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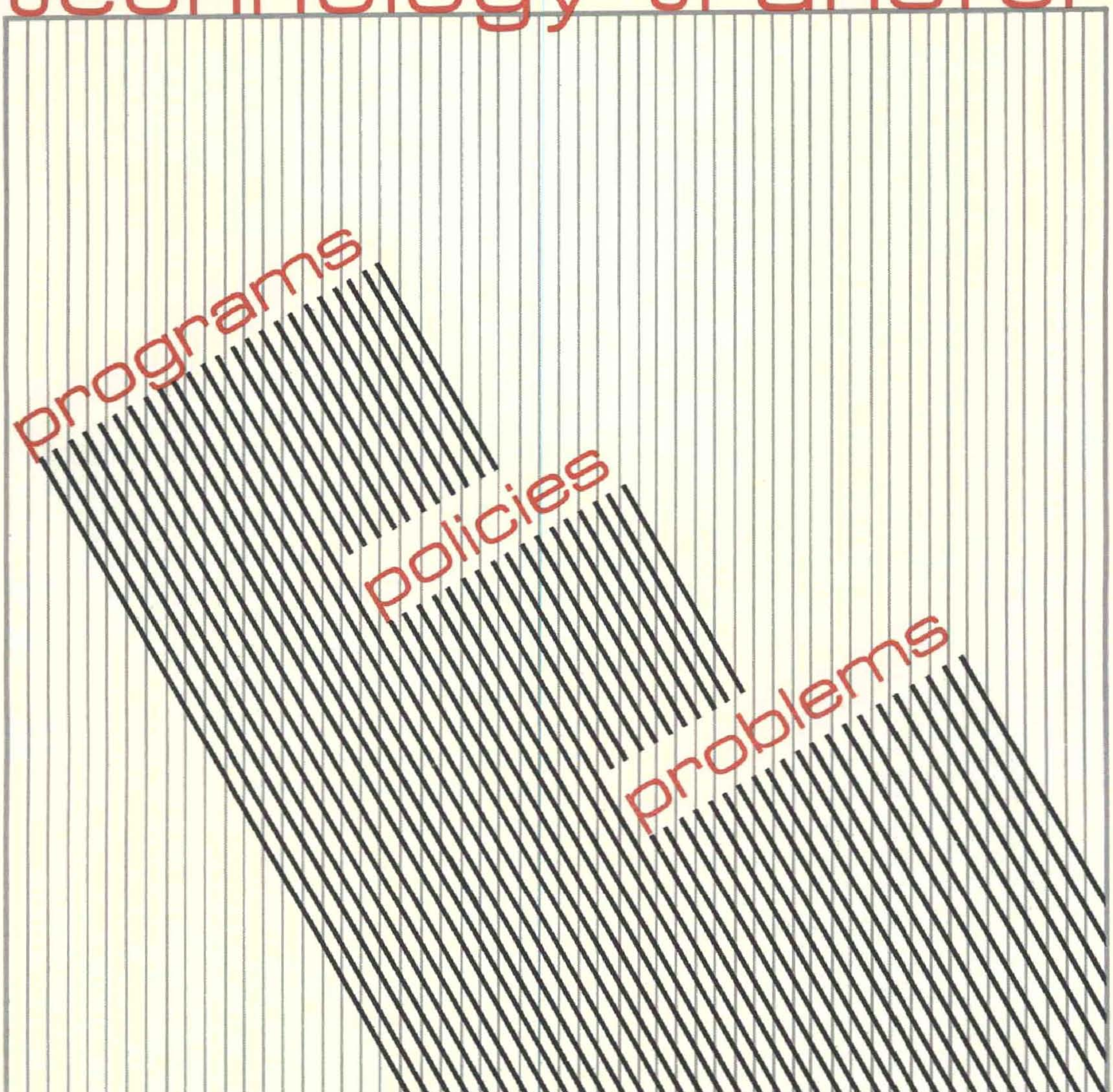
MAY - JUNE 1984

technology transfer



ARMY R,D&A

Vol. 25 No. 3 MAY-JUNE 1984

OFFICIAL MAGAZINE OF THE RDA COMMUNITY, established 1959

ABOUT THE COVER:

The three lead articles in this issue are the first in a series concerning the policies, programs and problems associated with the transfer of technology to our friends and adversaries. In subsequent issues we will feature articles addressing various other aspects of technology transfer. The back cover relates to an article on the importance of battlefield environment conditions. Cover designed by Christine Deavers, HQ DARCOM Graphics Branch.

FEATURES

DEPARTMENTS

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(USPS-584-330)

Army R,D&A Magazine (ISSN 0162-7082) is an official Army periodical published bimonthly by the Development, Engineering and Acquisition Directorate (DRCDE), HQ U.S. Army Materiel Development and Readiness Command (DARCOM), Alexandria, VA 22333, under sponsorship of the Assistant Secretary of the Army (Research, Development & Acquisition); the Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army; and the Commander, DARCOM.

Second class official mail postage paid by the United States Army at Alexandria, VA. Forward copies per Domestic Mail Manual part 159.225. Use of funds for printing this publication has been approved by the Secretary of the Army on 1 December 1983 in accordance with the provisions of AR 310-1.

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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Submission of Material: All articles submitted for publication must be channeled through the technical liaison or Public Affairs Officer at installation or command level.

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Controlling Critical Technology

By Bryant R. Dunetz

Control of critical technology—commonly referred to as "technology transfer," is more than a euphemism—it's required by law. But what are we really talking about? This has been the focus of several major departments of the Executive Branch and the Department of Defense (DOD), specifically, the Office of the Secretary of Defense and separate Service elements.

The main statutes requiring the Executive Branch to take specific measures in controlling the transfer of technology to foreign governments are: the Mutual Security Act of 1954, As Amended; the Army Export Control Act of 1976; and the Export Administration Act of 1979.

Only interim policies and procedures related to technology control have existed since 1976 in the DOD. However, recently the Department of Defense published DODI-2040.2, Subject: Control of International Technology, Goods, Service, and Munition Transfers. This instruction requires the Services to:

- Designate an official point of contact to represent that component on technology goods, services, and munition transfer matters.
- Conduct assessments of proposed technology, goods, services, and munition transfer cases, as required, and render coordinated positions.
- Assist in identifying and assessing critical technologies and in supporting DOD participation in export control lists and reviews.
- Participate on the DOD International Technology Transfer Panel.
- Coordinate the development and negotiation of international agreements pertaining to technology, goods, services, and munitions transfer.

During the same period, the U.S. Army Materiel Development and Readiness Command (DARCOM) has begun to establish the requirements, internal policy, procedures, and architecture to deal with the subject effectively.

From the definitional point of view, it is essential to understand two different problems. When Fred Bucy "rang" one of the first alarms on control of technology, he targeted on the loss of manufacturing "know-how" in computers to the Soviet Union in his well publicized report to the Defense Science Board.

On the other hand, retired Admiral Bobby Inman has spoken of the "technology hemorrage" which covered the full expanse of defense and defense-related science and technology within the public sector, and which is being sopped up by the Soviet Union as fast as we are pumping it out.

Both of these situations represent the serious impact of allowing the Soviet Union to capitalize on our national investments in R&D. However, in terms of dealing with the two problems effectively, they are orders of magnitude apart.

In the Bucy case, the problem is to tighten product and product "know-how" export laws. In the Inman case, we are trying to plug the multitude of leaks in every form of technology as we know it today, and this represents an extremely difficult task for the U.S. Government.

In practical terms, the focus should be on controlling technology which, if compromised directly or through third parties, will have a marked impact on our military operational capability. Where transfers are justified, it is incumbent on DARCOM to ensure that proper safeguards in terms of binding international agreements are in place and can be enforced.

During the summer of 1983, DARCOM Headquarters conducted an ad hoc study to review its role in technology transfer and technology control.

The study generally concluded that technology transfer needs could be divided into three parts. First, there should be controls to prevent direct transfers to the Soviet Union. Secondly, there should be controls to prevent inadvertant transfers through third countries. Finally, there should be controls to minimize the availability of unclassified critical technology in the public domain that could fall into Soviet hands.

The control of unclassified technology transferred by generally open and uncontrolled means is the single largest hole in the "technology bucket." Cooperative and security assistance programs are small by any measurement. However, at times they too represent a formidable challenge.

After examining DARCOM procedures used in the formally authorized or structured programs (i.e., FMS, co-production, co-development, information exchange, etc.), very few deficiencies were identified. The DARCOM Headquarters Directorate for International Programs, and the Directorate for Security Assistance are well acquainted with the technology transfer process and have been centers for assisting the field commands. They will continue in that role.

The single major deficiency identified in this effort is the lack of a coherent methodology and practical rules for analyzing and deciding upon which technologies should or should not be transferred; or stated another way: What types of controls should be placed on specific technologies?

A number of very important initiatives were undertaken as a result of this effort. For example, the DARCOM Commanding General directed that the Deputy Commanding General for Research, Development and Acquisition would have overall responsibility for technology transfer in the Command. Authority for review and approval of technology transfer cases was delegated to the Assistant Deputy for International Research, Development and Standardization.

Another initiative is that general command policy and implementing procedures have been published.

Additionally, a systematic methodology development has been started for both a subjective and comprehensive approach to technology transfer assessment, and formulation of a data base on technologies and systems is underway. However, much more has yet to be done to institutionalize the entire process.

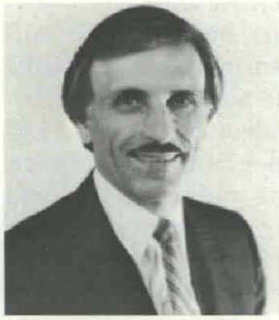
Dealing with our Allies on this subject has not been easy. Some countries are beginning to understand the concerns of the U.S. and support its policies. It has been perceived by others, however, as closing the door on opportunity for transatlantic cooperation.

It must be made clear to our friends and Allies that this is not the case and that the U.S. still seeks meaningful cooperation that will benefit our mutual security. We are simply trying to do a better job, collectively, of preserving our cutting edge of military technology—in many cases, our principal advantage over the Soviets.

What is in store for the future? First, there will be a continued campaign to raise the level of consciousness in the Command so that people are familiar with more than simple slogans. The subject will be publicized through media forms and Command involvement.

Second, technology transfer considerations will be addressed up front in the RDT&E process. We will want to know the impacts early in preparing the acquisition strategy for systems so the issues can be resolved prior to commitment of large expenditures.

Foreign military sales and potential co-production arrangements will be dealt with early to establish the acceptable limits of technology transfer and to provide guidance to our project and commodity managers. Problems associated with technology transfer represent a great challenge for the future. Practical solutions must be found.



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DOD Sponsors Small Business Innovation Research Program

It doesn't necessarily take vast amounts of money to coax bright ideas from industry. That is the philosophy behind a new program sponsored by the Department of Defense—one that is getting enthusiastic participation from the Army's Ballistic Missile Defense (BMD) Organization.

Thirteen U.S. small businesses have been awarded contracts by the BMD Organization in the first phase of the DOD Small Business Innovation Research Program. The contracts are for approximately $50,000 each.

The purpose of the program is to stimulate proposals and support small businesses in high quality, innovative research and development related to important defense-related scientific or engineering problems. Increased use of small businesses in Federal R&D will stimulate creation of new jobs and economic expansion.

For a participating agency, there are more direct benefits. Virginia Wright, the Small and Disadvantaged Business Utilization specialist for BMD, manages the organization's involvement in the program. "This approach gives small businesses a chance to express their innovative ideas, and we have gotten some outstanding proposals through the program," Wright said.

A particular plus about the program, Wright said, is that the subjects being investigated not only are potentially fruitful areas for BMD technology advances, but areas which otherwise might not have been uncovered.

The program takes a slighty different R&D approach compared to the traditional contracting process. Instead of calling for a contractor to provide a specified product or service, government agencies in the small business program submit topics for investigation. As an example, the BMD topics for 1984 included one titled "Software Development Technology: tools and techniques to improve the ability to produce high-quality software systems in a rapid manner."

Interested small businesses with expertise in that area responded with proposals, and an evaluation committee at BMD selected the most promising one for a phase one award. The same procedure was followed in 10 other topic areas listed for 1984.

To foster long-term goals of the program, the government will allow participating firms to obtain commercial rights to any invention made in either of the program's first two phases. Furthermore, during phase one, contractors are encouraged to try to obtain a commitment at that stage for follow-on private-sector or Federal non-program funding of their work. And those who are successful in doing so will be given extra consideration during evaluation of phase two proposals.

A Perspective on Technology Transfer Dichotomies

By Howard C. Race

Introduction

Domestic technology transfer is the positive exchange of information among the members of the defense and non-defense scientific and engineering communities within the U.S. Technology export can be intentional or unintentional and the results can produce strategic benefits or detriments for the Nation's economic, political, and military goals. The purpose of this article is to examine this dichotomy and the dynamics of national policies and directives on these two aspects of technology transfer.

The roles of personnel in the government lab, industrial R&D center, and the university research facility must be delineated, and guidance provided on how to separate classified information from unclassified militarily significant technology, and from other unclassified technology information.

Technology transfer means different things to many people. Sometimes it means the *rational progressive movement* or hand-off of technology from basic research (6.1) to exploratory development (6.2), to advanced development (6.3a and b), to engineering development (6.4), and to the acquisition, fielding and life cycle support of military equipment.

"Technology infusion" is also an integral part of logistics R&D, integrated logistics support, manufacturing methods and technology, and preplanned product improvements.

Secondly, technology transfer has been understood to be the *positive exchange* of scientific, technical, engineering, and manufacturing data and know-how among and within academia, industry, and government agencies to the enhancement and growth in the overall body of knowledge.

Benefits are accrued by harnessing the laws of physics and science for mankind. Economic benefits are obtained by competitive industry in the marketing of new and innovative products that push the state-of-the-art. Increased sophistication in technology also allows the military-industrial complex to develop improved weapons and equipment.

Finally, technology transfer has become the dominant phrase relative to the *loss of technology* across our borders which may result in a detrimental impact on our national defense posture and industrial economic well being.

The Dichotomy

Technology advancements are known to produce an increase in a nation's economic prosperity, while at the same time improving its military preparedness. Obviously the United States wants to maximize domestic technology transfer and manage or control the export of all technology to our allies and friendly non-aligned nations. This will assure our favorable economic position in the world, and enhance our allies' military stature.

We also want to minimize technology export to our potential adversaries to maintain, gain, or regain economic and military advantages. An exception, of course, is if a political decision dictates we make a purposeful technology export for a particular reason.

We must keep in mind that the U.S. may not be the world leader in all fields of science and engineering and that intentional technology export could yield a beneficial reciprocal technology import.

For obvious national security reasons some of this information is classified. Some of the generally unclassified information has been labeled as "military critical technology" and subject to export control laws.

Clouding the issue is the fact that some technology has a "dual-use" (both military and non-military application), and that means the "end-use" abroad may be in question. One of the most prominent comments is that governmental control of basic research technologies is contrary to the established "openness" atmosphere in the U.S. academic arena.

Similarly, U.S. industry is concerned about maximizing profits in the world market by the sale of their goods and services—both military and commercial. Industry is frequently perturbed by excessive delays and inconsistencies in processing munitions control cases and the voluminous Militarily Critical Technologies List.

U.S. scientific and technical knowledge is analogous to the water in a reservoir. The U.S. is continually trying to expand its capacity through positive contributions while limiting the uncontrolled discharge and leaks.

Our open society affords friends and foe alike the opportunities to obtain scientific knowledge just for the asking, for a fair price, and by less than honorable means. Specifically, why do potential adversaries want our technology? The Soviets and their Warsaw Pact allies have derived significant military gains from their acquisitions of Western technology, particularly in the strategic, aircraft, naval, tactical, microelectronics, and computer areas. This multifaceted Soviet acquisition program has allowed the Soviets to:

- Save hundreds of millions of dollars in R&D costs, and years in R&D development leadtime.
- Modernize critical sectors of their military industry and reduce engineering risks by following or copying proven Western designs, thereby limiting the rise in their military production costs.
- Achieve greater weapons performance than if they had to rely solely on their own technology.
- Incorporate countermeasures to Western weapons early in the development of their own weapon programs.

