

PROBLEM	*FUEL-RELATED PROBABLE CAUSES*
Excessive Engine Wear	• High Sulfur • Dirt (Silicon) Contamination
Poor Combustion Performance	• Inadequate Octane • HE Contamination • Gum Impurities
Cold Starting Difficulties	• Improper Volatility • Water Contam.
Hot Handling	• Improper Volatility
Induction System/ Carburetor Fouling	• HE Contamination • High Fuel Sulfur • Gum Impurities • Soluble Trace Metal Contaminates
Filter Plugging	• Water Contam. • Silicon Contam.
Spark Plug Fouling	• Aromatic Content

Performance of these engine systems is primarily controlled by two fuel quality factors. These factors are termed "Fuel Development and Use" and "Environmental Effects." Fuel development and use factors evolve during refinement, fuel section and usage of fuel specifications.

These individual factors relate to changes and events which occur during processing, consumption/use pattern, blending operations pipeline movements, etc., of fuels *prior* to their positioning in a tank and/or dispensing unit. These factors can be referred to as "intended changes" to fuel quality since they occur with some prior knowledge as to the event.

The other fuel quality factor, environmental effects, occurs after fuel is refined. Some of these factors cannot be controlled. For example, deterioration is a function of composition and trace contamination which is extremely difficult to control once autoxidation starts.

In discussing both types of fuel quality factors, engine performance problems can be directly related to one or more fuel properties. The problems versus fuel-related causes for performance of spark-ignition engines are summarized on Table 2. All the causes listed are either a function of fuel development and/or environmental factors.

The problems versus fuel-related causes for performance of compression-ignition (Diesel) are summarized on Table 3. More critical problems are those related to combustion, injector nozzle/pump fouling and filter plugging.

TABLE 3
Quality Effects on Performance Of Compression-Ignition Engines

PROBLEM	FUEL-RELATED PROBABLE CAUSES
Poor Combustion & Performance, Smoking	• Low Cetane No. • Water Contam. • Wrong Cloud Point • Gasoline/Residual Fuel Contam.
Excessive Cylinder Wear	• Fuel Dilution • High Fuel Sulfur • Dirt (Silicon) Contamination
Injector Nozzle Plugging Wear	• Soluble Trace Metal Contaminates • High Boiling Fractions Impurities • Gum Impurities
Injector Pump Fouling & Sticking	• High Sulfur/Hetero Atom Content • Heavy End Contam. • Gas Contam. • Low Fuel Viscosity
Filter Plugging	• Water Contam. • Fuel Impurities • Wrong Cloud Point • Thermally-Reactive Hydrocarbons
Excessive Engine Deposits	• Heavy Ends Contam. • Low Cetane No. • High Sulfur/Hetero Atom Content

The fuel-related problems associated with gas turbine engine operation are listed on Table 4. As is shown, the control of combustion characteristics minimizes carbon deposition in burner liners and on stationary turbine hardware, and also minimizes increases in burner liner temperatures caused by incandescent carbon particle radiation.

Luminous flames radiate more heat to these metal parts than do nonluminous flames, resulting in higher metal temperatures and reduction in component life. Relative to contamination, gas turbines operate best on clean fuel because of their sensitivity to particulate debris, water, and metallic fuel contaminates.

Since these continuous combustion engine systems operate at higher average metal temperatures and pressures than in other types of power plants, they are more prone to corrosion and erosion problems. The types of contaminates that affect engine performance are trace metals (i.e., sodium, calcium, potassium, vanadium, lead and copper), residual fuel contamination, water suspended dirt/debris, other fuels, surfactants, microorganisms, and refinery treating solution carry-overs.

TABLE 4
Fuel Quality Effects on Performance Of Turbine Engines

PROBLEM	FUEL-RELATED PROBABLE CAUSES
Poor Combustion & Performance	• Low Luminometer & Smoke Point • Aromatic Content • High Carbon Residue Values • Distillation Fuel Contamination
Excessive Liner & Blade Deposits & Hot End Distress	• High Viscosity • Low Hydrogen • High Sulfur/Hetero Atom Content • Aromatic Content • Soluble Metal Cont.
Fuel Nozzle Plugging/Wear	• High Particulate Contamination • Soluble Trace Metal Contam. • High Boiling Fractions Impurities • Thermal Stability • Fuel Sulfur Content
Fuel Control System Malfunctioning	• High Sulfur/Hetero Atom Content • Heavy End Contam. • Thermally-Reactive Hydrocarbons • Low Fuel Viscosity • Marginal Lubricity
Fuel Filter Plugging	• Water Contam. • Surfactant Contam. • Microbio Growth • Fuel Impurities • Wrong Freeze Point • Thermally-Reactive Hydrocarbons

Current Army Fuels Policy specifies two primary fuels for ground equipment, gasoline and diesel. JP4 is the primary fuel for aviation engine systems. Many

TABLE 5
Unique Requirements For Army Fuels

- **Survivability to Reduce/Eliminate Fuel Fire Hazards**
- **Commonality of Fuels**
  - **—NATO Standardization**
  - **—Interoperability**
- **Enhanced Storage Stability**
- **Multipurpose Use (Low vs. High Ambient Temperatures)**
- **Specific Fuel Inhibitors Required**
- **Increased Combustion Efficiency and High Energy Potential Desired**
- **Potential for Emergency Fuel Applications**

engine systems have fuel requirements which are very sensitive to changes in quality. This aspect is referred to as fuel sensitivity, fuel tolerance, or having a "multifuel capability."

The AGT-1500 gas turbine engine used in the new M1 tank is the least sensitive (i.e., having the most fuel tolerance) since it can use gasoline, turbine fuel, or diesel. The most sensitive engines relative to fuel quality are the Detroit Diesel Two-Cycle compression-ignition engines. These have a well-defined criticality for fuel sulfur content, other hetero-atoms, and upper distillation end point.

Army mobility fuels have unique requirements setting them apart from fuels being used within the civilian sector which establishes the basis for research and development efforts (see Table 5). Major requirements are survivability, commonality, and storage stability.

Survivability concerns itself with the reduction of fuel fire threats for armored vehicles (i.e., the fuel is not to burn until it is injected into the combustion chamber). Commonality is required because of NATO and other host country support which dictates interchangeability and interoperability.

Major Army R&D programs involving fuel quality and engine performance are designed to develop the ability to utilize synthetic/alternative fuels in military engines without performance problems; develop a capability for accelerating the time interval for fuel acceptance and engine qualification procedures (i.e., reducing the time intervals for certification of new engine systems on existing and future fuels) and; be in a posture to utilize GASOHOL as a substitute fuel for all gasoline consuming tactical equipment.

As the synthetic fuel industry develops and significant quantities of these fuels become available, the Army must be prepared to make the transition to new fuels without loss of combat readiness. The current program involves laboratory characterization, combustor tests, and engine tests on a variety of synfuels derived from shale, coal, tar sands, biomass, and other sources with the objective of determining which are most feasible for military use.

Development of a new accelerated fuel qualification procedure methodology was also recently initiated. This effort, requested by DOD in late 1979, tasked the three services "to develop more efficient military fuel qualification procedures to effect capacity to react quickly to changes encountered in the petroleum refining industry." This new accelerated qualification procedure methodology, once formulated would be updated with new test techniques, software and modeling procedures as they become available. Procedures would also be employed to evaluate the resultant performance of alternative/emergency type fuels that become available.

Evaluation of GASOHOL in military equipment will culminate with the development promulgation of a fully-coordinated military specification by the end of FY 81 or early part of FY 82. Once completed, DOD will be in a position to procure GASOHOL in lieu of gasoline for all military tactical as well as administrative and commercial designed equipment.