Potential technology transfer channels can be categorized as overt (lawful, political, economic) or covert (less than honorable). The quality and quantity of the technology transferred (exported) can vary tremendously as can the level of public knowledge (the cognizance of the victim).

In the unclassified CIA report, *Soviet Acquisition of Western Technology,* which is favorably accepted throughout the executive and legislative branches of the U.S. Government, certain technologies and equipments are identified as projected Soviet technological needs and acquisition targets through the

1980's. They range from manufacturing and programming information for computers to propulsion systems technology and sensor systems technology.

Non-Defense Technology Transfer Fundamentals

The nation's technological reservoir is filled by the basic scientific research conducted in our 150 research universities throughout the States. While the universities are basically educational institutions, they have taken on the role of research centers as an inseparable responsibility and necessity.

Today, the universities conduct more than one-half of the basic research in the country with only about 10 percent of the total R&D dollar. This body of knowledge is communicated in many ways. Scientists publish their findings in many of the more than 2,000 international technical journals, and attend meetings to present their findings.

These technical discourses on non-defense related subjects are, in many instances, transferred to industrial R&D centers and engineering laboratories to be transformed into consumer goods. Sometimes technological design and know-how are stamped "proprietary" by its owner and safeguarded with every facility available except maybe an armed guard. This proprietary information and its benefits are held for timely disclosure to maximize sales potential. The market of today and the future belongs to the successful "secret keeper," with the right technical solution.

From the defense/industry/academia science and technology perspective, basic and applied research is performed in government laboratories and conducted for the Government by defense contractors and in the university research facility.

Exchange of defense produced technology takes place through official government publications, closed government/contractor conferences or workshops, and restricted access symposiums, sometimes co-sponsored by non-government organizations such as the American Defense Preparedness Association which support national defense objectives.

Other written and verbal information about defense produced technologies is also transferred through scientific journals, open meetings, and symposiums just as for the non-defense technologies generated outside the Government.

Information Programs

Execution of the DOD Scientific and Technical Information Program is accomplished by every technology producing DOD agency and by the Defense Logistics Agency (DLA) through its Defense Technical Information Center (DTIC), located at Cameron Station, Alexandria, VA.

When a technical report is prepared by a DOD agency or defense contractor, it is given primary dissemination directly to other defense agencies and specific industrial/academic facilities participating in the development of that specific technology.

Most documents are also placed in the repository of DTIC where their abstracts, titles, etc., are announced biweekly in the *Technical Abstract Bulletin* to alert registered government agencies and defense contractors of their existence and availability for secondary distribution. The technical bulletin and its annual index are classified confidential. Authorized government agencies can request copies of available reports directly from DTIC.

To facilitate the acquisition and analysis of specific technical information in a narrow field, the Department of Defense has established 19 Information Analysis Centers. Some are organized along the discipline line, such as plastics, or metals. Other centers have a mission area orientation, such as guidance and control, or infrared technology.

Complementing the DOD Scientific and Technical Information Program is the Department of Commerce's National Technical Information Service (NTIS). The NTIS, located in Springfield, VA, receives all DOD technical publications that have been "approved for public release—distribution unlimited" and other U.S. Government produced R&D and engineering reports.

This is an excellent domestic technology transfer mechanism for all government agencies, U.S. industry, universities and any U.S. citizens. A key concern though, is the fact that while information in the NTIS has been determined suitable for public release, it can provide our friends and allies economic advantages and can provide our potential adversaries an economic boost resulting indirectly in an enhanced military capability. It is interesting to note that until recently the Soviet Embassy in Washington, DC, had a standing order for two copies of every report available from the NTIS.

In the Stevenson-Wydler Technology Innovation Act of 1980, the Congress mandated that all federally funded laboratories establish an Office of Research and Technology Applications "to provide and disseminate information on federally owned or originated products, processes, and services having a potential application to state and local government and to private industry."

The act also required that the Department of Commerce establish a Center for the Utilization of Federal Technology. This center was institutionalized as a part of the National Technical Information Service.

Industrial Independent R&D

Most defense contractors have their own additional "Independent Research and Development" (IR&D) program to increase technology expertise and improve their competitive edge. Defense contractors formulate their own IR&D plan without any government direction, coercion, or intimidation.

The tasks selected by the contractor for an IR&D portfolio are the result of an analysis by the contractor of the market potential and a corporate decision to enter a new or expanding technology field.

Government laboratory bench engineers and managers provide an input to industry by evaluating each task and providing a numerical score on relevance and accomplishment, and by providing written comments to the contractor.

Government engineers review and discuss the IR&D tasks at on-site reviews and by one-on-one technical discussions with the industrial bench engineers, each trying to influence the technical direction of the other but under obligation to protect the proprietary considerations until the technology is marketed.

The defense industry IR&D program is a significant portion of the national defense technology base, since typically it represents 8 to 10 times the level of DOD program element funding in basic research (6.1) and exploratory development (6.2).

Government engineers are in an ideal position to determine when and where duplication of effort exists between contractors and government laboratories. In many cases, duplication may be warranted if it produces competitive technical approaches to solve the same problem.

Security Implications

Loss of unclassified technology with military application has been a center of concern because it has been the most readily available for a nominal cost and "legal" for acquisition by our allies and potential adversaries.

Information dealing with design and manufacturing know-how for military technologies, but not considered to cause "direct" damage to national security, is released for public consumption by government laboratories.

Additionally, unclassified government documents limited to the government and government contractors for various reasons have been subject to release under Freedom of Information Act requests. Once the subject material was available to the public, it could be purchased by anyone from the National Technical Information Service and exported without license requirements.

This release system made no allowance for limiting unclassified technical information with significant military application.

However, in October 1983, Secretary of Defense Caspar W. Weinberger issued an "Interim Policy for Marking and Disseminating Defense Technical Documents." The memorandum states:

> "The objective of establishing a system of controls (on technical data) in the Department and defense industry is to protect Defense technology, without incurring *substantial cost and minimizing the impact on scientific innovation* and *the capability of defense industry to compete successfully in domestic and international markets.*"

It is anticipated the DOD Directive 5200.20, "Distribution Statements on Technical Documents," dated 24 September 1970, will be updated to reflect the new policy statement.

The "subject matter technical expert" must understand that a distribution statement marking is distinct from a *security classification marking* assigned in accordance with DOD Regulation 5200.1-R, "DOD Information Security Program Regulation."

A Distribution Statement is used in marking a technical document to denote the conditions and extent of its availability for distribution, release and disclosure without additional authorizations being needed.

Controlling DOD offices are responsible for determining the distribution limitation of each report, whether it is an in-house effort of contract/grant effort or whether the effort is classified or unclassified, based on technology criticality among other things. *The Militarily Critical Technologies List* is one such reference that can be used in making that determination.

The control of technology with significant military application has been significantly enhanced by the promulgation of the Secretary of Defense's policy on distribution limitations. But what about the consternation of the bench engineer and his supervisor when they are using the *Security Classification Guide* and the critical technologies list to determine what information is classified, what information is unclassified—critical technology, and what information is unclassified and suitable for "public release—distribution unlimited."

An even more difficult job may be the preparation of the *Security Classification Guide* and submission of inputs on the *Militarily Critical Technologies List* specific technologies. Where do you draw the lines between classified, unclassified militarily critical technology, and unclassified information?

Some general rules and common sense may be the most appropriate method. Considering only research, development and acquisition technical and program information, the following rules may be applied:

Rule 1: *Consider Classifying This Information*—Information relating to performance and capabilities; specifications; vulnerabilities; procurement and production plans and schedules; and operations.

Rule 2: *Consider Denoting This Information as Militarily Critical Technology*—Information that specifically provides the "know-how" to design, fabricate, process, assemble, manufacture, and test military hardware and software.

Rule 3: *Consider Maintaining This Information Unclassified and Applicable to "Public Release—Distribution Unlimited"*—Basic scientific and technical information developed in the government laboratory, in the defense industry's R&D center, on IR&D, on contract, in the non-defense industry's engineering and manufacturing facility, and in the university research facility—until the *"state of emergence" is evident.* (The transition from basic research to exploratory development *with specific military application* as denoted in Rule 2 above.)

National Security by Accomplishment

The National Academy of Science panel on Scientific Communications and National Security sets forth the postulate that "Security by Accomplishments" is better than "Security through Secrecy," and that it represents a national strategy for long-term security through economic, technical, scientific and intellectual vitality.

Domestic technology transfer is enhanced in an open society. In the long run, the technological lead of the U.S. is maintained through effective vigorous research and development and a conscious effort to prevent the undesirable export of critical military technologies.

Active participation of defense community personnel is the key to moderation and balance in the technology transfer controversy. That moderation and balance will contibute to the achievement of the desired technological leadtime.

The preceding article is an extract from a special report titled Domestic Technology Transfer versus Technology Export Control—The Emerging National Policies and the Role of the Bench Engineer, *published by the Guidance and Control Information Analysis Center (GACIAC) as SR-84-01. Additional information may be obtained from IIT Research Institute, 10 West 35th Street, Chicago, IL 60616. Telephone (312) 567-4519.*

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The Role of International R&D in Technology Transfer

By Maxwell E. Westmoreland

There is much to be gained and much to be lost in the transfer of defense-related technology to foreign countries. Technology transferred to the right country, at the right time and for the right reasons can provide some real benefits. However, transfer to a potential enemy, through whatever means, can be disastrous.

Another important factor is that transfer of some technologies, although to a friendly country, could cause U.S. industries to be at a competitive disadvantage because of the accompanying loss of jobs and income. Thus, there are two considerations relative to technology transfer. On the one hand we need to share technology to enhance and expand military capabilities. On the other hand, we must regulate exports to maintain the edge in military capabilities while keeping potential economic losses within a tolerable range.

This framework of sharing is provided through international research and development efforts, comprised of many programs and procedures which are all institutionalized and covered in detail by regulation. Let us briefly look at what these are.

- The Technical Cooperation Program seeks to make participants aware of each other's R&D programs in order to identify areas of mutual interest for further cooperation. There are currently 71 technical cooperation panels. Participants are the U.S., the United Kingdom, Canada, Australia and New Zealand.
- The Mutual Weapons Development Data Exchange Program and the Defense Development Exchange Program, presently involving 228 agreements, provide for the exchange of scientific and technical information with allies and friendly countries.
- The U.S.-Canadian Defense Development Sharing Program consists of development projects (currently two) which are jointly funded by the U.S. and Canada.
- Another effort, the International Professional (Scientists and Engineers) Exchange Program, is a DOD program for the exchange of professional personnel between U.S. and foreign defense establishments. The U.S. Army currently participates in exchange programs with Korea, Germany, Israel and Egypt. Twenty-four foreign participants are presently assigned to U.S. Army activities.
- The American-British-Canadian-Australian (ABCA) Armies Standardization Program provides a means to identify, at an early stage, possibilities for future standardization of equipment and the means to currently exploit these possibilities through the development process. There are currently 248 ABCA research projects.
- The NATO Advisory Group for Aerospace Research and Development gathers expertise of NATO nations in the fields of science and technology to stimulate and advance aerospace R&D. Currently, there are 76 Aerospace R&D panels.

  Unique cooperative R&D programs include research in specific technology areas and cooperative development of specific weapons systems. These efforts are defined by international memoranda of understanding, of which there are presently 32.
- The NATO Defense Research Group exchanges information on new research and technology efforts which might lead to new equipment. Twelve such groups are now performing this task.
- Finally, the NATO Army Armaments Group (currently 15 panels and groups) exchanges information on national programs of defense R&D related to weapon systems and equipment for land forces with the objective of identifying areas for further cooperation.

These programs have been longstanding, have quite extensive organizations and activities, and cover practically all R&D development functional areas.

With the exception of the NATO Army Armaments Group, management of these efforts, including policy and operating procedures, is the responsibility of HQ DARCOM's International Programs Directorate. Disclosure authority for these programs has also been delegated to the DARCOM commander. Regulation of shared technology is achieved by retaining review and approval authority for program transactions, and approving position papers for international meetings and travel requests for counterpart visits and meetings.

A technology transfer under international R&D programs must meet three basic tests. It must be consistent with national disclosure policy and the level of classification approved for the participating countries. It must be within the scope of the agreement under which the transfer is proposed, and finally, there must be a clear benefit in the transfer.

Why is such control necessary? The answer probably lies in the old "moving train" analogy. All programs are constantly changing as are the people assigned throughout DARCOM to execute them. Not only is the train moving, but people are constantly getting on and off. Sooner or later, somebody doesn't get the word and the potential for a foul-up is there. Therefore, we bring all the trains through the same depot—HQ DARCOM. An added complexity is that policies from on high change too. There has to be a central point to get the word out and check on compliance. This control method has worked well, mainly because the people in the field understand the need for control and support it.

Unfortunately, technology is an all-encompassing term which can be virtually anything—the spoken word of an expert, scribbling on the back of an envelope, a test report, test methods, designs and a complete technical data package. You name it, and it has probably occurred. One point must be resoundingly emphasized—technical data packages or manufacturing information or processes in any form are not transferred under international research and development programs. Such matters are more appropriately addressed in security assistance channels. This is yet another factor requiring careful regulation.

Exchange of classified information is initiated only when the capability and the intent of the recipient country to protect it have been established by the completion of a favorable on-site survey and negotiation of a General Security of Information Agreement.

International R&D agreements also contain provisions for protection and restrictions against transfer of the information being shared, both classified and unclassified. Failure to provide such protection is grounds to terminate the agreement. These provisions provide assurances that the participating countries will afford the information the same degree of protection as is provided by the country furnishing the information.

Further control is attained by only transferring information through government channels. Industries can participate in international research and development agreements, and often do. Participating governments bind their industrial participants to security procedures, and an industrial security agreement is negotiated as an annex to an existing General Security of Information Agreement.

Another aspect of control concerns foreign visitors. Foreign visitors will not be received under auspices of international programs if they are not officially sponsored by the participating governments or appropriate international organizations, such as NATO. This assures that visit requests are processed through embassy channels and that visit clearances are obtained in a disciplined manner.

Thus, from a security viewpoint, we have confidence that our information will be adequately protected once it is transferred.

Emphasis on control of technology transfer in all forms has been increasing. Publication of DOD Directive 2040.2 on 17 January 1984 is evidence of this emphasis. This directive prescribes policy, procedures and responsibilities and establishes a system of panels to address issues of international technology transfer.

Recognition of such emphasis led to the issuance of a DARCOM policy letter on 5 January 1984. This policy requires that the accurate and efficient development, coordination and approval of DARCOM positions become a daily priority activity.

The Office of the Deputy Commander for Research, Development and Acquisition has been designated to review and approve significant transfers both at the conceptual stage and at a final coordinated position.

HQ DARCOM procedures to effect this policy were published on 22 February 1984. The Assistant Deputy for International Research, Development and Standardization has been designated as the review and approval authority for the Office of the Deputy Commander for RD&A.

Relative to programs in the International Programs Directorate, these policies mean that a decision must be made whether or not technology should be shared, with whom, under what circumstances, and when. This has widespread implications. First, a sound technical basis for determining the military significance of specific technologies must be established. Data have to be gathered on foreign availability of these technologies, and the feasibility of controlling them must be determined. Finally, the risk of loss through various transfer mechanisms must be developed. When this work is completed, the political and military issues associated with countries under consideration must be factored in and appropriate policy guidance developed.

All of the above must be done in a systematic fashion if all of the participants in international research and development are to receive consistent guidance. Consistent guidance is needed, and it is needed at the earliest stages. Discussions are constantly going on between U.S. participants and their counterparts in meetings and visits related to possible cooperation.

The International Programs Directorate wants to promote sharing of information that will lead to more substantial cooperative efforts, such as cooperative development. Those involved in international R&D need to know the limits on the realm of possibilities at the outset. That gives them more credibility and promotes an even greater atmosphere of cooperation.

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Multiyear Procurement:

How Can It Help the Defense Acquisition Process?

By MAJ Danton G. Steele II

Introduction

The entire weapons acquisition cycle has often been critized for being too long, too costly, too complex, and too unreliable and long overdue for meaningful reform. One result of this desire for reform has been the increasing acceptance of multiyear procurement in acquisition strategies.

This article will demonstrate that initiatives in multiyear procurement offer excellent opportunities to reduce defense acquisition costs and lead times for weapons systems and to strengthen the defense industrial base. Although multiyear procurement is not a panacea to cure all of the ills of the acquisition system, it can effect significant savings if applied properly.

Program instability has been a major problem with DOD contracts for years, and it has exacerbated the deteriorating condition of the industrial base in the United States.

Annual Contracting

Normally, DOD cannot sign a contract and obligate money for programs unless Congress passes two separate pieces of legislation, one authorizing the program and one appropriating the necessary funds to pay for it. This appropriation process results in the annual defense appropriation act, which provides funding for the purchase of equipment as programmed annually in the Five Year Defense Plan.

Funding for each procurement program is usually earmarked for the purchase of a single fiscal year's requirement for equipment. The purchase is then accomplished by means of a single-year or annual contract providing for the production and delivery of the items in the year's requirement.

The DOD's full funding concept mandates complete funding in advance to cover the total estimated cost for all end items in a fiscal year production quantity called for in the contract, unless an exception has been granted. Full funding is required by *DOD Directive 7200.4*.

Military equipment therefore, is normally procured by a series of annual contracts fully funded by annual appropriations. There are some obvious advantages to this process. It gives high visibility to high cost items on a continuing basis and it has considerable flexibility. It also provides opportunities on an annual basis for changes in design, production rate, and quantity to meet the changing threat, to take advantage of new technology, or to respond to budgetary pressures. Another advantage is that it does not force one Congress to honor financial obligations enacted by a previous Congress.

There are also disadvantages to the annual contracting process that many feel far outweigh the advantages. The short-term, annual approach is usually not the most economical way to buy items with production runs covering several years.

A 3 June 1981 Government Accounting Office report specifically addressed several of the disadvantages with the current annual process: it allows insufficient time to establish priorities; it inhibits long-range planning and adversely affects program stability; it prevents large-scale viewing of cross-agency programs because of time constraints; and it makes long-term efforts vulnerable to budget cuts and program interruptions.

The yearly appropriation process has the effect of limiting the methods by which DOD can conduct business. Annual contracting has been perceived as unprofitable by much of industry for a number of reasons. It fosters uncertain production schedules, prevents savings from large purchases of material and larger production runs, and inhibits contractor capital investment.

Annual contracting also leads to less attractive and competitive subcontracting opportunities, costs more to place and administer since contracts are consummated annually, and encourages Congress to reduce the money for buys as a means of controlling the budget.

Because of these problems, the deteriorating state of the industrial base, and the President's pledge to "rearm America," the DOD and Congress pledged to reduce the number of unstable weapons acquisition programs. That action would, in turn, reduce overall acquisition costs to the government.

It was in this environment that the Secretary of Defense charged the Deputy Secretary of Defense with the challenge to manage weapons acquisition programs in the most efficient and economical manner possible. This challenge led to the now-famous Defense Acquisition Improvement Program initiatives.

Perhaps the key acquisition improvement initiative was the advocacy of enhanced multiyear procurement (MYP) to encourage capital investment and to increase defense industry productivity. MYP is a generic term describing situations in which the government contracts, to some degree, for more than the current year requirement.

As the Under Secretary of Defense for Research and Engineering has stated, "This initiative is designed to reduce the cost of mature, low-risk weapon programs already in production by funding economical lot buys instead of small, piecemeal, annual buys."

The overwhelming majority of government, DOD, and defense industry officials have agreed that properly administered multiyear procurement arrangements on selected acquisitions can be extremely beneficial. These arrangements can significantly improve contractor capital investment and encourage economies of scale, which, in turn, can lead to the following benefits:

- Improve economies and efficiencies in production processes and better utilize industrial facilities.
- Decrease financial borrowing costs and reduce contract administration costs.
- Produce higher quality products through improved manufacturing technology, labor-saving devices and quality control.
- Enhance the continuity of subcontractor supply lines and improve surge capability and logistics sustainability, particularly after the second year when the materials and suppliers are available.
- Stabilize the size and quality of the work force and focus industrial engineers on improving learning curves.
- Broaden the industrial base by generating greater competition at prime, vendor, and subcontractor levels, and encourage greater participation by small and minority-owned firms.
- Enhance long-range planning and reduce dangers associated with dependence on overseas strategic materials through bulk buys.
- Decrease acquisition time and eliminate program "stretch-outs" which have contributed to cost overruns.

Both industry and government representatives have gone on record estimating between 10 and 30 percent constant dollar savings through the benefits accruing from multiyear procurement. On 6 March 1981 the Secretary of Defense estimated that MYP could save nearly $15 billion in the next five years, or $3 billion per year. The projected savings just from these initiatives in the FY 1984 defense budget total over $1.5 billion.

Multiyear Procurement Weaknesses

Those same officials, however, have almost universally agreed that if the technique is used inappropriately, the taxpayers' dollars will be wasted. If MYP is used to acquire a weapon system that is controversial in need, unstable in design, or the victim of bad cost estimates, DOD will lose flexibility in responding to changes in threat, economic conditions, or technological advance.

The risks involved with multiyear procurement are very real and must be recognized to prevent abuses, since not all programs are suited to its application. Improper or excessive application of MYP could lead to the following disadvantages:

- High costs to the government due to cancellation (up to the $100 million cancellation ceiling) and increased reluctance to cancel a borderline program to prevent "loss of savings."
- Increased financial obligations for future Secretaries and Congresses and less flexibility since a much higher portion of the Total Obligation Authority would be fenced and not available for higher priority programs without incurring significant penalty.
- Higher cost/risk due to possible obsolescence, due to costly rework/scrappage for design or configuration changes, and due to the hidden costs of storage, maintenance, and shelf-life/warranty expirations for advance procurement items.
- Fewer opportunities (possibly) to generate future competition once initial award is made.
- Difficulties convincing the Services and program managers to change direction mid-stream if already committed to an acquisition strategy.
- Increased Congressional concerns with its weakened oversight of military spending.
- High risk of poor cost estimating techniques affecting realism and anticipated savings.
- Higher start-up costs and extraordinary financial burden on the contractor initially, causing possible cash flow problems and increasing program risk if the contractor is not financially healthy.

It is evident that the penalties for incorrectly applying multiyear procurement are great, so it is critical that only appropriate programs be selected for it.

Multiyear Procurement Criteria

To maximize the probability of selecting appropriate candidates for MYP, certain criteria have been developed to aid the decision makers. However, a great deal of subjective judgment is still required to decide if the technique is appropriate and how it should be tailored. Congress and GAO have a strong interest in this selection process and attempt to insure that the use of MYP will result in reduced costs.

Multiyear procurement should apply only to programs that have continuing requirements consonant with current plans; that run a low risk of contract cancellation; that have a stable design with low technical risk; and that have realistic cost estimates.

There are several basic criteria, described in OSD's 1 May 1981 policy memorandum on MYP.

For example, there should be potential for realizing significant benefit to the government, usually expressed in terms of cost savings, when compared to conventional annual contracting methods.

Another criterion is that the procurement requirement should be stable. The total number of items needed and the desired delivery rates should be expected to change little if at all during the period of the contract.

There should also be reasonable confidence that successive annual budget requests, authorizations, and appropriations will provide the required level of funding throughout the contract period. The items contracted for should have a continuing high priority relative to other items with which they must compete for critical resource dollars.

Additionally, the item should be technically mature. It should be fully developed and tested, and there should be a low probability of expensive engineering changes, modifications, or retrofits during the contract period. Any changes that might occur should not drive total costs beyond the proposed funding profile.

The probable cost of the item should also be known with reasonable confidence, preferably for both annual and multiyear contracts. High-quality cost estimates are essential and should be based on prior cost history for the same or similar items or proven cost estimating techniques.

Finally, there should be confidence in the management skills and production capabilities of the potential prime contractor and subcontractors.

Special Considerations

The complexity of the system will largely determine which year to begin multiyear procurement. Those systems well within the current state of technology might start with the first production run, provided there were no major problems during the full scale development phase. If a system is more complex and on the fringes of state-of-the-art, it would probably be better to wait until the design has stabilized after the second or third production runs before introducing multiyear procurement.

Once it is determined that MYP might be a viable approach for an acquisition, the program manager must perform a comprehensive cost analysis to determine if the expected savings justify the risks. In a sole source situation where there is only one contractor, the program manager could approach the contractor directly for help in determining the nature of the savings and the risks involved.

In a competitive environment, less reliable in-house estimates of savings and risks must be generated. In any event, the effort to analyze and document potential savings of a multiyear procurement as opposed to an annual procurement can be time-consuming and expensive. Certainly, such an effort is not a precise science.

The level of difficulty increases as savings and risks are projected farther into the future. This procedure poses one of the biggest challenges to the government in its effort to select appropriate programs.

The decline of the industrial base has been particularly severe at the subcontractor level, but MYP can provide a potentially powerful force to reverse the decline even more effectively at that level than at the prime contractor level. Even a relatively high risk, unstable program could have stable, low-risk subsystems to which multiyear procurement could be applied. For the subcontractor tier to benefit, however, the prime contractors must pass along the benefits they receive from the MYP process.

There are several complications that could affect subcontractor tiers. For example, competition might actually be reduced with long-term contractual commitments. Both the prime contractor and some of his subcontractors would be locked in for a number of years into *de facto* single source situations, thus discouraging competition after the initial award.

Another problem could arise from the savings accrued from large lot orders. A prime contractor could order a large, one-time, short-duration order that a subcontractor could attempt to fill with existing facilities, rather than invest in new capital equipment.

Similarly, a prime contractor could be encouraged to develop his own capability and make components, rather than buy them from a subcontractor. The prime contractor could use some of his own excess capacity and ignore his subcontractor.

Conclusion

The entire defense acquisition community will be watching to see if the Congress and DOD cooperate as partners in the multiyear procurement initiative and accept the inherent responsibility for not making major changes in the program or quantity profiles once a program has been placed on multiyear status.

The obvious penalties for changing MYP programs are loss of expected savings and disruption to the delivery of end items to the government. The less obvious penalty is a loss of advocacy in Congress, in DOD, and in the public sector for a critically needed procedure that can effect exceptional savings in the acquisition process. We must get better teamwork out of Congress and DOD, and we must harness the potential of MYP.

Unquestionably, current initiatives in multiyear procurement offer excellent opportunities to reduce acquisition costs and lead times for major weapons systems and to strengthen the defense industrial base. Although MYP is not a panacea that can cure all of the problems that impair the defense acquisition system, its effective use is an important step toward providing sufficient quantities of quality weapons at affordable costs.

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Competitive Skunkworks During Full Scale Development

By LTC John E. Longhouser and William R. Stansberry

Competitive prototyping is not new to the acquisition process. However, it has historically taken place during demonstration and validation with award of a full-scale development contract to the winning contractor. This award is followed by delivery of a complete technical data package proposal (e.g., as was the case with M1 tank).

Skunkworks contracting also is not a new initiative. It was used as early as 1943 by the Army on a contract with Lockheed Aircraft Corp. for the P80, the first U.S. tactical jet fighter aircraft. More well known uses of the skunkworks concept were for the U2 and SR71 reconnaissance aircraft. Over the years the concept has been successfully used numerous times for a variety of programs.

A recent example of a skunkworks effort undertaken by the Army was the competitive development of the Conduct of Fire Trainer (COFT). The purpose of this article is to assess the results of the COFT application of competitive prototyping and to discuss the impact this acquisition strategy has had on transition from development to production for the largest Army procurement of a training simulator ever undertaken.

Refinements to the skunkworks strategy which makes the COFT effort different from most skunkworks efforts are:

- Competitive prototyping is taking place during full-scale engineering development and is followed by a competitive test resulting in a production award to the winning contractor within three years of the development contract award.
- The skunkworks is taking place as a competitive effort as opposed to sole source.

The dust has settled on the initial application of the strategy, and full scale production efforts are now 18 months old with initial simulator deliveries due later this year.

Although the concept achieved its goal to initiate production of a fully capable trainer within three years of the development contract award, there were circumstances which may require necessary refinement of the skunkworks approach. One important fact was that one of the contractors delivered a prototype which was unsuitable for developmental and operational testing, and the government found itself in a sole source environment far earlier than it would have liked.

This dilemma was unforeseen and prevented the government from realizing the full value of the strategy. Nevertheless, the government maintained its course; tested both the M1 and M2/3 prototype versions of the Conduct of Fire Trainer; negotiated a comprehensive scope of work for production; and awarded a production contract with follow-on options to General Electric Co. in September 1982.

Skunkworks is Not for Every Contractor

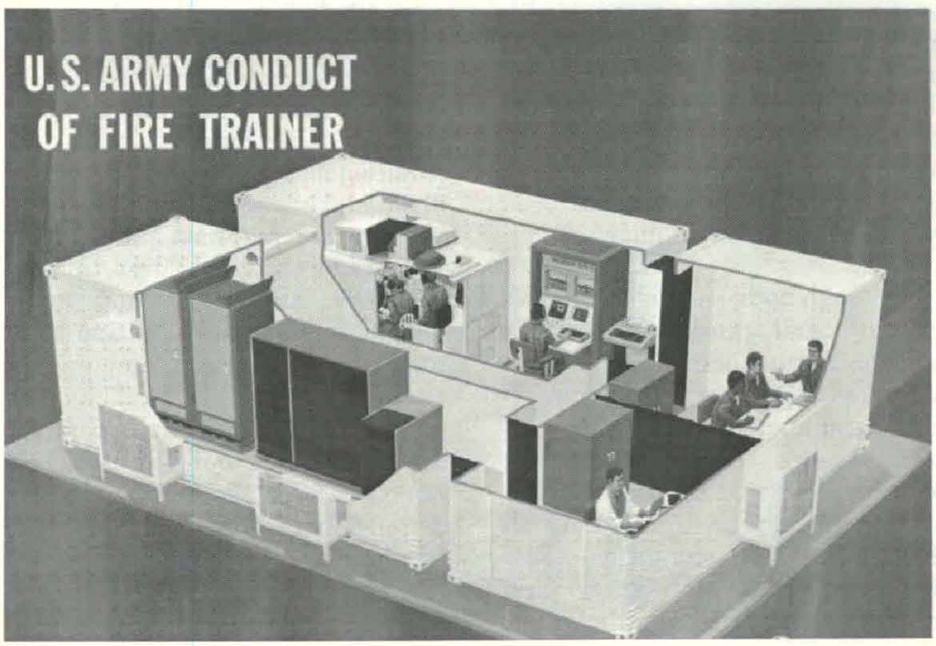
The competitive skunkworks approach presupposes that every contractor is seasoned in the transition from development to production. It envisions the delivery of a "mature" prototype ready for competitive testing and complete with an attendent production plan which can be properly priced and executed without missing a step.

All government contractors simply do not fit this mold; nor can they all be expected to arrive at the finish line with the ingredients essential for successful production in a hands-off environment.

In the case of the Conduct of Fire Trainer program, one contractor never made it to the wire. The other lacked large scale production maturity during development and, although equipped with a solid winner in terms of prototype performance, had great difficulty in pricing the forthcoming effort (transition and production) and conforming to the myriad of government data requirements in production.

This immaturity cost the government team approximately three months during transition since the teams on both sides worked shoulder to shoulder in creating a workable contract for quantity production.

In considering the application of



the competitive skunkworks approach, one must review the contractors' business history in terms of performance and staying power, and determine that the contractor is capable of converting flexibility in development into a rigid, comprehensive production plan and, can properly price a production program laced with the requisite data requirements. Normally, the contractors' history will provide necessary insight into refinement of the skunkworks strategy, as appropriate.