Successful completion of these research and development programs will result in faster adaptation to the world's rapidly changing fuel situation and will increase our Army's capability to operate worldwide on both present and future fuels.

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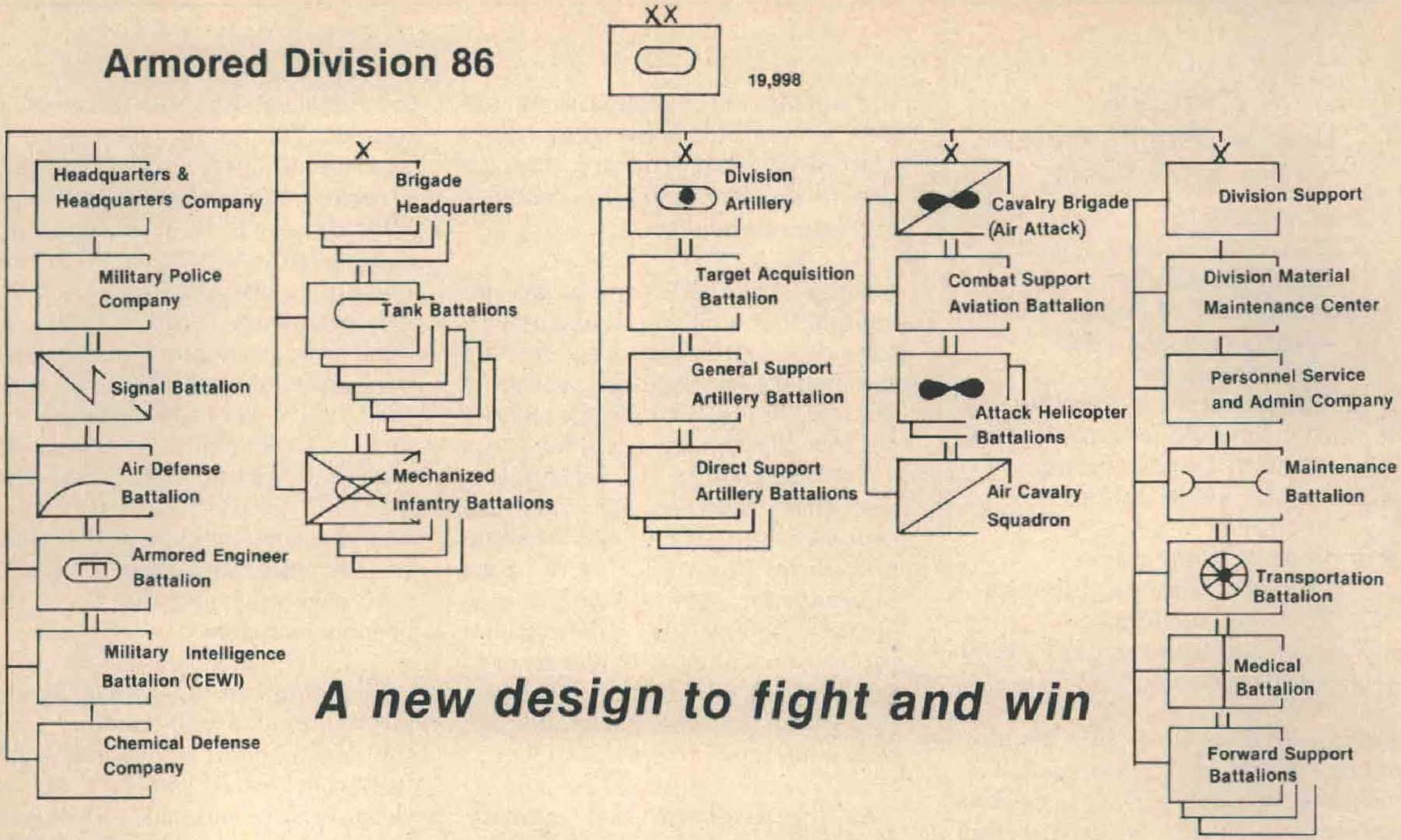


A new design to fight and win

Divison 86, or "heavy" division, is the name given to the first major reorganization of Army divisions since the 1960's.

The reorganization combines advanced battlefield concepts, new organizational design and modern equipment to give soldiers the best combat division for meeting the challenges of the future.

The heavy divisions are armored and mechanized divisions that will begin to show change starting in fiscal year 1983. Major shifts will be noticed as more new equipment rolls off the production lines.

The armored division, totaling 19,998 soldiers, is organized with three brigade headquarters, six armored battalions and four mechanized infantry battalions. The mechanized infantry division totals around 20,300 and is identical to the armored division, except that it has five armored battalions and five mechanized infantry battalions.

Each armored battalion will have four maneuver companies and a headquarters company. Each company will have 14 M1 Abrams tanks. The headquarters company will have two tanks and seven M3 cavalry fighting vehicles. There will be 58 tanks in each battalion, instead of the present 54.

Mechanized battalions will have four rifle companies of 13 M2 infantry fighting vehicles each and a headquarters company, including consolidated mortar, scout and maintenance assets. These battalions will also have an anti-armor company of 12 improved TOW vehicles. There will be 54 infantry fighting vehicles, seven cavalry fighting vehicles and 12 improved TOW vehicles in each battalion.

A big plus for the heavy division is a cavalry brigade (air attack). All division aviation resources will be joined in this brigade for better command and support. The brigade will have two attack helicopter battalions with three companies each, a combat support aviation battalion and a cavalry squadron of two air cavalry and two ground cavalry troops.

The cavalry brigade (air attacks) will be assigned 50 attack helicopters, 48 scout helicopters, 30 Black Hawk helicopters, 12 surveillance and electronic warfare helicopters and six observation helicopters. It will also have 41 M3 cavalry fighting vehicles.

Division artillery (DIVARTY) provides close support to the maneuver battalions. In the new DIVARTY, target-acquisition equipment will be increased. There will be a target acquisition battalion equipped with the AN/TPQ-36 countermortar and AN/TPQ-37 counter-battery radars to locate threat weapons. Another new item will be the remotely piloted vehicle that will provide over-the-hill visual capability.

Direct support artillery has been increased by the addition of 18 more 155mm tubes per division. General support artillery has been increased by the addition of a multiple launch rocket system battery with nine launchers and an increase in the number of eight-inch weapons.

The Division 86 headquarters has a capability of operating as separate cells over a large area for improved survivability. The military police company will be smaller than before, because many of its duties have been shifted to battalion and brigade scout platoons. The signal battalion has increased capability with improved tactical satellite, high frequency and FM communications.

The air defense battalion will have three DIVAD/Stinger and two Chaparal/Stinger batteries. Major equipment increases have been made to the engineer battalion which improves the survivability, mobility and countermobility of the division.

The nuclear-biological-chemical (NBC) company will have greater decontamination capability, plus a smoke capability. The military intelligence battalion (CEWI) contains a variety of new systems to locate, identify enemy units and to disrupt their communications.

Division 86 support, as in today's division, will come from the division support command (DISCOM). Each brigade will be assigned a forward support battalion. This unit will provide dedicated maintenance, supply and medical support to each brigade.

The new idea behind each support battalion will be to conduct logistical support as far forward and as close to the combat brigade as possible. This will save time in repair and resupply-time that may make the difference between winning and losing on the battlefield.

Where possible, repairs will be made without sending equipment to the rear area. Ammunition and fuel supplies will move as far forward as the tactical situation permits. Sick and wounded soldiers will either be returned to duty immediately after treatment or be medevaced out of the area by corps personnel. To recover essential heavy equipment, such as tanks, a heavy transport company with 24 transporters has been added to the division supply and transport battalion.

WSMR Cites Advantages of Video Tapes in Retrieving Test Data

During the past year, scientists and engineers at White Sands Missile Range, NM, have been experimenting with video tapes instead of motion picture film to obtain information from some missile tests.

This process is being studied for several reasons. Video tapes are less expensive than film and can be reused. Additionally, the tapes show a high degree of accuracy in optically recording a missile flight and tapes are ready for analysis almost immediately after a test.

Missile tests have been recorded on video tapes and delivered for analysis as quickly as two hours after the launch. Plans are also being made to install a telemetry antenna at the data reduction facility so video data can be sent immediately after a mission.

The turn-around time for motion picture film footage must include laboratory processing. Since finished video tapes are recorded directly from the field cameras' signals, they need not undergo lab processing. Data are then extracted by sophisticated computer controlled equipment and results are calculated and analyzed within a few hours after receipt.

Some of the range's instrumentation cameras can record missile images during tests at speeds up to 40,000 frames per second on film. This capability far outstrips a single standard video camera, which operates at 30 frames per second, in sheer recording power.

However, not all missile tests require such high frame rates and range researchers are presently devising a synchronization system with multiple video cameras that may provide image recording at up to 240 frames per second. Motion picture film will continue to be used when higher recording rates are required.

Comparison tests of data obtained from film and video tape have been conducted during the past year at the range to see how the two processes match up in evaluating missile performance. These tests showed that while data taken from film offered more accuracy, video tape data had sufficient quality to be extremely useful to engineers and scientists.

There are presently some technical limitations to video data that make film footage more attractive. Small details on film can be examined by using a magnifying glass or projection system. Because video data must be viewed on a television monitor, small details can only be magnified by complex electronic hardware.

Additionally, small missile images in haze or on a low contrast sky background can be seen better on film than on video recordings. However, video cameras which will nearly match film in image quality are currently on industry's drawing board and could be available for use at the range in the near future.

Interior Ballistics Termed 'Important' BRL Effort

One of the principal projects at the Army's Ballistic Research Laboratory (BRL) is to study the interior ballistic cycles of Army gun systems in order to develop a methodology for the development of propelling charges and their effects on projectiles and gun tubes.

The research, headed by Mr. Leland A. Watermeier, chief of BRL's Interior Ballistic Division, includes investigations of high risk feasibility and application of novel and advanced propelling charges for air defense and tank weapons systems as well as techniques to increase the performance of other Army devices.

In an effort to reduce the increasing cost of physical experiments and take advantage of modern computer technology, BRL scientists and engineers are also merging advanced color graphic display devices with computers to study the many aspects of interior ballistic phenomenology.

Hypervelocity interior ballistics is also in the forefront of the division's research and development in programs in support of systems that include a traveling charge concept.

Novel developments are also stressed in areas of chemical propulsion such as propellants with very low molecular weight combustion products, and in liquid propulsion technology and consolidated charge technology.

Additionally, considerable attention is being given to the design of minimum launch-weight projectiles that was applied to the Army's M1 tank cannon weapon systems without sacrificing structural integrity or accuracy, and to related areas such as the inbore behavior of projectiles as well as the role of heat transfer to the erosion of gun tubes.

Army-Developed Ada/Ed Compiler Gets AJPO Release Approval

Release of the first Ada compiler, developed by the U.S. Army Communications-Electronics Command (CECOM), was recently announced at the first Association for Computing Machinery (ACM) meeting held at the Courant Institute of New York University. Dr. Gerald Fisher of NYU, chairman of the newly formed AdaTEC committee, made the announcement.

The Ada compiler, known as Ada/Ed, was designed at NYU by Dr. Fisher and Dr. Robert Dewar under contract to the Center for Tactical Computer Systems (CENTACS), Fort Monmouth, NJ. Ada/Ed is the first implementation of the Ada programming language to receive the approval for release by the Ada Joint Project Office (AJPO).

The AJPO has the responsibility for assuring that all Ada products are validated to DOD specifications.

Development of the Ada programming languages was begun by the Department of Defense in 1975. The purpose was to develop a common programming language suited to the needs of the Army, Navy, and Air Force.

Existing languages were evaluated but none were found suitable for adoption as the DOD standard. It was then decided to proceed with the design of a new and modern high-order programming language for use in embedded computer applications.

In August 1977, four contracts were awarded for competitive language designs, and in May 1979, one of the competing designs was chosen to represent the DOD high-order programming language. The language was developed by CII-Honeywell-Bull, in Paris, France, and named "Ada" in honor of Ada Augusta, Countess of Lovelace, and daughter of Lord Byron. Ada is still considered by many to be the first computer programmer, having worked on the "Analytical Engine" of Charles Babbage.

The Ada/Ed program runs on the VAX 11/780 computer. Software allows programs to be written in the Ada language, checked for program errors, and executed on the VAX system.

Ada/Ed, sometimes referred to as a translator/interpreter, is designed to translate programs written in the Ada language into a different form called an "intermediate" language, which is then executed (interpreted) in a line-by-line fashion. While this method of design results in a rather slow running implementation, it does provide an understandable interpretation of the Ada language definition.

Future versions of the Ada/Ed, to be released later this year, will contain modifications which will allow Ada programs to run much faster than the current version.

Development of Ada/Ed by the Courant Institute began as a project jointly funded by the Defense Advanced Research Projects Agency (DARPA) and CENTACS. The effort began in February 1979 as a study of Ada implementation issues and development of an abstract compiler design. The design of Ada/Ed now represents almost a complete definition of the Ada language.

The Army assumed sole responsibility for the project in February 1980. CENTACS continued funding NYU for the continuation of the Ada/Ed project with the purpose of using it as an interim training device.

Outside of CECOM, many other activities are using or have expressed interest in Ada/Ed. West Point, for example, is using Ada/Ed as an integral part of their Ada computer language curriculum. The Navy and the Air Force have requested copies for their training programs.

Other government agencies, such as the Department of Energy, Corps of Engineers, FAA, and the National Bureau of Standards have also expressed their interest in Ada/Ed. Outside the governmental arena, CENTACS has received more than 70 letters, from industry and academic institutions, here and abroad, requesting information on how to obtain copies of Ada/Ed.

Unlike the Air Force with its previous Jovial language experience, and the Navy with its CMS-2 language experience, the Ada language experience marks the first time the Army has undertaken an effort of this magnitude.

Originally CENTACS' Software Technology Development Division was to be responsible for distribution of Ada/Ed. However, the numerous responses received from industry and academia resulted in engaging the services of the National Technical Information Services (NTIS), which was better suited to handle such a volume distribution.

NTIS is an agency of the U.S. Department of Commerce and is the central source for the public sale of information that results from government-sponsored research. NTIS charges a nominal fee to cover the costs of reproduction.

If successful, this method of distribution may also be used for future Ada products developed under government contracts.

Ada/Ed can be ordered by writing to: NTIS, Computer Products Support Group, 5285 Port Royal Road, Springfield, VA 22151 or calling (703) 487-4650. The order number is AD/A-101 670 and the price is $300.00.

Communications Agency Tests Alternate Power Source

Initiation of a program to study the feasibility of using renewable alternate energy sources at unattended defense communications systems line-of-sight relay facilities, has been announced by the U.S. Army Communications Systems Agency Project Manager DCS (Army).