Dollars Versus Deliverables

The COFT skunkworks contract was structured as a 'cost plus' contract with a cap, and all budgeted dollars were spent. It is noteworthy to consider how the contractors gave priority to the work in terms of expenditures, especially since, given the sequence of events, one can safely conclude that both contractors gave the government test top billing. Simply put, they knew the top performer during developmental and operational tests would win the production contract. Additionally, the contractors envisioned, that by the end of development, life cycle costs and production planning would also be criteria for source selection. Documentation and supportability would be cleaned up at a later date. In retrospect, one can hardly argue with that philosophy.

Each contractor, however, approached prototype performance differently. One contractor concentrated on hardware fidelity, knowing that training transfer would be a key discriminator. On the other hand, the other contractor focused on scene content and consistency in their newly designed computer image generator.

Although both contractors were afforded liberal guidelines regarding baseline documentation, great pain was taken on the part of the contractors to conform to classical, government-required documentation for both hardware and software control.

A point can be made that, although industry complains vehemently about excessive data requirements, when left to their own mastery they fall back on the government's approach to design description and documentation. Does this perhaps indicate we have created a monster that cannot be destroyed?

Testing A Skunkworks Prototype

As stated previously, one competitor never made it to test. A purely subjective and incomplete assessment would suggest that on the part of the losing contractor, not nearly enough import was placed on software baselining and integration. As a result, its hardware would not play, and thus could not train.

The Army team learned a valuable lesson from this calamity and has applied it to the preparation for the Conduct of Fire Trainer First Article Test. That is, regardless of the complexity of the task, in spite of unknown obstacles strewn along the way, and cognizant of the value of pre-testing, a period of system burn-in or wring-out before a major testing period must be planned and considered sacred—at almost any cost.

Test goals must be established and prioritized according to the parameters provided during development. Training transfer and effectiveness headed the list for the Conduct of Fire Trainer and provided the basis for operational testing. These criteria were soundly tested and verified during developmental and operational tests. There were, however, a substantial number of system deficiencies and shortcomings, as delineated by the test reports.

During operation, the visual scene accommodated an unacceptable amount of flashing and streaking. Additionally, a requisite degree of detail and special effects were missing. On the hardware side, fidelity was lacking in certain areas, and the reliability, availability, and maintainability requirement of 300 hours mean-time-between-failure was not attained.

Basically, a letter-perfect prototype did not emerge out of the skunkworks phase, and it should not be expected under the conditions of a competitive development effort.

Understandably, the government team considered a number of options. It could be short-sighted and parochial in its thinking and require the contractor to upgrade the prototype and initiate a plan for further formal testing. But if it did so, what value was the skunkworks? Alternatively, the government team could take advantage of the strengths of the prototype and maintain the advantage the skunkworks effort provided in terms of time and dollars.

The skunkworks approach does present risk in terms of design definition and performance criteria. One must consider these risks as the acquisition strategy is shaped, and not permit the risks to overwhelm the value of the skunkworks approach. In the case of the trainer, the risks associated with the outcome were seen as manageable.

All problem areas highlighted by the government test were categorized either as low risk, thus fixable during production, or moderate risk which had to be fixed and demonstrated before production. None of the deficiencies or shortcomings were considered 'showstoppers.'

The Conduct of Fire Trainer team embarked upon a 'fix and test' phase where both government and contractor resources were collectively involved with and committed to correcting the moderate risk problem areas. Testing, as necessary, would be conducted on appropriate hardware fixes.

A week long fix and test demonstration was held in June of 1982. All the governmental decision makers were in attendance. However, the real decision power rested with the users from Fort Knox and Fort Benning who were allowed to operate the trainer without restraint during a 14 hour free-play period to verify that all hardware and software fixes were demonstratable and acceptable.

The fix and test phase was a resounding success, and with unanimous support from the user, the supporter and the materiel developer (TRADOC, LEA, and DARCOM), the trainer team forged ahead towards production.

These types of management decisions should be expected with the skunkworks approach and can be dealt with using common sense and innovative acquisition strategy.

Plan for Competition but Don't Ignore Sole Source

Not surprisingly, a very large source selection team was required. The size, composition, and planning for this source selection team was further compounded by the fact that only one contractor reported for developmental and operational tests with a testable prototype.

In accordance with the intent of the acquisition strategy, the deficient contractor was terminated for convenience by the government. Though the skunkworks approach achieved the goal of competitively producing a technically acceptable prototype in a very short time, it left the government with the dilemma of a sole source acquisition. It was therefore decided that the source selection board would convene instead, as a Proposal Evaluation and Analysis Board, and would conduct its business similar to a Should Cost study. This led to an exhaustive search for experienced help from within several Army agencies.

The proposal board began its effort late in 1981. When the smoke cleared in mid 1982, the board had consumed 17½ man years of effort at a cost of approximately $2 million to the government. However, the board reduced the proposed program cost by $239 million without reducing requirements.

A project manager must use assets available within the government, especially in a sole source environment and remain strong during the evaluation and negotiating phase. He must argue forcefully within the government for the requisite skill necessary because the potential payoff is very large indeed.

Production Planning a Necessary Ingredient

Throughout the skunkworks phase, production planning was conspicious by its absence (traded off completely by both contractors). This was a clear impediment to speedy transition from development to production.

The initial months following developmental and operational tests were consumed by producibility studies and creation of a viable production schedule, the last of which was and continues to be changed by a dynamic distribution plan for the Abrams tank and the Bradley Fighting Vehicles.

As negotiations for production began, it became apparent that much more non-recurring costs would be experienced in the initial production year than originally planned for.

In retrospect, it is obvious that when using the competitive skunkworks approach, data and production planning will lag behind the priorities of hardware development, reliability and, in this case, training effectiveness. The logical recourse is to have the production plan become a non-tradeable item in the government statement of work. Of course, the price to the government will be more time and dollars in competitive development.

In order to manage a production program effectively, the umbilical cord to R&D must be severed as soon as possible. The necessity of having a government/industry team engaged in both development and production activities can be counterproductive. Most likely, the outcome is cost growth, schedule risks, and a moving baseline.

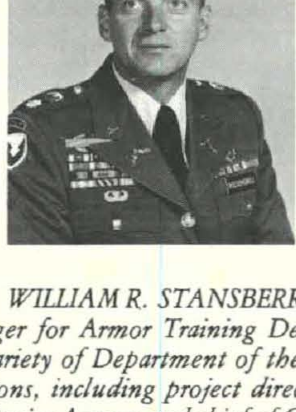
The Training Device Dilemma

Although the government goal is generally to have the training device available to train soldiers engaged in operational testing of the weapon system, this goal is seldom achieved, and the Conduct of Fire Trainer is no exception. However, the trainer will catch weapon system distribution within three years of initial fielding. This catch-up is, to a great extent, a result of the skunkworks approach, and can be sustained through an innovative acquisition strategy and program stability.

Summary

The first two lots of the Conduct of Fire Trainer five lot production program were awarded in September 1982 and February 1983. The program remains on schedule and within cost. The system has proven to be effective—comparable with gunnery training on the actual weapons system. The next important step subsequent to delivery will be not only to enhance its real training effectiveness, but to measure cost savings realized in ammunition, fuel, and repair parts. An increase in the Army's readiness posture is a sure bet.

The skunkworks approach for COFT, although a success, has had its warts, as will any innovative concept. Its precepts must be intertwined with common sense, clear goals, acquisition awareness, and the willingness to take properly assessed risks. Despite the warts, the strategy will result in the fielding of simulators five years from program inception. It has fulfilled its objective.



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The Light Infantry Division . . .

A New Direction in Force Design

By CPT(P) Timothy Hassell

In August 1983, the U.S. Army Training and Doctrine Command (TRADOC) was tasked to design a new Light Infantry Division. This article contains a brief overview of the conceptual basis for the division, some characteristics of the organization, including its capabilities and limitations, and a description of the division's organizational structure.

Recent Army 86 force design efforts have been oriented against enemy heavy forces in mid-to high-intensity settings, resulting in large organizations ranging from about 16,000 soldiers in the Airborne Division to almost 20,000 in the Mechanized Division. The focus of the new light division is to defeat opposing light forces in low-to-mid intensity settings. It can, when properly augmented, be employed in other scenarios to include NATO.

Because it is smaller, the division can be more rapidly deployed and is therefore more strategically responsive. It can then be used to meet world-wide contingencies or to reinforce other deployed forces. The division is not designed to stand alone, toe-to-toe against heavily armored, mobile opposition.

Guidance provided during the initial phase of the study stated that the division should be comprised of about 10,000 soldiers, have nine maneuver battalions, and have a high percentage of infantry. Additionally, the division would be deployable in 400 to 500 C141 sorties, and would capitalize on lessons learned from the experience gained in other force design efforts.

Given that the purpose of the division is to provide a rapidly responsive credible force capable of stabilizing situations, showing force, or securing a base for expansion, its basic characteristics can be appreciated. The division, as depicted in the accompanying diagram, is the small and versatile fighting force that is needed.

It is composed primarily of fighters equipped with lightweight systems capable of being displaced with organic air and ground assets. The division features commonality of vehicles and equipment wherever practicable, with all equipment being deployable by C141 aircraft. Emphasis has been placed on night fighting ability, and there will be a high density of both image intensifying and thermal imaging night vision devices.

Combat support and combat service support assets are particularly austere in the division. It must be reiterated, however, that the division was designed for the low-to-mid intensity end of the spectrum where, for instance, the threat of air attack and requirements for engineer support in the first 48 hours of combat are reduced.

Risks associated with the reductions were identified and assessed during the design process. Limited organic support was of primary concern and TRADOC addressed the limitations by incorporating an augmentation concept throughout the division.

The division staff and subordinate headquarters include staff elements that will serve as "receptacles" for augmenting assets which are provided by Corps or other headquarters to give a specific, situation dictated capability to the division. Augmentation may include combat, combat support, and combat service support assets.

In some cases, such as in the areas of air defense artillery, military police, fire support, and nuclear biological and chemical support, specific organizations will exist at the parent Corps level to support the light division.

In all cases, Army-wide personnel and equipment savings have been realized by centralizing the respective supporting asset at Corps. A brief description of the organizational structure, by major functional area, will serve to further identify the nature of this new division.

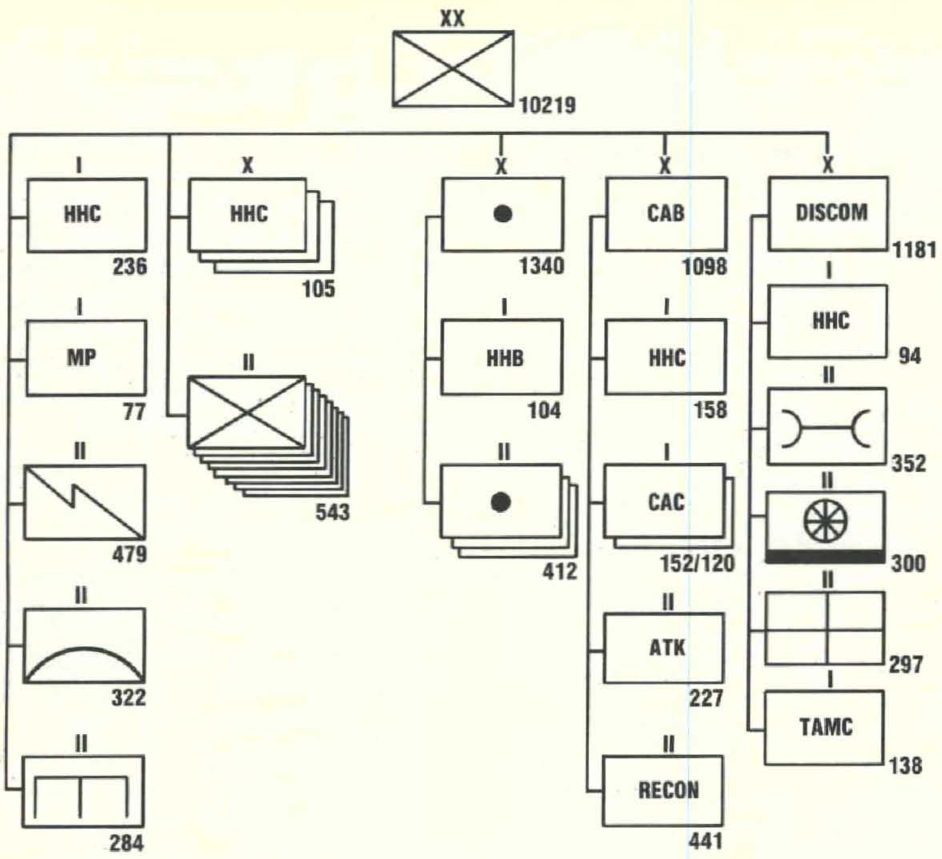
Command, Control, Communications and Intelligence (C^3I) functions are conducted by the division headquarters and headquarters company (HHC), the three brigade HHCs, the military police company and the signal battalion. The HHCs contain the normal staff planning assets as well as some unusual features.

The division headquarters and headquarters company contains a consolidation of all personnel management assets in the division. There is no adjutant general (AG) company, but the minimum necessary AG functions have been incorporated into a G1/AG section.

Also included in the division HHC is an organic military intelligence support element which provides intelligence analysis support for the division. Other military intelligence assets exist in the division's recon squadron, and will be discussed later.

The brigade headquarters and headquarters companys consolidate maintenance and mess support for their infantry battalions in order to avoid placing vehicles larger than a 5/4-ton High Mobility Multi-purpose Wheeled Vehicle in the infantry battalion, and to centrally manage the assets. Support is also provided to other divisional elements proximate to the brigade on an area basis. The brigade HHC contains organic liaison officers and a property accountability section to manage subordinate units' property books.

The military police company is very small, and provides general support to the division with its three pla-



Light Infantry Division Organizational Diagram

toons. There are no direct support platoons specifically identified for each maneuver brigade. Each military police squad is a dual purpose organization with two military policemen per squad serving as designated air defense gunners to launch stinger missiles. These soldiers are military policemen by specialty, but help to thicken the division's air defense capability.

The last major organization in the C[3]I area is the signal battalion. It too is small and relies on lightweight equipment. The battalion uses multichannel tactical satellite systems for communication within the division, high frequency net radio interface over extended distances, and line-of-sight multichannel as a primary system. It provides support to the division HHC and subordinate headquarters on an area basis.

Air defense functions are performed primarily by the air defense artillery battalion. Because enemy air activity in the initial stages of a low intensity setting will be minimal, the battalion is small. It provides general support to the division on an area basis with its two Gun/Stinger batteries. The gun currently envisioned is the Product Improved Vulcan Air Defense System. The 40 Stinger teams in the battalion are tied into the Forward Area Alerting Radar System, and are supplemented by the 18 dual purpose Stinger teams in the military police company.

Additionally, there are two dual purpose teams in each howitzer battery in the division artillery, two teams in the division headquarters and headquarters company, one team in each brigade HHC, and one team in each infantry battalion heavy mortar platoon. A total of 90 teams is available.

The engineer battalion also reflects the nature of low intensity conflict support requirements. There are three engineer companies with two platoons per company. Support is provided on an area basis, and the battalion headquarters is staffed to rapidly integrate Corps engineer augmentation. There is no construction capability within the battalion. Emphasis is on mobility and countermobility operations with a limited capability to assist in survivability type missions.

Nine infantry battalions constitute the nucleus of the division. Each battalion contains a headquarters and headquarters company and three rifle companies. The battalions are light and basically footmobile, each containing only 34 high mobility wheeled vehicles. All of these vehicles, as well as 15 motorcycles, are located in the battalion HHC.

Each battalion features a high percentage of dismounted fighting strength, a very small deployability profile that allows the battalion to be moved in eight C141 aircraft, a commonality in weapons calibers to minimize resupply requirements, and a very high leader-to-led ratio. Features include four towed heavy mortars, and a high density of night vision devices to open the night battlefield to the infantrymen.