Using a specially constructed test facility at Fort Huachuca, AZ, the Army Communications Systems Agency and the Army Communications-Electronics Engineering Installation Agency will evaluate the performance of commercially available solar cells, wind and thermoelectric generators, batteries, and control logic equipment as an integrated system.

The prototype system will be tested to determine the efficiency, reliability and cost effectiveness of using unattended alternate power sources under various climatic conditions for periods of three to six months.

A 500-watt thermoelectric generator, provided by the U.S. Army Electronics Research and Development Command, will be evaluated as a back-up to the solar cells and wind generator.

Solar and wind power sources are designed to continually charge the sealed, low maintenance, low self-discharge storage batteries. Additional power will be supplied directly to meet the communications-electronics load. When the batteries reach a predetermined discharge level, the nonrenewable generator would automatically be activated to supply power for load requirements. The batteries would also be recharged.

Officials believe that if tests of the system are successful, two major power sources problems may be alleviated Unattended facilities will no longer be dependent on local commercial power if alternate power sources are used. Also, current costs to store and transport huge quantities of fossil fuel will be greatly reduced.

Waterbased Foam Substantially Reduces Noise From Explosives

Noise resulting from explosives can be reduced substantially by use of a fluffy cloud of foam, according to a recent announcement from the U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL.

In recent experiments, CERL has determined that a volume of high expansion waterbased foam 10 feet square by 8 feet deep will make the noise from five pounds of explosives sound like the noise from half a pound.

The noise reduction produced by a thickness of foam for a particular weight of charge can even be predicted. The scientists also discovered that the foam does not necessarily have to be in contact with the explosive to be effective.

Using foam as a noise reduction technique was discovered accidentally by the British. To minimize fire risk from a bomb placed in a building by the Irish Republican Army, the building was filled with foam before the bomb went off. Blast damage and noise were much less than expected. Results of follow-up tests demonstrated that, not only did foam significantly reduce noise levels, it dramatically reduced smoke and particles produced by an explosion.

The CERL acoustics team has measured the blast-noise reduction both when the foam is confined in a pit in the ground and when it's in a container with metal walls. They have also measured noise reduction for unconfined areas where the explosive charge is placed on the ground and the foam is supported above the charge by walls of plastic polyethelene sheeting.

In addition, blast-noise reduction has been measured for different amounts of foam, different densities of foam and for differing amounts of explosive charge.

"The wide range of foam experiments performed by CERL can be tailored to a particular noise- or blast-reduction problem," said Dr. Richard Raspet of the acoustics team. "One of the problems is training troops in the use of explosives without inconveniencing nearby civilian residents. Another is explosives work near sensitive structures."

Explosives training must be done on remote ranges to protect people living on or near military installations from blast damage. On small installations, it may not be possible to locate demolition ranges far enough from populated areas to avoid complaints or damage. On large installations, considerable time and expense are involved in transporting troops to a remote location.

Explosive charges can be buried, but the procedure is time-consuming and presents difficulties in clearing misfires if a charge fails to detonate.

In most cases, these problems can be solved by detonating the explosives in rigid-walled foam enclosures.

Foam can also be used in building demolition. According to researchers, use of explosives is the least expensive method of demolition. However, in the past, explosives frequently could not be used due to potential damage to nearby buildings.

The CERL experiments have shown the foam can be supported over a charge by polyethelene sheeting stapled to a wood frame or in a polyethelene bag constructed of plastic drop-cloth material heat-sealed together. The result, the researchers say, is reduction in noise pollution and no damage to surrounding buildings.

New Automated Bath Unit Offers Multiple Savings

Substantial water, energy, and manpower savings are believed possible with a new multi-head automated bath unit, designed by the Aero-Mechanical Engineering Laboratory (AMEL), U.S. Army Natick R&D Laboratories.

The new Army bath unit has three independent shower head assemblies, each equipped with three individually controlled shower heads, features not in previous field bath units. Thus, substantial quantities of water can be saved with the new unit when shower heads are not being utilized. The unit is also capable of accepting additional shower head assemblies in various configurations so that fields troops may determine their own set-up needs.

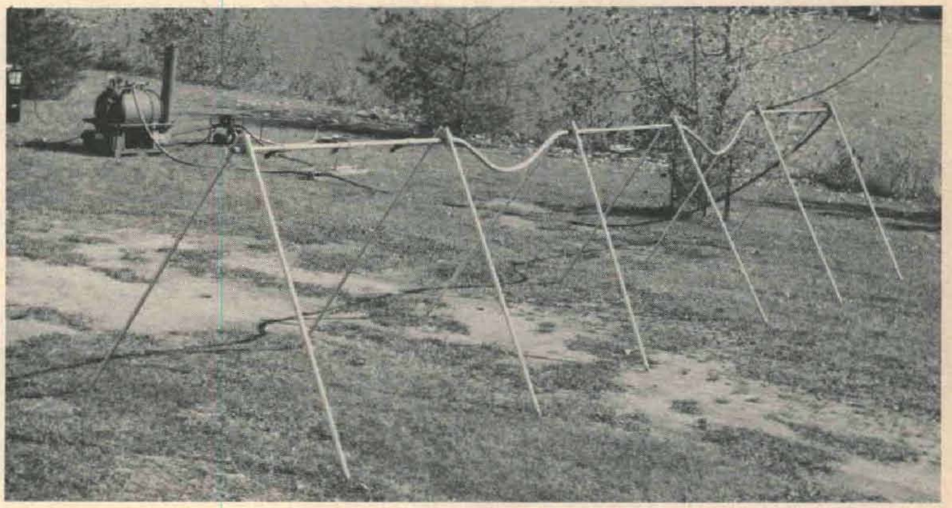
At the heart of the bath unit is the redesigned Water Heater M-80 which automatically shuts off once the water temperature reaches its predetermined maximum temperature, or when the unit's sensors indicate a malfunction. These built-in automatic safeties eliminate the need to have personnel constantly monitoring the operation. The unit ensures the water is always within a certain acceptable range.

Savings in fuel are great because the system, unlike its predecessor, does not constantly heat water that may not be used, but rather heats water only when there is a demand for it. The redesigned M-80 Water Heater is a multi-purpose piece of equipment which can be utilized to supply hot water for the field laundry unit and the field messing unit.

A centrifugal water pump relays water from either natural or artificial sources, such as a lake or a 400-gallon water trailer into the Water Heater M-80 for heating, as well as directly into a second line for cold water. Once the water has been heated, it enters a mixing valve which automatically regulates the hot water from the M-80 and the cold water from the source to a shower temperature of approximately 105°F. The water then flows directly to the shower head assemblies, and shower heads.

During shipping and storage, the entire bath unit, with the exception of the Water Heater M-80, is contained in two reuseable wooden boxes, one of which is covered with a rubber mat so that it can be used as a bench by personnel when showering.

The unit incorporates the latest state-of-the-art engineering, improves safety, and simplifies the basic operations while conserving fuel, electrical power, water, and manpower. The American GI should soon be taking advantage of this new improved unit in the field.



Multi-head Automated Bath Unit

HOW MUCH DO YOU KNOW?