All mess and vehicular maintenance support is provided to the battalions by teams located in the parent brigade HHC. The battalion HHC, along with the command and control element of the battalion, contains a large medical platoon, a support platoon, a communications section, and scout, antiarmor (TOW), and heavy mortar platoons.

The primary fire support agency in the division, the division artillery, contains a headquarters and headquarters battery and three field artillery battalions, with one battalion in direct support to each maneuver brigade. The field artillery battalions each contain a headquarters and headquarters battery and three howitzer batteries with six, 105mm howitzers in each battery.

The 105mm howitzer was chosen to reduce the division artillery deployability profile, and permit battlefield displacement of the howitzers using the division's organic UH60 Blackhawk aircraft. The division artillery target acquisition system consists of Q-36 countermortar radars organic to the field artillery battalions and a small meteorological section at the division artillery headquarters battery. Like other divisional organizations, the division artillery is organized to rapidly assimilate augmentation assets, particularly those from Corps artillery.

All divisional aviation assets are consolidated under one command in the combat aviation brigade. It has the primary missions of reconnaissance, battlefield mobility of combat forces and materiel, and destruction of enemy forces. The aviation brigade contains an HHC, a reconnaissance squadron, an attack helicopter battalion, and two combat aviation companies.

All-weather reconnaissance capabilities for the division are provided primarily by the reconnaissance squadron's one ground reconnaissance troop, with a mix of High Mobility Multipurpose Wheeled Vehicles mounted TOW missiles and 25mm chain gun systems, and two air reconnaissance troops, with six scout and four attack helicopters per troop.

Within the squadron is a military intelligence company which contains the division's electronic intelligence collection assets. A long range surveillance detachment, which provides the division commander a human intelligence collection capability under his immediate control, is located in the squadron.

A potent, fast-moving maneuver force is provided by the attack helicopter battalion which is of standard Division 86 design, containing a headquarters and headquarters company and three attack helicopter companies. Each attack company contains seven attack and four scout helicopters. The helicopter battalion constitutes the division's primary antiarmor system.

The two combat aviation companies contain the division's materiel and troop lift assets as well as command and control aircraft and tactical heliborne electronic jamming systems. With the two aviation companies, the assualt elements of one infantry battalion can be moved in one lift.

Aviation intermediate level maintenance is provided by the transportation aircraft maintenance company which is located in the division support command, the last major command in the division. Other organizations in this command include an HHC, a medical battalion, a supply and transport battalion, and a maintenance battalion.

Although the division support command is austere in the new division, it contains the essential combat service support capabilities to enable the division to operate for the first 48 hours of combat in a low intensity setting. Support is oriented forward with emphasis on fueling, fixing, and rearming as close to the battle as practicable.

Maintenance within the division emphasizes component replacement over component repair and new systems like the UH60, high mobility vehicle and SINCGARS family of radios facilitate that concept.

Reduced service support assets present a risk, but a recognized one that permits achievement of overall design goals for the light division. As in other functional areas, an increase in conflict intensity levels or in duration of operations requires augmentation, and the division support command is staffed to readily accept and incorporate Corps or other assets as they become available.

The Light Infantry Division represents a new direction in U.S. Army force designs. It is a departure not only from the tendency toward larger divisions, but also from the idea that one organization can meet every conceivable contingency. Its small, light, rapidly deployable structure can be used during the relatively narrow critical response window that normally accompanies contingency crises.

Timely use of the light division or its subordinate organizations may well preclude the necessity for larger, heavier, more expensive units later in the crisis. Though heavier forces with their concomitant heavier firepower may in many cases be more effective, the new light division is the one to send when getting there first counts. If a crisis can be defused early, stalemate or high risk situations may be avoided.

Its innovative design that provides a capability for rapid augmentation to meet situational needs is a logical approach toward meeting the nation's most likely defense requirements in the foreseeable future.

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NOTICE

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Correction

On page 31 of the January-February 1984 issue of *Army RDA Magazine* (AMCCOM Establishes Ammunition Career Program), the entry level of acceptance for the new Ammunition Career Program was incorrectly published as GS-4. The correct entry level is *GS-5*. Our apologies for the error.

Corps of Engineers AirLand Battlefield Environment Thrust

By Dr. Richard Gomez and CPT Michael J. Van Atta

"It is always necessary to shape operations plans . . . on estimates of the weather" . . . Frederick the Great

The environment has always influenced combat, and the commander that understands and exploits the environment will gain an advantage over the enemy. Hannibul crossed "impossible snows" to surprise the Romans with an attack. Mud and rain restricted communication and movement of units at Waterloo and contributed to the defeat of Napolean. Excellent forecasting made it possible for the D-Day "GO" decision to be made by General Eisenhower while incorrect forecasts lulled the Germans into relaxing their vigilance. Hitler waited for inclement weather to launch the Battle of the Bulge.

Looking to the future, the importance of the environment is illustrated by examining the Soviet threat doctrine. The Soviets expect to move rapidly in adverse weather, take advantage of the terrain, and use smoke in movements. They will also use sophisticated weapons.

Threat forces possess a significant numerical advantage in combat fighting personnel, armored fighting vehicles, artillery tubes, air defense weapon systems, chemical and biological warfare delivery systems, engineering equipment designed to expedite countermobility obstacle breaching or crossing, and tactical air vehicles capable of achieving air superiority on the battlefield. The numerical advantage of the threat has long been recognized.

Current friendly tactics have been realigned to accommodate a 7:1 battle ratio of threat to friendly forces, but there remains concern. Sheer numerical advantage of threat forces at any one point on the battlefield could (a) expend friendly forces and equipment at a totally unacceptable level and (b) render friendly forces incapable of further fighting until reconstituted, reinforced, or resupplied. This would allow remaining threat forces to continue their attack essentially unopposed.

The AirLand Battle Doctrine and AirLand Battle 2000 Concept are our response to the overwhelming numerical advantage presented by the threat forces. The essence of AirLand Battle is vastly improved agility, deception, maneuverability, and firepower.

An integral part of the AirLand Battle is the planned use of advanced-manual, remotely-controlled, and completely robotic logistics and weapon systems. The doctrine and concept also account for fighting in a battlefield dense with combat systems where range, lethality and employment capabilities surpass anything used historically.

One major means the Army has taken to counter the overwhelming advantage presented by the threat forces is to increase the lethality of friendly forces through technological innovation.

High technology applied to weapon system design and use offers a means to maximize the total combat effectiveness of a numerically smaller unit. For example, enhancement of weapons systems, command and control capabilities, and advanced warning systems will enable the friendly fighting force to mass and optimize firepower, achieve surprise, and deny threat forces their maneuver capability and permit their defeat. Conversely, it offers a means for increased survivability on the battlefield.

Emerging technology in sensors, Very High Speed Integrated Circuits, and lasers; the quantification of electromagnetic field-terrain interactions; the use of satellites, pattern recognition/target discrimination; and advanced computer technology provide the technological opportunity to integrate near real-time environmental data (provided by a wide variety of spatially distributed sensors) into an automated system that will give the field commander the tool to use the battlefield environment as a significant combat force multiplier.

A fielded Army that depends on high technology as a combat multiplier must employ doctrine developed in context of all facets of the modern battlefield environment that will be deep, dirty, diffuse, and dynamic.

The fact that today's weapons and support systems are more sensitive to battlefield environmental conditions than were past systems is recognized in current training circulars, field manuals, technical bulletins, and training manuals for the available and planned Army systems. However, our capability to realize the potential offered by using high technology in conjunction with advances in our understanding of the environment requires a well planned, well coordinated, and well budgeted Research, Development, Test, and Evaluation (RDTE) Program.

The Office Chief of Engineers has Army Staff responsibility for the Department of the Army's Environmental Sciences R&D activities. This includes planning, programming, budgeting, performing, coordinating, and supervising all Army research, exploratory development, and nonsystems-related advanced development in the environmental sciences programs. These include, but are not limited to, the Army atmospheric, terrestrial, and topographic sciences.

As part of these responsibilities, the Corps of Engineers has initiated a RDTE Program entitled "AirLand Battlefield Environment (ALBE) Thrust" to focus its RDTE efforts in support of the Army's realistic battlefield requirements. The Program will: (a) provide the Army with environmental effects information needed to operate in a realistic battlefield environment and (b) provide the Army with the capability for near real-time environmental effects assessment of the effectiveness of military materiel and operations in combat.

The AirLand Battlefield Environment Thrust Program was designed to improve the Army's capabilities by emphasizing both preparedness-in-peacetime (materiel acquisition, training, and doctrine activities) and preparedness-in-war (field Army combat operations). The Program goals are as follows:

Goal I is to provide materiel acquisition, training, and doctrine activities with the capability to assess and exploit battlefield environment effects.

Goal II is to provide the field Army with operational capability to perform and exploit battlefield environment effects assessments for tactical advantage.

There are several objectives for each of the above goals under each goal as discussed below. The five objectives of Goal 1 are:

- Measure and Model the AirLand Battlefield Environment. This objective is designed to provide knowledge of the basic constituents of the battlefield environment essential to an understanding of the battlefield environment effects on men and materiel. Modeling includes the quantitative statement of extreme and likelihood conditions, geographical extent, measurement units, and other pertinent data.
- Define Realistic Conditions. Realistic AirLand Battlefield conditions are those combinations of natural and battlefield induced environment constituents that are found in actual combat situations.
- Develop Environmental Sensor Technology. Environmental sensors are required to perform measurements of the battlefield environment constituents in support of RDTE and training activities.
- Describe and Quantify AirLand Battlefield Environment Effects on Military Operations and System Performance for RDTE, Training, and Doctrine Activities. The description and quantification of AirLand Battlefield effects on military operations and systems performance involves the modeling of physical interactions between the military operations and systems and the battlefield environment.
- Develop Methods to Extend System Test Results Throughout the Range of Variation in Realistic AirLand Battlefield Conditions. This requires the pursuit of three types of information:
  - —The range in variation of battlefield environment conditions in (at least) high potential combat areas.
  - —The identification of what causes the difference in battlefield environment from one region to another and what can be used as an indicator to expediently infer the conditions.
  - —The extrapolation or interpolation of described and quantified AirLand Battlefield Environment effects on military operations and systems performance to important areas where there is insufficient test data.

As discussed earlier, there is another set of five objectives to meet the second AirLand Battlefield goal. They are:

- Assess AirLand Battlefield Effects on Friendly and Threat Operations and Systems Performance and Distribute the Resulting Information. A wide range of battlefield environment conditions can impact on a system, on combat performance, or on the performance of combined systems in a combat operation.
- Develop System Performance Indicators and Operations Performance Indicators. System performance indicators are quantitative measurements or calculated estimates of how a specific system or operation will perform in a given situation or range of situations.
- Develop Tactical Environmental Automated Measurement Systems Technology. Environmental sensors are required to assess and provide, in real or near real-time, the character of the battlefield environment and provide the data directly into the information analysis and processing center. The sensor systems are intended to collect information on that portion of the battlefield environment that changes rapidly, either naturally or because of combat preparation or action, or because of deliberate inducement. These data are essential intelligence in the framework of simulation and optimization theory used to provide quantitative procedures for assessing specific actions and classes of actions.
- Develop Tactical Decision Aids for the Field Commander to Exploit the AirLand Battlefield Environment. Tactical decision aids are readily accessible, understandable, and usable intelligence support items that help a field commander assess the battlefield environment situation, provide a rationale and directions for inducing or countering selected conditions, and for taking advantage of the AirLand Battlefield Environment.
- Demonstrate AirLand Battlefield Environment Prototype Systems. These demonstrations are field exhibitions of major products formed by the integration and synthesis of AirLand Battlefield results in several technical areas. They are intended to show Army capabilities that are field operable, have high payoff, and are troop supportable. Demonstrations are also intended to focus on how the Army can both achieve a higher payoff in the use of presently fielded systems, and intelligently provide direction for future requirements through use of technological capabilities in a usable form with emphasis on realistic battlefield operations.

Goal II of the AirLand Battlefield Environment Thrust Program keys on the use of high technology to counter enemy numerical superiority on the future battlefield. High technology products in a readily understandable and usable form will enable the tactical commander to use his advanced intelligence-gathering capabilities to better anticipate enemy intentions and deny the enemy the element of surprise.

Incorporation of AirLand Battlefield Environment products into advanced command and control communications systems will allow the field commander to: maneuver his forces in a more integrated and rapid manner, thereby achieving the combat multiplier of surprise; use tactical decision aids to mix his forces and systems in the best way possible to mass firepower more effectively than the enemy; and multiply his mobility and countermobility capabilities by providing real-time weather information to integrate into his battle plan.

An integral part of the AirLand Battlefield Environment Thrust is a series of demonstrations to allow the user community to quickly evaluate the application of research to various phases of RDTE efforts, tactical employment and doctrinal philosophy, and to planning combat deployment of weapons systems and logistical support.

The Thrust Program is administered by the Office Chief of Engineers, Directorate of Research and Development. An Executive Committee, chaired by the Directorate of R&D and composed of participating laboratories' representatives, provides program direction. An advisory group of Army users provides guidance.

Four working groups (Battlefield Terrain, Battlefield Atmospheres, Product Integration and Application, and Systems Demonstration) coordinate AirLand Battlefield Environment work. The Corps of Engineers and DARCOM laboratories providing executive members and working group chairmen are: The Cold Regions Research and Engineering Laboratory, Hanover, NH; the Engineering Topographic Laboratories, Fort Belvoir, VA; the Waterways Experiment Station, Vicksburg, MS; the Army Materiel Systems Analysis Activity, the Chemical R&D Center; and the Office of the Project Manager for Smoke/Obscurants, all located at Aberdeen Proving Ground, MD, and the Atmospheric Sciences Laboratory, White Sands Missile Range, NM.

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Livermore Lab Studies Army Laser Pulse Acceleration Technique

The Lawrence Livermore National Laboratory is investigating a technique developed by the U.S. Army Electronics R&D Command's Electronics Technology and Devices Laboratory, Fort Monmouth, NJ, that accelerates laser pulses used for fusion and weapons research programs.

Called the Ferrite Transmission Line Pulse Sharpener, the technique was developed by Dr. Maurice Weiner, a physicist who heads up the laboratory's Nanosecond Pulser Team. It is a prime candidate for use in Livermore's Pulse Power Conditioning Department for advanced work in its inertial confinement fusion program.

Fusion involves the use of high-power lasers to heat up plasma and extract from it enormous amounts of energy.

The Weiner technique uses a ferrite-loaded coaxial line to sharpen laser pulses. Peculiar magnetic properties of the ferrite material sharpen the electrical pulse as it travels along the coaxial transmission line.

The technique can supply extremely fast pulses, said Weiner. "It has application not only for driving high energy lasers but other types of electronics such as millimeter wave transmitter tubes as well," he added.

The Livermore approach to inertial confinement fusion involves firing a large number of glass lasers with split-second precision. Timing of each firing is controlled by a crystal device called a Q-switch.

By controlling speed and power levels, the Q-switch shapes the laser output into packets of intense light energy a billionth of a second (nanosecond) wide produced at a precise instant in time.

According to Weiner, the ferrite line he has formulated provides a combination of switching speed and power levels inherently superior to any other pulse now being used.

Experimental verification of results using the Ferrite Transmission Line Pulse Sharpener was originally published in July 1981 in the Institute of Electronic and Electrical Engineers *Transactions on Magnetics*.

Weiner is a past recipient of the Army R&D Achievement Award and has had 30 publications and eight patents in the fields of nanosecond pulsers and microwave devices.

The following is the second and concluding portion of an article which began in the March-April 1984 issue of the Army RD&A Magazine. The first segment addressed economic, demographic and social trends and their potential implications for DARCOM during the next two decades. This segment examines technological and political trends.