Answers to Questions on Page 16

1. *Planning, Programming and Bud geting System.*
2. *Five Year Defense Program.*
3. *"CG" when used by program and budget people means* consolidated guidance *which is the guidance received by the services from OSD prior to the submission of the POM.*
4. *The POM—Program Objective Memorandum, is a recommendation submitted by each service to the Sec/Def yearly for the allocation of all services resources requirements for the current fiscal year plus one year, and has as its frame the planning guidance received earlier from OSD.*
5. *Program Decision Memorandum and it reflects the OSD decisions on the military service POM. Thus, it follows the POM in the PPBS cycle.*
6. *A Selected Acquisision Report is a standard comprehensive summary status report on a major defense system for management within DOD. It is submitted quarterly on DOD designated systems.*
7. *They are all requirements documents.*
8. *IPRs are In-Process Reviews. These are periodic formal reviews of normally non-major programs to determine a future course of action. Unless otherwise designated by DA, the materiel developing agency will exercise approval authority on IPR recommendations.*
9. *Army Systems Acquisition Review Council. This body, chaired by the Vice Chief of Staff, establishes the Army recommended course of action on OSD designated major systems in preparation for similar reivew (DSARC) at OSD level. It also makes major decisions on non-DSARC major acquisition programs.*
10. *Defense System Acquisition Review Council. It is an advisory body normally chaired by the Under Secretary of Defense for Research and Engineering that reviews major service acquisition programs. The council recommends a course of action to the Sec/Def or Dep/Sec/Def.*
11. *DTs are basically tests to demonstrate that an item meets technical requirements in a controlled laboratory like environment. OTs are tests conducted by typical user troops in a practical environment to demonstrate that an item can meet tactical requirements.*
12. *AR 70-1*
13. *A TDP is a Technical Data Package or a technical description of an item or service adequate for use in procurement; all applicable technical data, such as plans, drawings, and associated lists; specifications; purchase descriptions; standards; models; performance requirements; quality assurance provisions; packaging data; etc.*
14. *Are*
15. *False. The analysis is the primary responsibility of TRADOC with the PM providing technical data.*
16. *6.3a programs are those that are in advanced development but are not yet specific system oriented, that is destined explicitly for some new item of equipment. 6.3b programs are advanced development efforts aimed at a specific program or programs.*
17. *A D&F—Determination and Finding is one of the approvals required by Defense Acquisition Regulations prior to entering a negotiated contract. It does not apply to formally advertised contracts.*
18. *The SSEB is the body that evaluates contractor proposals and produces the summary facts and findings required for the actual source selection. It is normally composed of both military and civilians representing the various functional and technical areas involved in a procurement.*
19. *The SSA is the official designated to direct the source selection authority process and to make the selection decision. He serves in a major executive position within the DOD. Selection of the SSA is normally done by the Secretary of the Army.*
20. *The SSAC is a group of senior military and civilian personnel who represent the various functional areas involved in a major procurement. Members are designated by the Source Selection Authority (SSA). Acting for the SSA, the SSAC controls the procurement. The project manager and contracting officer as well as the SSEB, work for the SSAC. It establishes the criteria to be used by the SSEB and reviews its findings and weighs the results.*
21. *A dollar amount specifically and legally reserved against an appropriation for payment of an order placed, contract awarded, or services ordered.*
22. *RDTE funds are available for obligations for a period of 2 successive years.*
23. *Funds are considered available 1 Oct, the first day of each fiscal year. If an Appropriation Act has been passed by 1 Oct. obligations can be incurred as authorized by the Appropriation Act. In the absence of an Appropriation Act as of 1 Oct, obligations are authorized for a specified time period and within the constraints and limitations of Continuing Resolution Authorities (CRA) passed by Congress.*
24. *Total Risk Assessing Cost Estimate (TRACE) funds are amounts included in development system budgets to finance cost of unanticipated problems related to technical risk and/or schedule uncertainty that have a high probability of occurring during program execution. TRACE requirements are developed by analyzing the acquisition strategy of a program, quantifying the technical risk and uncertainties, and allocating the TRACE budget by fiscal year.*
25. *Cannot*
26. *A DASC is a Department of the Army System Coordinator and is the individual designated by the DCSRDA who functions in the ODCSRDA as the HQDA point of contact for all aspects of materiel acquisition of a given project/program, and who coordinates the status of all events in the life cycle management of a system.*
27. *Budget year designates the fiscal year for which financing is requested for items, tasks projects or parts of projects previously approved.*
28. *False. An agency other than the project manager's office conducts these, as an independent check process.*
29. *True*
30. *PEP is the acronym for Producibility Engineering and Planning, and applies to those RDTE funded planning and engineering tasks undertaken by the developer prior to quantity procurement to ensure economic producibility of the item.*
31. *The DCP is the Defense Concept Paper—an OSD document prepared by a service, that sets forth the rationale for starting, proceeding into the next acquisition phase, reorienting, and stopping a development program at each critical milestone in the acquisition cycle.*
32. *A WSM—Weapon System Manager is the person in HQ DARCOM who serves as the single Washington Operations Point for the staff management of an assigned system or systems. The WSM is responsible for all Headquarters staff activities related to the system or systems.*
    A WSSO—Weapon System Support Officer, is the technical expert who is responsible for supporting a WSM as a member of a matrix management oriented Weapon System Management Team. A WSSO may serve on one or more teams and is drawn from the various directorates at Headquarters.

Capsules . . .

Aviation R&D Contracts Exceed $14 Million

Aviation research, development, test and evaluation contracts totalling more than $14 million were announced recently by the U.S. Army Research and Technology Laboratories (AVRADCOM), Ames Research Center, Moffett Field, CA.

A contract for $6.4 million was awarded to Sikorsky Aircraft Division, United Technologies to demonstrate the manufacturing technology for making a composite main rotor blade for the Black Hawk Helicopter.

Hughes Helicopter was awarded $3.7 million to develop two experimental systems that provide the Army's attack helicopters with the ability to spot and engage both stationary and moving targets in bad weather and smoke and dust conditions.

A 21-month, $2,547,000 contract has been awarded to redesign, build and test certain critical components of the AVCO-Lycoming PLT-34A Advanced Technology Demonstrator Engine. Critical components reportedly have a significant potential for improved performance and durability. Shale derived fuels will also be tested in with the PLT-34A engine to determine effects on performance and operability.

A 42-month, $904,575 contract was awarded to Canadian Commercial Corp., for design, fabrication, and test of a high pressure ratio centrifugal compressor. All work will be subcontracted to Pratt and Whitney Aircraft of Canada, Ltd.

Teledyne CAE will prove the feasibility of modulating thrust horsepower of a turbofan engine with a variable pitch fan under a 17-month, $637,044 contract.

General Motor's Detroit Diesel Allison Division will receive $229,189 under a 15-month contract to instrument an existing radial turbine and conduct tests in an existing rig to measure surface metal temperatures and cooling air temperatures and evaluate heat transfer design capability for cooled radial turbines.

Under a $65,420 contract, Santa Barbara Research Center, will develop a discriminating sensor for a helicopter fire detection-supression system. The goal is to develop a fuel fire generic detector capable of detecting fuel fires but ignoring all potential false alarms.

A 3-month contract for $33,201 was awarded to Meterology Research, Inc. for development of a Small Intelligent Icing Data System which will provide a right-now capability to adjust an artificial icing cloud just before a test aircraft flys into it.

Hughes Helicopters received a $28,000 Army contract for the generation of an interface requirements document, which will identify the interfaces between a helicopter automatic targeting system and the AH-64 Advanced Attack Helicopter.

Contract Calls for Critical Pershing Items

The U.S. Army Missile Command (MICOM) has awarded $87 million to Martin Marietta Aerospace at Orlando, FL, for initial production items for Pershing II, the Army's most powerful battlefield missile.

This initial FY 82 buy is for critical, long-lead-time items. Martin Marietta will perform most of the work at its Orlando facility. The cost plus incentive fee contract covers 18 months.

Pershing II is an evolutionary improvement to the Pershing 1A currently operational in Europe with U.S. Army and Federal Republic of Germany troops and will increase accuracy by more than an order of magnitude and more than double the range. Pershing II will be deployed in the mid 1980's.