Trends and Their Implications for DARCOM During the Next 2 Decades

Technological Trends

Future fighting concepts such as AirLand Battle 2000 (now known as Army 21) and FOCUS 21 (a Joint Service outlook by Army and Air Force) are largely based on technology. Consequently, interest in long-range trends for technology is increasing throughout the Army as it plans for its 21st century mission.

Our research has shown several categories of technological trends, affecting the Army to include: bioengineering, chemical and biological technology, electronics, lasers, and robotics. Within these categories are also particular areas of interest in which Army goals have been set. These Army technology thrust areas are: soldier-machine interface, very high speed integrated circuits, very intelligent surveillance and target acquisition systems, distributed command, control, communications and intelligience systems, and self-contained munitions.

The Army will continue to depend upon the Air Force for rapid deployment in the next two decades, and will continue to rely upon the Navy for a prominent amount of strategic lift. Due to this dependency, both the Air Force and the Navy must be brought into the early design phase of systems as they relate to transportability. Additionally, the Army must stay abreast of new commercial transportation developments from the private sector since intermodal means of transportation will be increasingly important considering a global realm of conflict.

The Army technology thrust areas are applications sought within a category that, once captured technologically, will subsequently be replaced by other thrust areas that build synergistically upon both the present category of the trend itself and the successfully captured thrust areas. Opportunity payoff trends are:

Bioengineering. Bioengineering is the application of engineering principles and techniques to problems in medicine and biology such as the design and production of artificial limbs, organs and foods. According to The Army Plan, biotechnology will emphasize the application of new technologies to the prevention and treatment of casualties. This includes the development of vaccines, antidotes, and other treatment compounds for use in hazardous nuclear, biological and chemical environments. Primary responsibility for this major technology thrust area lies with the Surgeon General.

We have hardly begun to scratch the surface of potential applications for biotechnology, but such research will undoubtedly yield clues to more effective ways to provide nutrition and medical care to our soldiers.

Chemical & Biological Technology. The spread of chemical and biological warfare capabilities have caused a renewed interest in their supporting technologies. The U.S. declared a unilateral self-imposed moratorium on chemical munitions in 1967, but the Soviet Union has continued to increase its lead in development, production and stock-piling of chemical and biological munitions. TRADOC has, through Mission Area Analysis, identified a need for significant improvement in the Army's capability to meet this challenge, including the need for protective equipment.

The Army response must be to develop better protective equipment, detection devices, demilitarization techniques, as well as to solve serious decontamination problems. We must also assure adequate supplies in the out-years based on stock surveillance data.

Electronic Technology. Electronic technology has for the past decade played an increasingly important role in our lives, and one of its primary impacts has been on how we get our information. During the next two decades more attention will be focused on computers, communications and satellite technologies. Two key technology thrust areas for the Army are the development of very intelligent surveillance and target acquisition techniques and the distributed command, control, communications and intelligence systems.

Channels of communication within organizations can change drastically as the computer draws people of similar interest together for direct communication. Since this is far different from the usual groupings of individuals by rank and status, and since information is power, electronic technology can be a direct threat to hierarchical organizations.

Software used in conjunction with electronic technologies, almost nonexistent a few decades ago, is rapidly becoming a dominant element in the design of most major systems. The primary benefit of electronic technology will be increased responsiveness by a system which is less manpower intensive. One of the primary challenges is to assure modern weapon systems are "user friendly."

Laser Technology. Modern laser technology currently has been applied to target designators, training simulators and communications equipment. The Army must also look for new ways of applying laser technologies. The Army's major technology thrust area of self-contained muntions draws upon both laser and electronic technology. We also must continue to explore ideas such as designing-in a training device laser on our new weaponry since it may result in considerable cost savings later.

Robotic Technology. Increased manpower costs and reduced availability will lead us to look for manpower substitutes, including robotics. Use of robotics will result in improved productivity, especially through revisions in industrial and manufacturing processes. These "tin collar workers" are programed to perform a variety of manipulative tasks. According to LTC (P) Dennis V. Crumbley, author of *Concepts for Army Use of Robotics Intelligence in the 21st Century*, published by the U.S. Army War College, military applications of robots include use in hostile environments such as underseas, space and nuclear, biological or chemical environments. Robots may also be used for deception (such as for an artificial command post), detecting laser irradiation, target engagement, removal of dead and wounded, ammunition loading equipment, and in the training environment. Future development effort will include an artificial intelligence capability to simulate the human thought process. The Robot Institute of America, an admittedly optimistic source, anticipates production of robots to rise from 1,850 in 1980 to over 200,000 by 1990. By 2000 they are expected to number one million!

Army application of robotics to date has been limited in maintenance and repair facilities. The soldier-machine interface encompasses several facets of robotics technology. Over the next two decades, hundreds of industrial applications will be found in throughout the Army's logistic system.

Political Trends

Looking at global, regional, and national political trends and their possible implications for both the Army and for DARCOM, we find that in the future, as in the past, conflicts will be fought between political entities for the purpose of attaining political aims.

Among the most important trends are the continued expectation and diffusion of social, economic, political, military, and religious power by people of the world through proliferation of independent nation states.

The global political environment has changed from a bipolar to a multipolar world. The political complexities of these emerging nations will affect both the Western (Capitalist) bloc and the Eastern (Communist) bloc.

New or emerging political support, or the shifting of existing political support throughout the world, could affect existing or potential overseas base rights and the Prepositioning of Army Materiel Configured in Unit Sets (POMCUS). The Army must continue to develop alternatives to forward stationing of troops and materiel in foreign territory. Expanded host nation support arrangements must be considered and/or alternate increased sea and airlift capability sought.

Two decades ago, there were four nation-states (U.S., USSR, UK, and France) in the "nuclear club." Currently, unclassified sources state there are six "known" nuclear weapons nation-states (the above plus China and India) which have manufactured and exploded a nuclear weapon or other nuclear explosive device. There are also at least two "suspected" nuclear weapons nation-states (Israel and South Africa) reputed to have constructed or to have the capability to quickly construct nuclear weapons.

There are now at least 34 "near" nuclear weapons nation-states that can become technically and industrially able to develop the capability to manufacture and to explode a nuclear weapon or other nuclear explosive device (and may do so) by the year 2003. An important component of this capability is the commissioning of a nuclear reactor, either for research or for the generation of electricity. These other 34 nations are third-world or mid-tier nations.

The danger in the profileration of nuclear weapons is that this will tend to increase the probabilities for nuclear conflicts and nuclear blackmail attempts. Consequently, the number of possible conflicts involving U.S. interests, which could escalate (by accident, miscalculations, or design) to nuclear warfare, will potentially grow in a substantial manner.

Implications for the Army will be an increased likelihood that any conflict in which it is deployed will require preparations for tactical nuclear conflicts. Army implications include the research and development of materiel for use in a "dirty" or contaminated environment.

According to the U.S. Army Center of Military History, during 1963 there were four wars between nations involving one general area of conflict with "war" being defined as armed conflict with professional armies engaged on both sides. The Center of Military History identified 10 wars between nations being fought now, and projected at least 20 wars between nations for the year 2003—hence a substantial increase in probability.

If the U.S. is a protagonist in any future wars between other nations, the Army will be heavily involved in fighting to win or in protecting our national security interests.

If the U.S. is not a combatant, the Army can still be involved in such roles as military advisers, trainers, surveillance monitors, communications specialists, observers, intelligence analysts, arms and equipment suppliers or as part of multinational forces for such other purposes as peacekeeping.

A state of readiness must be maintained to support the soldier whether as a combatant or as a non-combatant (through the complete cycle, from peace to mobilization, to armed conflicts, and again to secured peace).

Of the many major multinational alliances involving the U.S., the NATO alliance has been considered most important because it has kept the Warsaw Pact at bay in Europe. This has resulted in a near-term focus for the U.S. Army since it developed and articulated its doctrine with NATO as its most demanding mission.

A long-range, global perspective shows other areas of conflict emerging as being potentially more demanding for the U.S. Army in terms of its mission. According to the Center for Strategic and International Studies of Georgetown University, NATO will lose its cohesiveness within the next two decades. The Army is presently maintained overseas in NATO and Korea to support U.S. political and military interests. It must be capable of being deployed around the world to either deter or rapidly respond to any acts of aggression against these interests in other geographical areas. Implications for the Army include policy decisions in POMCUS, security assistance, host nation support, foreign materiel procurement, and foreign licensing arrangements with nations that have an industrial base to produce materiel. This also gives credence to planning for materiel on a global rather than a "theater of operation" basis.

A "sleeper" issue for the future is the Law of the Sea Treaty which the U.S. has not yet signed. This treaty covers navigation rights, ecological provisions and uses of the sea beds. If a broadly accepted law of the sea does not emerge through international agreement, we face the prospect of each nation determining its own view, possibly thru force, with ever-widening claims to ocean space and resources.

However, even if the International Law of the Sea is broadly accepted, it may still restrict passage for military ships through newly defined territorial straits and exclusive economic zones. An extension of national jurisdiction to 200 nautical miles or more off all coasts, including those of islands, could affect at least one-third of the sea area that covers at least 70 percent of the globe.

Air space rights are also being increasingly contested, with the same analogies applying to it as in the case for the Law of the Sea. The U.S. Army Concepts Analysis Agency has forecast that by the 21st century, most nations will be able to protect their air space against unauthorized overflights. The Army must be aware that changes in the global political environment that affect littoral nations can restrict the Army's freedom of movement through these choke points.

Anticipating restrictions in the Army's freedom of movement, the Army should develop weapon systems that are more easily transported, maintained and supported at lower levels of maintenance and logistics.

In view of this Soviet intent, the Center for Strategic and International Studies recommends more emphasis on the "high-probability," "low risk" or "low-intensity" side of the armed conflict levels continuum, such as terrorism. The Army must be ready, flexible, strategically deployable, technically competent, tactically sound, and sustainable in this type of conflict.

DARCOM, in turn, must translate this Army requirement into materiel developments and readiness capabilities for both this element of war and the entire spectrum of armed conflict levels. However, if the shift of emphasis is toward the "high-probability, low-risk" side of the continuum, i.e., terrorism, this will mean a shift of emphasis from the current individual "high dollar" items such as tanks to a much broader mix of conventional materiel.

U.S. National political trends oscillate between military-political ends and continued turbulence as shown by sometimes open then restrictive military budgets/funds from continued vacillation of public support for defense. Such budgets determine what the Army may acquire and possess to fight as well as political constraints and restraints on it when it does fight (e.g., Vietnam). One need only review the Federal budget allocations over the years to see this.

The Federal budget is the single most tangible and important expression of our national priorities. The Army's share of the budget and its future roles, as well as the public's support of the defense budget and trends, will continue to be dependent on the public's perceptions of national security and on the public's political inclinations.

Through appropriate public promotional programs and the media, the Army can help promote the "National Resolve" by explaining to our democratic society not only what we want, but why we want it so it can in turn decide through the political process what it will support.

The conventional wisdom of our day is being continually challenged. Events and proposals such as conflict in the Faukland Islands and the High Frontier Concept for satellite platforms have brought such basic concepts as the role of tanks and ships for warfare under close scrutiny. We must, therefore, constantly monitor trends that impact upon our mission and our effectiveness and be prepared to take appropriate action.

The preceding article was authored by the following personnel during their service as members of the DARCOM Strategic Long Range Planning Team: Joyce L. Brunsell, team leader, Dr. Jarugula S. Rao, John Kato, and William J. Greer.

The Light Cavalry Helicopter:

A Management Approach

By LTC(P) Donald E. S. Merritt and

CPT Warren T. Dudenbostel

Background

The concept of a Light Air Cavalry Troop, equipped with a light cavalry helicopter, is part of the design of the High Technology Light Division being developed and tested by the Army Development and Evaluation Agency, (ADEA), in association with the 9th Infantry Division, Fort Lewis, WA.

ADEA, in conjunction with the U.S. Army Aviation Board, Fort Rucker, AL, and the Armor Center, Fort Knox, KY, developed a test plan to evaluate the concept and determine the potential of the Light Air Cavalry Troop and the light cavalry helicopter (see accompanying photograph).

Given immediate tactical deployment to an unsecured airhead by means of available air transportation to the lodgment area, the light cavalry helicopter should provide reconnaissance, security, observation, target handoff, artillery adjustment, air-to-ground attack, and air-to-air self-defense. It should also be capable of destroying personnel, light armor, and tank targets, with the acquiring and attacking of these threat targets at the maximum range of the weapon systems carried.

The perceived need was for a small, supportable, highly mobile, light cavalry helicopter capable of rapid deployment in sufficient quantities and with adequate firepower to constitute a viable strike or assualt force.

This aircraft should be able to acquire, designate, and engage its own targets in the attack role or, when in the Scout role, acquire and designate for larger attack aircraft, plus the ability to utilize divisional artillery assets in either role.

The Management Approach

Test requirements and materiel support to the High Technology Light Division are generally provided within the framework of the following procedures:

- The Army Development and Evaluation Agency or a TRADOC School, develops an organizational and operational concept with an Independent Evaluation Plan that will evaluate the organizational and operational concept.
- The organizational and operational concept plus the evaluation plan (which includes identification of surrogate items required to perform evaluation) are sent to the Combined Arms Center, Fort Leavenworth, KS, for validation.
- Validation of the evaluation plan starts a chain of actions that results in an accelerated acquisition or actions to provide surrogate test items.
- ADEA then tasks one of the test boards or another agency to manage the test.

While this procedure is fundamentally sound, time constraints require a focus of attention on the early steps of this process, hence, the very early involvement of the U.S. Army Aviation Systems Command through the Weapon Systems Management Office (WSMO) for Scout/Observation Helicopters.

As the management office for the Scout/Observation fleet, one of the WSMO's missions is to keep abreast of hardware that is currently available in both commercial and military markets. In the light cavalry troop test, the management office saw an ideal opportunity to take a look at some current technology and see how it would function in the aircraft.

The philosophy behind providing ADEA with surrogate aircraft to test the light troop concept was to use, as much as possible, currently available commercial hardware and any Army-developed and still-in-development equipment that was available. Through the use of various low cost lease programs and loan agreements, the management office was able to put together a variety of hardware.

The purpose of this article is to articulate an approach to developing a surrogate for early feasibility testing. During this testing, the organizational and operational concepts can be validated before significant effort is invested in system acquisition. Clearly the surrogate feasibility test cannot be considered a replacement for the acquisition process. Early feasibility evaluations in no way replace the design and test efforts necessary to substantiate the integrity of the system.

Since the surrogate aircraft were to come from 9th Infantry Division assets and were required to be returned to their standard configuration after the test, it was decided to use 13 (the number specified by ADEA) OH-58As being modified to OH-58Cs at Bell Helicopter's Amarillo facility and scheduled for delivery to the division.

These aircraft were in the latest OH-58C configuration and offered the greatest potential to safely modify aircraft into whatever configuration was needed for the test. It was decided to use the capabilities available at the U.S Army Aviation Development and Test Activity, Fort Rucker, AL, to modify the aircraft and provide support.

One of the requirements was to make the OH-58C air transportable with the minimum amount of disassembly. The Army had already conducted limited transportability testing with the OH-58C for another project and the original prototype kits were still available. These kits were removed from storage and installed on six of the aircraft.

The following is accomplished in order to make the aircraft transportable. The main rotor blades are folded back and supported by a blade support rack mounted on the tail boom and both the main rotor head and transmission driveshaft are locked into position to relieve pressure on the rotor head and to keep it from rotating. The standard landing gear is replaced with a set of landing gear that can be lowered by the use of screw jacks.

Aircraft transportability is also aided by adding a plate with two cam slots to the backside of the vertical fin so that the fin can be rotated parallel with the tailboom. Additionally, the horizontal stabilizer can be removed depending on what transport aircraft is available. The lower wire strike protection system cutter is also removed for transportability by using quick disconnect pins to remove and reinstall it.

Having solved the transportability problem, we then looked at both weaponry and target acquisition/sighting devices, and were interested in what was available to meet both the attack and scout requirement. For the target acquisition/designation requirement, a decision was made to follow the study that had been conducted for our use by the U.S. Army Armament R&D Command as a result of the Scout/Observation Helicopter Joint Working Group, conducted in September 1981.

A Direct View Optic type system was chosen because of the simplicity of the installation, the great reliability that it offers, and it's relatively light weight. Three contractors offered us the use of their systems, these being the SFIM Corp. of France, Ferranti of England, and Saab of Sweden.

Each of these systems is currently installed on the aircraft, with each providing the capability for day, clear weather target acquisition and detection comparable to that of the telescopic sight unit on the AH-1S. All the systems are capable of growth with the addition of laser rangefinding/designating plus a night capability but still remain a bolt-on modification.

The list of possible armament subsystems included the 2.75 inch rockets, the M27E1 minigun system, the multi-purpose lightweight air-to-air Stinger missile system, and the capability to fire an antitank guided missile. Since the direct view optic system is the primary sight for the firing of the antitank guided missile system, an additional sight was needed for the pilot who is required to fire the other weapon subsystems. Here again, we obtained a production sight from the SFENA Corp., and also a prototype sight that CAI Industries had been looking at for use with the Stinger missile system. This provided the chance to evaluate two different approaches to the sight application for the Stinger, 2.75 inch rocket and minigun sighting requirements.

After having looked at some of the available sights, we were then faced with the problem of how to mount a standard NATO 14 inch lug system on the aircraft to accept the various weapons subsystems. Although a mounting system had been developed and was usable, it had several deficiencies. To correct these deficiencies, a system that is currently being developed by Bell for their light aircraft is being assembled and installed on a light cavalry helicopter for evaluation.

Another problem associated with armament subsystems was where to obtain a weapon management system. The BEI Co. supplied a production control panel for the 2.75 inch rocket system that is very similar to the panel used in the AH-1S. For the control of Stinger, minigun, and other weapons, individual manual control panels were utilized.

The next area considered was avionics. Knowing how limited space is in the OH-58C cockpit and looking at all the requirements for additional equipment, it was necessary to provide a means of either remoting much of the equipment or possibly utilizing a limited MIL-STD-1553B multiplex data bus system.

Since the Army doesn't have an operational multiplex bus system that could easily be adapted to the OH-58 aircraft, we looked at the Air Force and Coast Guard system that had been developed and could be easily adapted to the OH-58 and the requirements for the light helicopter.

Collins Avionics Division of Rockwell International was contacted for possible lease of one of their CMS 80 systems. What is unique about this system is that the Army paid for its development and bought much of the data resulting from this effort but never fielded it. Currently, this system is being used on both Coast Guard and Air Force aircraft and is therefore logistically supportable and readily available.

For installation in the OH-58C, some software changes were needed, and were made, to realign the equipment for use. The key point is that once the multiplex bus is in an aircraft, the amount of additional capability that can be realized is phenomenal.

The multiplex bus in the aircraft is used to control various avionics systems, including a doppler navigation system. It also has the capability of automatic target handoff and is being used to control all the weapons functions. The pilot will control the weapons systems and change radios without having to release the controls. This system would allow much of the avionics to be installed on a pallet that will, in turn, fit into the avionics compartment of the OH-58C.

In essence, we have a system that works, and will fit in any OH-58C, or other aircraft, that is state-of-the-art technology, readily available, logistically supportable, and doesn't require a lot of development time before it can be fielded.

A commercial cargo hook system was obtained from Bell Helicopter and is installed on one of the aircraft to provide for the demonstration of the sling load capability.

At this point, you may have some doubt whether the OH-58C aircraft has the power-to-weight ratio or gross weight capability to meet the light cavalry helicopter performance requirements. The answer is that current production OH-58Cs do not.

An approach that might be used to gain the needed capability would be to utilize the technology that is being developed for the OH-58D or Advanced Helicopter Improvement Program (AHIP) aircraft. To capitalize on the increase of gross weight to 4,500 lbs, the complete drive system used on the AHIP aircraft or Bell's planned 406 commercial fleet is needed. This would include the C3OR engine, the AHIP transmission, the four-bladed main rotor system, and AHIP's tail rotor system. This could increase the logistical supportability of the AHIP and result in overall lower per unit cost for its components.

This approach would give the light helicopter a greatly enhanced power-to-weight ratio and gross weight capability and would provide a more capable aircraft to meet the light helicopter requirements of the commander.

Summary

In summation, this article has outlined the approach of the Weapon Systems Management Office to a concept evaluation program that uses the state-of-the-art technology to meet the requirements for a surrogate light cavalry helicopter. By adopting a philosophy of using existing technology, in either military developed equipment or off-the-shelf commercial equipment, we will be able to keep both the nonrecurring R&D costs and the surrogate system procurement costs low.

Risks associated with a program to field a full-up light cavalry helicopter aircraft may be reduced since we are currently evaluating operational feasibility of the majority of the equipment that will be needed.

This is our management approach to meeting the conceptual testing requirements of The Army Development and Evaluation Agency and providing them with a surrogate product capable of facilitating their examinations into the requirements/feasibility process.

Author's Note: Tests conducted by the Aviation Board and ADEA at Fort Lewis last year have produced a number of changes and refinements to the essential characteristics of the helicopter and its mission equipment package. We are currently looking at other sighting systems, and a plan to fire the weapon system is being developed. Additional information is available from the authors.

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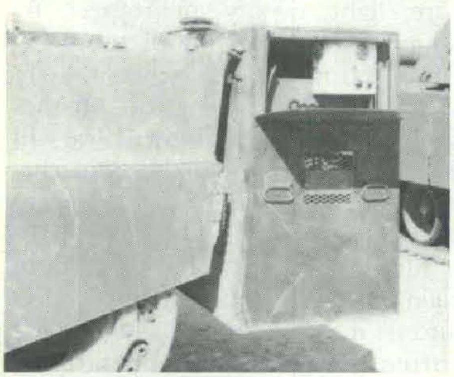
CPT(P) WARREN T. DUDENBOSTEL is assigned as a program management specialist in the Weapon Systems Management Office for Scout/Observation Helicopters in the Directorate for Systems Management, AVSCOM. He holds a BS in management from Widener College and is a graduate of the Transportation Officer Advanced Course.

Auxiliary Power Unit for the M1 Tank

By LTC Michael D. Jackson



M1 tank Auxiliary Power Unit

When the M1 development program began, the overriding concern was not fuel consumption but crew survivability. Obviously speed and agility are as much a means of survival as is armor protection. Speed certainly provides tactical advantages as well as crew protection but to get that speed you need power. The ACT 1500 engine used in the M1 provides that power. What it doesn't provide is fuel economy, particularly when idling.

The M1 Tank consumes considerable fuel when idling more so than when moving at high speed. That is the nature of the engine. Even though we armor types would like to promote the myth that, when mounted, we are constantly moving at high speed, stopping only to refuel and rearm, the fact of the matter is this: a tank's engine spends more time idling to keep batteries charged and electrical systems operating than physically powering the tank from point A to point B.

Fuel consumption of the M1 became a concern during initial production. Today the same concern still exists. The reasons for concern are operating costs and resupply requirements in training and in combat.

What then is the solution? State-of-the-art is not, in the near future, going to provide us with a power plant that will provide a tank with the performance of a "Corvette" but with the fuel economy of a "Chevette." We, therefore, need a means of charging the M1's batteries and providing power to the electrical systems without having to run the engine. The answer is an auxiliary power unit (APU) or "Little Joe."

In June 1983, III Corps Commander LTG Walter F. Ulmer, Fort Hood, TX, pointed out to engineers from the M1 Program Manager's Office, as well as to this writer, the need for a "peacetime" APU for the M1 Tank as a means of cutting operating costs. Consequently, with the PM-M1's approval, the Materiel Fielding Team, CONUS at Fort Hood, TX, immediately began an informal, unfunded, concept/feasibility study to determine the most logical, least time consuming and inexpensive solution to the acknowledged need for a field applied auxilliary power unit. Since the start of this project, the need for such an APU has also been expressed by the Army's Vice Chief of Staff, General Maxwell Thurman.

Not since the M48 Tank was fielded has a U.S. main battle tank had an APU. The unit on the M48 proved its worth. However, when the M60 series of tanks were fielded, fuel was inexpensive, fuel consumption/usage was not a significant problem to the user nor the logistician, and there was no stated need for a "Little Joe." Our concept/feasibility study was intended to answer the following questions:

- Would an off-the-shelf (Army inventory) auxiliary power unit provide the necessary power to recharge the batteries of an M1 Tank quickly and maintain that charge with all electrical systems in operation?
- What is the most feasible location for mounting such an APU allowing for quick adaptation and ease of mounting and dismounting?

Alternatives

Based on resources immediately available to the Materiel Fielding Team, two alternatives were examined, one being the turbine auxiliary power unit used on the CH47 Chinook Helicopter, the second being the diesel unit used on the M88A1 recovery vehicles. The turbine unit was ruled out because of unit cost (excess of \$23,000), fuel consumption (14½ gallons per hour) and an excessively high noise level.

The M88A1 APU was selected because of its unit price (\$7,500), low fuel consumption (less than one gallon per hour), low noise level, and its easy obtainability and maintainability.

Concept to Hardware

The unit was placed in an enclosed mount and suspended from hinges (same hinges that suspends the tanks armored skirts) off the left rear of the tank. The logic for this mounting concept was that it would help avoid any interference with traversing the main gun; simplify, as much as possible, the routing and hook-up to fuel and electrical sources; and it would insure ease of mounting and dismounting the APU.

In order to mount the unit as described, the left tail light and protective bracket were removed. The original intent was to run both the electrical cable and fuel line through the aperture for the tail light cable into the hull. We found that there was insufficient space in the hull, around the fuel cell, to do this and for safety reasons probably was not a smart thing to do. Instead, the cables are routed externally on the hull (not the back deck) and covered with a protective shield. The smoke generator fuel line was tapped for fuel and a fuel pump added to reduce fuel pressure feeding into the APU.

The electrical hook-up was made into the positive and negative terminals of the starter. This provides a direct "trickle" charge to the batteries for charging purposes as well as for drawing current to start the auxiliary power unit itself. It will start at 18-20 volts battery charge.

The tank engine requires a starting voltage of 19 volts (per the technical manual), 20-23 volts per experience. Both electrical and fuel cables have quick disconnects for connections within the tank hull and at the APU. The back deck and power pack can be removed without removing the unit.

Contained within the auxiliary power unit are a master control box for the APU (same as on the M88A1), a 150 amp voltage regulator, and a muffler (from a 10KW compressor). An intack air cleaner filter (from a 10KW generator) is externally mounted.

APU Terrain Testing

The auxiliary power unit with mount has been field tested to determine if the mount is sufficiently rugged enough and stable to survive cross country movement at speeds of 35 to 45 MPH, successfully negotiate deep depressions, fording sites, backing into and bouncing off trees and to withstand the shock of main gun firing. We have also proved that a 60-ton tank, backing into solid ground, i.e., the side of a ravine, will smash the APU mount. The APU however, remained operational.

The auxiliary units mounting hinges were tested to determine if the mount would move, when necessary. Mud build-up around the sprocket on the tank as well as moving into and out of depressions will require the mount to move. A pin was affixed to the mount and tank hull to keep the APU stable but allow it to move (break away), if required.

Tests showed that the pin worked well but was not needed. The combination of APU weight and the tank suspension system allowed the auxiliary unit to ride steadily at high speeds over undulating terrain. In fact, throughout testing, it rode as if it were an integral part of the tank hull.

APU Firing Testing

This test was conducted to determine if the auxiliary power unit would charge the tank's electrical systems with the engine shut down and with all systems on, including the thermal sight and radios in operation. Additionally, a part of the test was to determine if the APU would withstand the shock the main gun firing.

During stationary tests, 5 rounds each were fired over the left front slope, 5 rounds over the right (starboard) side of the tank and 5 rounds over the back deck. During this firing, the main engine was shut down and the APU provided electrical charge. The turret was completely power-up to include the thermal sight and radios in use.

In the moving tank test, 3 rounds were fired over the left front slope, 2 rounds were fired over the back deck with the gun tube directly over the APU when firing.

Results

At the completion of the firing exercise, the APU was inspected for damage. All connections were intact, and the unit was operational. Minor damage occurred to the shear pin mount when the tank crossed a narrow, approximately 5-foot ditch, 3-4 feet deep. As a result of this incident, we will replace the shear pin mount with a rubber bumper affixed to the back side of the APU where it butts up to the tank hull. As previously stated, the shear pin is not needed anyway.

Cross country and firing testing proved that the mounting concept worked and that the auxiliary power unit, as presently configured, provides the necessary power requirements to charge the tank's electrical system and operate all electrical equipment without the turbine engine running.

We have not, in the course of testing, attempted to change the track (left side) with the APU mounted. I believe it can be done, if necessary. In a situation where a track is *thrown* to either the inside or the outside, the APU would probably need to be removed.

A smaller auxiliary unit package will provide more ground clearance when mounted than the one discussed in this article. Then even a thrown track would not present a problem.

I want to emphasize that the intent of this test was not to sell the idea of using an M88AI APU on the M1 Tank. There are units commercially available that will provide the desired power output and yet reduce by as much as one-fourth the size of the APU and mount that we test, consequently, reducing the total weight by at least 30 percent. Reduction in size, particularly ground clearance, is important.

To date, total cost in hardware for the auxiliary power unit mount we tested, not counting labor, is under $11,000. All components used are in the Army supply system and can be quickly adapted for field use. Refinement of this mount is needed and we are doing that. We also know that cosmetic improvements are needed.

Engineers with M1 PM's Office and the Armor Engineer Board, Fort Knox, KY, in reviewing options, costs and schedules, including our APU mounting concept, summarized their findings in a decision brief to GEN Maxwell Thurman on 31 October 1983. The recommended and approved option is a smaller, commercially available, diesel APU mounted off the rear of the M1 Tank in a similar manner as the one discussed in this article.

It is considered opinion by all involved in this program that the M88A1 auxiliary unit is too large for mounting in this fashion and that a smaller, lighter but just as powerful APU is the way to go.

The auxiliary power unit that is ultimately fielded for the M1 Abrams will contribute significantly towards reducing operating costs and wear-and-tear on the M1's turbine engine without degrading, in any way, the crew's ability to train on their tanks.

LTC MICHAEL D. JACKSON, a graduate of Infantry OCS and Ball State University, is chief of the CONUS based M1 Fielding Team, Fort Hood, TX. He has commanded a tank company in CONUS, armored cavalary troops in Vietnam and West Germany and was executive officer of the Army's first M1 Battalion.

The Single Manager for Conventional Ammunition

By John Masengarb

The Department of Defense began integration of its management of wholesale conventional ammunition in November 1975 when it named the Secretary of the Army to be the Single Manager for Conventional Ammunition (SMCA). With little precedence for its undertakings, the single manager approach has brought about many improvements, with the strong support of the military services.

As DOD's single manager, the Army has three principal objectives:

- Achieve the highest possible degree of efficiency and effectiveness in DOD operations to acquire top quality conventional ammunition for U.S. forces during peacetime and mobilization.
- Integrate the conventional ammunition logistics functions of the military departments to the maximum extent practicable to eliminate unwarranted overlap and duplication, thereby increasing the efficiency and effectiveness of the overall conventional ammunition logistics system.
- Maintain an integrated production and logistics base to meet peacetime, surge, and mobilization requirements for assigned ammunition.

After a nearly 2-year transition period, the single manager approach became operational on 1 October 1977 when the Secretary of the Army assumed the title of Single Manager for Conventional Ammunition. He delegated single manager functional responsibilities through the U.S. Army Materiel Development and Readiness Command (DARCOM) to the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) at Rock Island, IL (then known as the U.S. Army Armament Materiel Readiness Command (ARRCOM) before 1 July 1983).