Pershing II accuracy is achieved by a terminal guidance technique called radar area correlation. As the missile reentry vehicle descends in the target area, the guidance unit compares radar images with stored images and makes course adjustments until the views coincide, producing almost pinpoint accuracy.

USMA Seeks Associate Professor

The U.S. Military Academy, West Point, NY, has announced formation of a committee to screen applicants and recommend the appointment of a permanent associate professor. Applicants should be of lieutenant colonel or promotable major rank. The selectee will serve as director of Administration and Management in the Office of the Dean.

The position includes responsibilities in facilities management, personnel administration, and budgetary management. Experience and/or graduate training in all three areas would be advantageous. Since the position may also entail classroom instruction of cadets, prior teaching experience is desirable.

Additional application information may be obtained from: LTC William R. Calhoun, Selection Committee Secretary, Office of the Dean, USMA, West Point, NY 10996 or (914) 938-3122, or AUTOVON 688-3122. The deadline is 1 April 1982.

Voice Systems Linked to Photo Interpretation

A research project at the U.S. Army Engineer Topographic Laboratories (ETL) could make it possible for photo-interpreters to work without taking their eyes away from the stereoviewer.

The area of Voice Interactive Systems Technology, first investigated as an In-House Laboratory Independent Research effort, is now being applied to the Computer-Assisted Photo Interpretation Research (CAPIR) system.

VIST hardware will be used in the CAPIR system to increase the speed and accuracy of data input for photo interpreters. The information extraction process will be faster and easier than the traditional "look, stop-record and look-back-again" procedure.

Other ETL development projects will be examined to identify those that can benefit from the use of voice interactive systems, and attempts will be made to apply VIST hardware to these programs.

Army Opens Aeromedical Research Facility

Activation of the new U.S. Army Aeromedical Research Laboratory facility, Fort Rucker, AL, was announced recently. The complex, which comprises 116,620 square feet, replaces the 21 World War II hospital wards in which the laboratory was housed since its establishment in 1962.

Ground for the $7.8 million facility was broken on 2 May 1978. The new facility houses laboratories for sensory, biodynamic, and biomedical applications research. USAARL, one of nine laboratories of the Army Medical R&D Command, is internationally known in the field of aviation medicine.

MERADCOM Gets Key Mission for Lubricants

A new U.S. Army Materiel Development and Readiness Command Regulation 750-11, entitled "Use of Lubricants, Fluids and Associated Products," has been approved and is now being distributed throughout DARCOM.

The regulation establishes the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, as having the lead mission responsibility for integration of all fuel and lubricant requirements into the materiel acquisition cycle.

The regulation establishes the requirement to control use and entry of lubricants, fluids, and associated products on new designs and procurements by imposing the selection criteria described under Military Standard 838.

A major requirement of the regulation is that subordinate commanders or project managers are required to coordinate with the Energy and Water Resources Lab's Fuels and Lubricants Division in the development of lube order and lubrication instructions for all materiel systems.

Mobile Water Chiller Passes Operational Tests

A small mobile water chiller designed to military specifications as part of the water supply system for the Rapid Deployment Joint Task Force has passed operational tests.

The chiller, developed by the U.S. Army Mobility Equipment R&D Command (MERADCOM) because of the non-availability of suitable commercial hardware, was tested for performance, feasibility, and transportability at Fort Bragg, NC. It was environmentally tested at MERADCOM and road tested with the 400-gallon water trailer at Aberdeen Proving Ground, MD.

The water chiller is designed to be used with the 400-gallon water trailer and the 250- and 500-gallon collapsible water drums. It can cool 40 gallons of water per hour or 800 gallons of water per day from 120°F. to 60°F.

The chiller can be used in a recirculation or single pass mode to cool water. The entire system is mobile, efficient, and capable of supporting company-sized units by providing four gallons of water per man per day which is the daily consumption in desert environments.

Rebuy Contract Calls for 308 Air Conditioners

The U.S. Army Mobility Equipment R&D Command (MERADCOM) recently completed a rebuy contract for 308 vertical compact air conditioners valued at more than $2.75 million. The 36,000 BTU/HR air conditioners are for use by the Army, Marine Corps and Air Force.

The largest part of the order, 276 units, is for use in Hawk Missile System Battery Control Centrals. Twenty-four of the remaining 32 units were delivered for use in the tri-service Technical Information Processing and Interpretation Program. The last eight units were shipped to Germany for an Air Force system.

The program was conducted by MERADCOM rather than the Troop Support and Aviation Materiel Readiness Command (TSARCOM) because this air conditioner had not been purchased since 1968 and numerous Technical Data Package changes were anticipated.

Physical configuration and functional configuration audits were performed during the contract and updated technical data packages for both 60 and 400 hertz units were submitted to TSARCOM.

2 New Greases Offer Several Improvements

As a result of the U.S. Army Mobility Equipment R&D Command's efforts to improve the overall performance of Army automotive and artillery grease, two improved candidate products have been developed.

The proposed MIL-G-10924D candidate products offer improved corrosion resistance to salt and fresh water contamination, improved water washout resistance, better storage stability, low temperature fluidity at -65 degrees F and enhanced high temperature operability.

The Fuels and Lubricants Division of the command's Energy and Water Resources Laboratory has initiated preparations to conduct field performance testing of the products at Fort Belvoir; Fort Campbell, KY; Hill Air Force Base, Utah; Camp LeJeune, NC; and Twenty Nine Palms, CA.

MERADCOM is soliciting the assistance of Department of the Army and DOD activities to find other appropriate test locations to expand the geographic and climatological factors for testing the candidate greases.

PM Terms Smoke Week IV Tests 'Successful'

The Office of the Army Project Manager for Smoke/Obscurants (PM Smoke) has reported the successful completion of PM Smoke's fourth major field test (Smoke Week IV). The Army, Navy and Air Force participated in the week-long series of tests at the Army Missile Command, Redstone Arsenal, AL.

PM Smoke, a major activity of the Army Armament R&D Command (ARRADCOM), conducts periodic "Smoke Weeks" to develop and disseminate information for the Department of the Army on the effect of smoke and other obscurants on electro-optical (E-O) devices and other weapon systems which require the transmission of electro magnetic energy through the atmosphere.

Information generated from these tests assist some E-O system developers to determine their systems susceptibility to a variety of U.S. and foreign smokes/obscurants; assist other weapon system developers to more clearly define the performance profile of their developmental and fielded systems; and simultaneously enables the developer o. smoke/obscurants munitions to assess the potential of these low cost munitions.

Among the major items tested during Smoke Week were two Navy seekers, the 5-inch semi-active laser (SAL), designated "Dead-Eye," and an 8-inch guided projectile (both are laser-guided weapons that seek out their target), as well as an obscurant munition cluster bomb unit (CBU-88), and a 5-inch ZUNI, a rocket carried on an aircraft.

The Air Force contribution to "Smoke Week IV" included testing of a laser guided bomb and the use of their Basic Airborne Seeker Evaluation System (BASES pod), a seeker system that measures the amount of thermal or heat energy on the ground and indicates by the strength of the energy, the type of equipment in the battlefield environment.

The Army's participation included tests on forward-looking infra-red systems (FLIR); M1 tank optics; the Hellfire, Copperhead systems as well as a target acquisition designation sight/pilot night vision sight (TADS/PNVS) supported by a ground locator laser designator (GLLD), and several contractor versions of an "Assault Breaker," also referred to as "top attack," a concept of attacking a tank from the air.

COL Samuel Eure, PM Smoke, said the success of Smoke Week IV demonstrated an outstanding degree of cooperation by representatives of MICOM, ARRADCOM, ERADCOM, AVRADCOM and TECOM, five subordinate commands of the Army Materiel Development and Readiness Command (DARCOM), as well as the numerous contractor representatives who participated in the test program.

Career Programs . . .

DARCOM Automates S&E Job Announcements

Establishment of an automated vacancy announcement mailing system, for engineers and scientists currently employed in the Federal Government or in non-Federal organizations, has been announced by the U.S. Army Materiel Development and Readiness Command.

Identified as the DARCOM Announcement Distribution System (DADS), the program is geared to mid-level or higher positions. Registration, which is free, is voluntary and consists of a brief indication of interest relative to grade level (GS-12 thru GS-15), occupation, specialty and functional qualifications, and geographic availability.

Vacancy announcements will be mailed directly to registrants at their home address and will include positions for which the registrant appears at least minimally qualified as reflected by the qualifications code on the registration form.

Qualifications codes, developed by subject matter experts, are designed to match registrant skills with Army needs in fields such as medical R&D, communications, aviation, transportation, weapons, etc. Application for a specific position may be made to the servicing civilian personnel office at the discretion of the registrant receiving the vacancy information.

Creation of the DARCOM Announcement Distribution System was prompted by DARCOM's disestablishment, in July 1981, of a centralized recruiting process for mid-level and higher positions. Until that time, most positions were filled through a system known as the DARCOM Career Inventory.

Engineers and Scientists currently employed by the Department of the Army will now receive a DADS registration form and instructions from their civilian personnel office. All others may obtain a registration package by calling (800) 572-5500 (Virginia only), (800) 368-3311 (other states), or by writing: Commander, U.S. Army Materiel Development and Readiness Command, ATTN: DRCLD, 5001 Eisenhower Avenue, Alexandria, VA 22333.

Keefer Participates in Scientific Exchange Program

Mr. John H. Keefer, a physical scientist in the Army Ballistic Research Laboratory (BRL), will be in Australia for the next six months to work in the Aussie Army's Materials Research Laboratory, as a participant in a scientific exchange program.

Keefer, an internationally recognized expert in shock wave phenomena and its effects, will study the after-effects of a blast and the amount of damage caused to Army targets.

This will be the second U.S.-Australian joint project for Keefer, a team leader in the Blast Dynamics Branch of BRL's Terminal Ballistic Division.

He began his Federal service career 29 years ago as a BRL mathematician after receiving a bachelor's degree in mathematics from Shippensburg State College, PA, and a master's degree in mathematics from Indiana University.

Keefer has been involved in many BRL international projects, including large scale nuclear weapons simulation testing such as MISERS BLUFF and DICE THROW, and is an advisor to the Defense Nuclear Agency. In addition, he serves as a technical advisor to a multitude of scientific panels and international committees for military, industrial and academic organizations.

In previous joint scientific work with the Australian government, Keefer was in charge of a U.S. team that conducted Operation Blowdown, in 1963, studying the effects of detonating a multi-ton charge above a rain forest.

Personnel Actions . . .

El-Bisi Chosen as Natick SAT Lab Director

Dr. Hamed M. El-Bisi has been named director of the Science and Advanced Technology Laboratory (SATL) at the U.S. Army Natick Research and Development Laboratories, Natick, MA.

SATL, a new major corporate research center, consolidates Natick's primary scientific assets and studies of the physical, natural, behavioral and engineering sciences to ensure maximum survival, sustenance and support of our troops under the most hazardous and extreme environments.

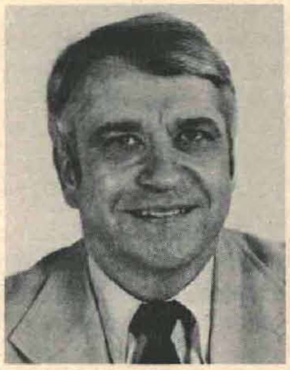
After receiving a BS degree (Summa Cum Laude) from his native country, Egypt, in 1947, and an MS and a PhD from the University of Illinois in 1952 and 55, respectively, Dr. El-Bisi accumulated over 10 years of distinguished academic service as a member of the graduate and research faculties at the Universities of Illinois and Massachusetts.

He served as a consultant to the National Academy of Sciences Space Science Board, the National Aeronautics and Space Administration, and the Jet Propulsion Laboratory during the planning and execution of early unmanned lunar missions and became the principal architect of procedures instituted to prevent interplanetary contamination.

After joining the Natick staff in 1963 to head its microbiology program, Dr. El-Bisi moved to Washington, DC to become chief of Research for Headquarters, Army Materiel Development and Readiness Command (DARCOM). He managed a $100 million plus program conducted at about 20 laboratories. In 1975, Dr. El-Bisi returned to the Natick Laboratories to serve as its deputy technical director until his recent appointment as the Director of SATL.

Dr. Hamed M. El-Bisi

Dinger Chosen as FSTC Deputy Director



Donald B. Dinger

COL Joseph R. Tedeschi, commander and director of the U.S. Army Foreign Science and Technology Center, has announced the selection of Mr. Donald B. Dinger as the Center's new deputy director.

As deputy director, Mr. Dinger will be responsible for participating with the commander in Center-wide technical and administrative matters and for planning and directing Center technical activities carried out by a workforce of approximately 500 personnel. Dinger's previous position was technical director of the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.

Dinger possesses a Bachelor of Science degree in electrical engineering and Distinguished Military Graduate Award from the University of Rhode Island, and a Master of Science degree in engineering and an applied scientist degree with major in operations research from the George Washington University.

Dinger has received the Department of the Army Meritorious Civilian Service Award in 1979, U.S. Government Senior Executive Service Exceptional Performance Ratings in 1980 and 1981, and the George Washington University Engineer Alumni Achievement Award in 1981. He is a fellow of the Washington Academy of Sciences and a member of Omega Rho/International Operations Research Honor Society, Sigma Xi/The Scientific Research Society, the Institute of Electrical and Electronics Engineers, and the American Defense Preparedness Association.

Historical Basis For The Combat Developments Process

NOTE TO THE READER: The following letter was recently discovered at an undisclosed site in Greenland. The Scandinavian runes were translated by a prominent linguist.

In this letter, dear Thor, I would like to explain the origin of our fighting materiel. As a new chief, you need to know the most efficient method of equipping your warriors for battle. As you will soon learn, the suply of maidens, horses, and sheep is limited even for a chief. Thus, even though fighting materiel is functional and pleasing to the eyes, one must use his head and retain sufficient barter to pay his men. I'll use the recent purchase of five score shields by your neighbor Lief as an example.

The first consideration in a purchase of weapons is the enemy. (I think Lief calls it the "threat".) In this case, we are facing Britons and Franks whose weapons are admittedly crude, but they can still kill you if you are careless. Their weapons are mostly light and can be easily defeated. Arrows, stones, and light spears comprise their arsenal. Now if we have taken one of their villages by raid, they cannot very well hurt us in the village, but they can hurt us as we carry booty back to the ships—and a maiden slung over your shoulder won't be improved at all if she is shot full of arrows—so we need something to protect us as we are moving. I realize this thought is really very simple, but it's surprising how many chiefs buy weapons without regard to their enemy. You no doubt remember Olag the Short who purchased a large horse and heavy armor from the Slavic chieftain and was later drowned when his ship sank, probably from excess weight. He paid the price for his folly. Now Lief figured he needed something to protect himself and his men from arrows, stones, and small spears. A shield is the obvious choice.

The second step Lief took was to figure out what kind of shield he needed to do this. He and several of his local chieftains sat down over some ale and discussed their next raiding season and exactly how they figured to fight. It soon became obvious that all concerned wanted the same thing—booty—and this involved the usual system of using our ships to sail close to a British or Frank town, land quickly, and have our men run to the town and attack it rapidly, sacking it and returning to their ships so that the inhabitants cannot gather. For, as you recently experienced, the Franks seem to outnumber the ants when you stay too long in a town. So the shield will be used by small, fast raiding parties (Lief calls this the "concept of operations").

Now Lief called his scribe and had him write a letter to Woden the Younger, Golad the Greedy, and Lupo the Wolf, asking them to come to his fief to discuss the way the shields would be made. Woden, Golad, and Lupo discussed the matter with each of their blacksmiths and each came up with a shield design. The only guidance Lief had given was that the shield would be: (1) no less than an arms-length wide, (2) round, (3) carried on one arm, (4) weigh less than one stone, and (5) stop arrows shot from a Frank bow from two score and ten paces, or (6) a short spear thrown from ten paces. The next thing Lief did was to check each shield. They all met the first four tests. Lief then had each man stand behind his shield and shot an arrow from a captured Frankish bow at each shield. Alas, Golad the Greedy had used green leather and he was killed by the arrow. Lief called this a "developmental test."

Next Lief took Woden and Lupo with their shields on a small raid to see how the shields actually worked in a fight. Woden brought his shield back to the ship full of arrows, but his skin had collected none. Lupo did not return. One warrior saw him with a Frankish spear stuck in his shield and a Frank pulling his shield down. Woden had several holes in the surface of his shield from spears, but apparently the thin layer of bronze below the leather prevented their sticking into the shield. Lief called this an "operational test".

One thing Woden did complain of was the sores on his arm from the shield straps. Apparently he had made them too thin and later widened and thickened them. (Lief called this a "product improvement").

When Lief had returned to his village and was preparing to barter with Woden for five score shields, a young upstart named Modrag came up with another style shield. (Lief called this an unsolicited proposal.) Modrag said he could make five score shields for five sheep and one maiden (one less maiden than Woden wanted). He even pointed out the polished surface of the shield as a way to blind the enemy. The shield may have been good, but, alas, Woden's war axe was better and he hewed Modrag where he stood.

Lief told Woden he would pay five sheep and two maidens for the delivery by the spring thaw of five score shields, provided that any five shields picked at random would stop the Frankish arrows as well as meet the rest of the tests. Woden grumbled, but understood that this would motivate his craftsmen since they would be behind the shields. Lief called this "quality assurance".

So you can see, Thor, that Lief was very smart in his purchase of five score shields. You might be surprised at the number, since Lief has only four score and ten able warriors. But you know as well as I that some warriors occasionally drop their shields or even "borrow" one from a neighbor. Also, the arm straps break and replacements are needed. Lief calls his ten extras an "operational float".

Perhaps you can learn some lessons from Lief's methods, perhaps not. Do as you will.

Vernock the Squat

Dear Uncle Vernock-

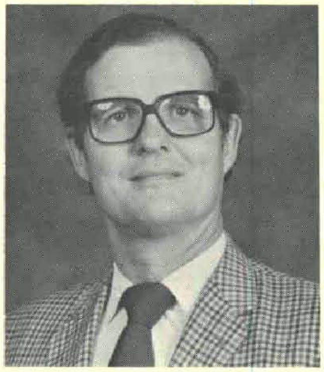
I thank you for your letter about Lief's way of buying weapons. As you may have heard, I went with him on his last raid and his warriors' shields worked quite well. I would buy one, but the maiden I was carrying looked like one of Liga's pin pillows. I must needs wait till the next raid.

Thor the Savage

(Our thanks for the preceding letter go to CPT Timothy B. Savage, U.S. Army Aviation Center, Fort Rucker, AL.)

Ballistic Modeling

By Harry L. Reed



HARRY L. REED, a mathematician, has been chief of the Ballistic Modeling Division at the Ballistic Research Laboratory since 1976. He supervises a research staff that conducts experimental work in the use of optical and radar systems. He was the 1966 recipient of the BRL Kent Award, and received the Army's Meritorious Civilian Service Medal in 1975.

Mathematical and computer modeling analysis of weapon systems, considered to be an important phase of materiel R&D, is a primary mission of the Army Ballistic Research Laboratory's Ballistic Modeling Division.

Ballistic modeling involves system analysis, decision theory and control theory, as well as theoretical and experimental studies related to electromagnetic wave propagation, target signatures and target acquisition.

In addition to analyzing weapon systems, the Ballistic Modeling Division is also involved in the direct development of mathematical and computer models. These types of models analytically describe the total performance of complete weapon systems.

Major efforts are also underway in millimeter wave technology. This work played an important role in the development of a 140-GHz and a 217-GHz IMPATT diode source and have made 140- and 217-GHz radar systems practical for the tactical Army—providing the small size, simplicity, and ruggedness of solid-state systems.

The Ballistic Modeling Division has five specific teams, each specializing in a different area, but primarily responsible for weapon system analysis and system engineering. They are as follows:

- An air defense team is heavily involved in the evaluation of two competing systems for the Army's new Division Air Defense (DIVAD) gun system and in advanced systems such as smart air defense projectiles and hypervelocity projectiles.
- An artillery team is addressing the characterization of an artillery system that allows enough detail to permit the evaluation of engineering changes in weapon subsystems and enough tactical meaning to provide truly useful measures of effectiveness. The team is specially concerned at present with multiplayer interactive computer simulation of an artillery command-control communications 3C network.
- The armor team has made significant contributions to the Army's medium-caliber antiarmor automatic cannon. Its tradeoff studies of mobility, armor and armament have provided a valuable data base for vehicle designers.
- The infantry weapons team has contributed to the development of improved infantry antitank weapons. This was achieved through its system engineering analyses of the STAFF (Smart Target-Activated Fire-and-Forget) and SADARM (Sense and Destroy Armor) munitions.
- A smoke and obscurants team is involved in the planning and coordinating of an Army program on multispectral screening agents, especially related to the millimeter wave realm.

Ballistic modeling scientists and engineers have also made significant contributions in interactive and distributed computing. Working with the UNIX system, developed by Bell Laboratories, computer scientists have developed a new processor version of UNIX and have instituted a BRL network of distributed computers to service the engineering and administrative needs of the laboratory.

In addition, BRL scientists and engineers involved in applied physics are conducting research in a variety of high-technology areas including electomagnetic propulsion, magnetic signatures, as well as ion plating and the application of radiographic techniques to ballistic instrumentation.

ATTENTION Authors

Do you have an article you would like to submit for possible publication in the *Army RDA Magazine*? If so, we would like to hear from you. Consideration will be given to all articles, based on importance of the subject, factual content, timeliness, and relevance to our magazine. The following are general guidelines for submissions:

- *Length.* Articles should be about 2,500 to 3,000 words. Shorter or longer articles are acceptable, depending on what is required to adequately tell the story.
- *Photos.* Include any photographs or illustrations which complement the article. Black or white or color are acceptable. We cannot promise to use all photos or illustrations and they are normally not returned unless requested.
- *Biographical Sketch.* Include a short biographical sketch and photo of the author/s.
- *Clearance.* Article must be cleared by author's security/OPSEC Office prior to submission.

Articles should be addressed to: HQ DARCOM, ATTN: DRCDE-OOM, 5001 Eisenhower Avenue, Alexandria, VA 22333. Telephone: Autovon 284-9587, Commercial 202-274-9587.

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