AMCCOM became responsible for full-scale procurement and production, the conventional ammunition production base, wholesale supply and maintenance, demilitarization and disposal, transportation, and related support functions for assigned munition items. At that time, Navy conventional ammunition production, maintenance and storage facilities located at McAlester, OK, Hawthorne, NV, and Crane, IN, were transferred to the Army. They were added to the more than two dozen other Army ammunition plants and activities in AMCCOM located around the Nation.

Centralized management of functions came about when the Secretary of the Army approved a Single Manager for Conventional Ammunition charter in August 1981 delegating his authority for execution of operations to the DARCOM Commander. In turn, the DARCOM Commander appointed an Executive Director for Conventional Ammunition to carry out those responsibilities.

The Executive Director has a small, jointly-staffed office of military and civilians collocated with HQ DARCOM in Alexandria, VA. The dedicated single management organization interfaces with the military departments, Congress, the Office of the Secretary of Defense, the Office of Management and Budget, and the General Accounting Office.

In June 1982, the Executive Director for Conventional Ammunition, with the outstanding support of AMCCOM and the Military Services, published the first Integrated Conventional Ammunition Procurement Plan, incorporating the military Services' 5-year defense ammunition procurement plan. Preparation of the integrated plan included review of programs for production base impacts, economy of production, production leveling among producers and balancing of production schedules.

Military departments were given integrated plan recommendations for review and acceptance. Recommendations involved consolidation of several years procurement quantities into a single, economical buy; use of one Services' assets to satisfy the requirements of another Service; and cancellations or deferrals.

The Executive Director for Conventional Ammunition and AMCCOM began a 2-phase effort to automate preparation of the Integrated Conventional Ammunition Procurement Plan soon after it was first published. The first phase focused on methods to consolidate requirements for common programs, workload balancing and production base implications. It was completed to support the FY1986-90 integrated plan published 1 June 1983. The second phase completing automation efforts is planned for completion in April 1985 to support publication of POM FY1987-91 integrated plan.

A companion document, the Integrated Conventional Ammunition Maintenance Plan (ICAMP), examines the capability of the Single Manager for Conventional Ammunition to perform assigned maintenance programs in support of all the military Services. Also, it analyzes availability of funding, components, facilities equipment and technical documentation. Recommendations for maintenance program improvements are included in the ICAMP, first published in June 1983.

A series of joint conventional ammunition policies and procedures are scheduled to be published in DOD Manual 5160.65-M. They outline policies, procedures, responsibilities, and interfaces between the single manager and the military Services for each functional area.

Through the single manager approach, important improvements in the acquisition process were brought about after the Conventional Ammunition Working Capital Fund (CAWCF) became operational 1 October 1981. The fund promotes economies of scale through consolidation of conventional ammunition procurement orders. Standard prices are established for items with available production history.

During the capital fund's first year, significant improvements included elimination of work order proliferation, reallocation of personnel spaces, refinements in industrial stocks management, improvements in cost visibility and reduction of government-owned/contractor-operated ammunition plant reports.

Currently, AMCCOM is seeking OSD approval for contract authority which would allow it to procure components for end items, designated by the military Services as low risk, before receiving a funded requirement. The concept has received favorable comments from the DOD Inspector General, the General Accounting Office, and the President's Private Sector Survey on Cost Control, and others.

An especially significant initiative was the establishment of an Industry Committee of Ammunition Producers in the American Defense Preparedness Association. Top officials from ammunition producers study subjects and problems as requested by the AMCCOM commander and also advise the commander as to possible improvements in the AMCCOM/industry interface. The industry committee's charge is to develop positive, workable ideas and concepts to help the single manager achieve its ammunition procurement and production objectives.

In response to personnel needs, an Ammunition Specialist Career Program was developed recently. It is designed to produce commodity-oriented expertise needed to adequately replace the many employees who are retiring from careers begun during the 1940's and 1950's.

Recognizing that ammunition is a unique and hazardous commodity, military and civilian positions are being identified for career development. Managers, specialists, and operators with conventional ammunition logistics missions are being authorized additional training and education.

Although the program is Army-wide as a first step, its goal is to have a DOD-wide commodity-oriented Ammunition Specialist Career Program. The first class of 20 interns began the formal 58-week program of instruction at the U.S Army Defense Ammunition Center and School in August 1983. When formal training is completed, the interns will be assigned to ammunition installations and command headquarters with ammunition missions for on-the-job training for the remainder of their 2-year internship. The program will be continuous with interns inducted annually to replace anticipated losses.

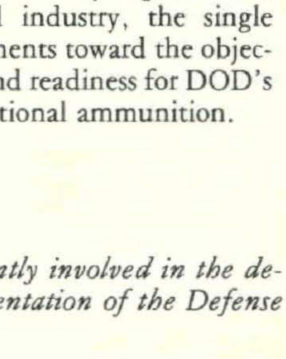
During the first five and a half years of the single manager approach, cost avoidances in excess of $662 million have been achieved. The savings were achieved through reuse of assets in long supply, economies in transportation, better selection of supply sources, reuse of production equipment to fill voids in production lines, efficiencies in procurement and maintenance programs, and elimination of duplicate procedures.

The Office of the Executive Director for Conventional Ammunition proposed an ammunition and production base combat allocation system to the OJCS chaired Joint Materials Priority Allocation Board. The system was adopted by OJCS. It established procedures for allocating ammunition to unified and specified commands and distributing critical service-owned assets to the military Services.

Also under study are improvements in the development of acquisition strategies, development of a standard DOD-wide automated system covering the wholesale logistics functions assigned to the Single Manager for Conventional Ammunition, standardization of hazardous testing for non-nuclear muntions, expansion of its automated requisition processing system to include overseas customers, and contigency and mobilization planning.

Areas for further improvement remain. With the continued outstanding support of the military departments, other government agencies, and industry, the single manager will build on its achievements toward the objectives of efficiency, effectiveness, and readiness for DOD's management of wholesale conventional ammunition.

JOHN MASENGARB is currently involved in the design, development, and implementation of the Defense Standard Ammunition Computer System. Employed at the U.S. Army Armament Munitions and Chemical Command, he has performed work for the past nine years which is related to planning, implementation and operation of the Single Manager for Conventional Ammunition. He is also the executive director of the Joint Conventional Ammunition Program Coordinating Group.



New Tire Tester May Help Find Hidden Defects

The sometimes difficult task of finding defects in tires before and after retreading may become much easier, thanks to a new inspection system now under development at the U.S. Army Tank-Automotive Command (TACOM), Warren, MI.

An engineering prototype of the system is now operating in a pilot project at the Ober-Ramstadt Army Depot in Germany, the only U.S. facility in Germany that retreads military tires. A second prototype underwent tests early in 1983 at the Tooele Army Depot, UT. The systems were built for TACOM by the General American Research Division of GATX Corp.

Called the tire quality monitor, the tester is a portable, computer-controlled system that uses ultrasonic pulse echoes to locate ply separations and other internal defects of both steel radial and textile tires. Echoes from defective tires are different than those from tires free of flaws, and the system can observe these differences and find bad tires.

The system would supplement visual inspection. It is not meant to detect localized defects, such as nail holes or sidewall damage, which a tire inspector can see. Instead, it looks inside the tire and sees things that a tire inspector cannot see, and provides an assessment of the tire's overall condition.

The tire quality monitor consists of a hand-held scanning probe that transmits and receives ultrasonic signals, a temperature probe, and a unit comprising a computer, a control panel and an alphanumeric display.

To inspect a tire, the operator first calibrates the system for the type of tire to be tested by pressing the appropriate switches on the control panel. He then applies a film of a polyvinyl-alcohol solution to about 25 percent of the tread surface. This liquid enhances the transmission of ultrasonic signals between the scanning probe and the tire.

An important measurement that must be made before the inspection begins is the temperature of the tire. Changes in temperature affect both the speed of sound and the amount of attenuation of sound by the tire materials. Thus, the computer must be programmed to compensate for these differences when analyzing the pulse echoes. This is done by inserting the temperature probe into the tire at the inspection site.

After allowing about four seconds for the equipment to take a reading, the operator depresses a switch and the reading is automatically stored in the computer. He then holds the scanning probe against a flat portion of the wet tread to begin the test procedure. During the test, ultrasonic signals from the scanning probe enter the tire and echo back to the probe. When enough signals have been obtained for the computer to make an evaluation, a signal appears on the display, and the operator stores the data in the computer. The operator then repeats the process at four other points along the tread test area.

When all five readings have been stored, the operator requests a tire analysis, and the computer compares the stored data with signal parameters recorded earlier from known good and bad tires. Within a few seconds after the analysis begins, an alphanumeric display of the test results appears, and an accept/reject light is illuminated.

Results achieved with the engineering prototypes at Ober-Ramstadt and at Tooele have been good. And General American Research Division is under contract to build an improved version of the tester that will be designed to further simplify the calibration procedure for the operator.

Tests of the advanced system are scheduled to start at Tooele in May and should take about four months to complete. If the upcoming tests are successful, the next step will be to get Army approval to purchase the tester for general use. If we succeed, it will mean the percentage of retreaded tires that fail in the field will be reduced significantly.

The price tag for the system would be about $12,000. According to an economic analysis, however, the money saved by reducing the number of defective retreads would equal the purchase cost after inspection of approximately the first 1,000 tires.

The preceding article was authored by Robert J. Watts, a project engineer and group leader in the Army Tank-Automotive Command's (TACOM) Product Assurance Directorate, and George Taylor III, a technical writer and editor at TACOM.

From The Field...

AMSAA Plans Operations Research Symposium

The 23rd Annual U.S. Army Operations Research Symposium (AORS XXIII) will be held 2-4 October 1984, at the U.S. Army Logistics Management Center, Fort Lee, VA. About 200 Army, academic, and industrial leaders are expected to participate. The theme of this year's symposium is "Excellence in Army Analysis." The symposium will allow an exchange of information on significant Army analyses and expose practitioners to constructive critique and, in general, broaden the perspective of the analysis community.

Attendance will be limited to invited observers and participants. Papers will be solicited which address the theme of the symposium. Selected papers and presentations will be published in the proceedings.

The U.S. Army Materiel Systems Analysis Activity (AMSAA), directed by Keith A. Myers, is responsible for the overall planning and conduct of AORS XXIII. For the 11th consecutive year, the U.S. Army Quartermaster Center and Fort Lee, commanded by MG Harry L. Dukes, Jr., the U.S. Army Logistics Center, commanded by MG Robert E. Bergquist, and the U.S. Army Logistics Management Center, commanded by COL Billy C. Holland, will serve as co-hosts.

Inquiries pertaining to the symposium should be directed to: Director, U.S. Army Materiel Systems Analysis Activity, ATTN: DRXSY-DA, Aberdeen Proving Ground, MD 21005-5071. Phone inquiries should be made to Glenna Tingle, AUTOVON 283-6576 (Commercial (301) 278-6576) or Marie Stidman, AUTOVON 283-6577/6597 (Commercial (301) 278-6577/6597).

Flight Demonstrates Small Radar Technology

The second flight experiment of a program in which the Army is exploring technology for nonnuclear "kill" of strategic nuclear missiles within the atomsphere was conducted earlier this year at White Sands Missile Range, NM.

The flight was intended to demonstrate execution of programmed maneuvers by the Small Radar Homing Interceptor Technology flight vehicle.

Preliminary indications are that the first two planned maneuvers were completed. After the second maneuver, the vehicle exhibited unexpected areodynamic instabilities which resulted in departure from the planned flight profile. Analysis is under way to determine what caused the departure.

The small radar technology experiments are being conducted by the Army's Ballistic Missile Defense Advanced Technology Center to determine the miss distance that can be achieved with an agile homing interceptor operating within the atmosphere. The first flight experiment was conducted in January. Vought Corp. of Dallas, TX, is the prime contractor for the program.

R&D on Chemical Agent Alarm Will Continue

The Environmental and Process Instruments Division of the Bendix Corp. has been awarded a contract to continue development of the Army's new XM22 Automatic Chemical Agent Alarm (ACADA). The XM22 is an advanced man-portable point sampling alarm system based on the concept of ion mobility spectrometry.

Rad Baker, spokesman for the Army Armament, Munitions and Chemical Command (AMCCOM) at Aberdeen Proving Ground, said the $27,163,733 contract modification is for the continuation of R&D on the XM22 previously performed at the Bendix Baltimore plant.

"Bendix started the R&D program with a $10 million contract awarded in 1982. The total $37 million for the development is one of the largest awards of its kind we have made to a Baltimore firm," Baker said.

The system is being developed by the Army Chemical R&D Center, an AMCCOM research activity at APG.

The XM22 will have an improved sensitivity over the Army's current field chemical alarm system, the M8, and will also have the capability to detect a greater number of military chemical agents that could be used against U.S. or allied forces.

This is the first time that the ion mobility spectrometry concept has been utilized in the development of a small portable field alarm. The system is designed to detect agents on the ground as well as on battlefield equipment and other surfaces and will afford a greater degree of protection for the soldier than is now available from any one device.

New Additive Should Extend Antifreeze Life

A new method of preserving antifreeze that could save millions of dollars annually has been developed at the Belvoir Research and Development Center, Fort Belvoir, VA.

The liquid chemical extender, should prolong the life of used antifreeze at least four years, says project engineer James Conley.

"Presently the Army's composition based antifreeze should stay effective for at least five years," says Conley. "If used properly and in conjunction with the technical bulletin governing standard use of antifreeze, this additive could extend antifreeze life to 10 years," he adds.

By utilizing the Army's Reserve Alkalinity Test Kit, soldiers in the field can quickly identify ineffective antifreeze and then add the extender. The additive project was developed by Conley and technician Robert Jamison of the Belvoir R&D Center's Fuels and Lubricants Division.

According to DoD procurement figures, the Army is presently spending over $12 million annually on antifreeze replacement. Officials say with proper use of the test kit and a reinhibiting extender, this figure could be cut to $2 million. Even further DOD savings will be realized if other Services adopt the product, says Conley.

Belvoir R&D Center Installs Radar Test Arch

Enemy forces will have a harder time using radar to detect Army equipment as a result of a new facility recently installed at the Army's Belvoir Research and Development Center, Fort Belvoir, VA.

The radar test arch measures the radar absorbing and scattering properties of materials used in camouflage netting and paints. These materials reduce the amount of radar signal reflected back from an object. By changing its radar 'signature' they reduce the possibility of detection.

The arch itself consists of radar sender and receiver units mounted on a semicircular track. A chain drive operated by a computer enables the technician to move these units independently along the arch to take readings of stationary samples from different angles while a turntable can be used to rotate scale models for a complete 360-degree study.

Unlike the radar test arches in use at other research laboratories, the Belvoir R&D Center's facility was designed to operate horizontally rather than vertically. This unique construction, which was developed jointly by the Belvoir R&D Center and the Georgia Institute of Technology, allows the operator to get more accurate readings over a greater range of radar bands and enables the arch to be used to study the properties of scale models and antennas. Data provided by the new radar test arch will help scientists select the best materials for camouflage protection.

The turntable, when coupled with the neighboring 100 GHz radar facility, enables radar measurements to be made on scaled models. This provides information needed to translate laboratory measurements to full scale field measurements. In addition, data needed to properly emplace camouflage materials on targets and to measure effectiveness are obtained.

ETL Tests Printer for Copying Field Maps

An electrostatic color printer being developed by the U.S. Army Engineer Topographic Laboratories is expected to meet the Army's need for a fast, cost-effective way to reproduce maps in the field. The advanced development model of this Quick Response Multicolor Printer was recently completed and has been used successfully to produce full-color, full-size (24 × 30 inch) maps from both paper originals and digital data files.

The printer will match the quality achieved by the lithographic presses used in the field today. The new equipment, however, eliminates much of the set-up and production time associated with offset lithography—and cuts hours off the map reproduction process.

Unlike conventional lithographic presses, the equipment features a printing process similar to that found in commercial color copiers. Addition of a laser scanner improves the dry copying process and provides the high resolution required for reproducing maps.

This combination of color xerographic techniques and laser technology allows the quick response printer to print maps and other graphic products with the speed and accuracy needed to support combat operations. When fielded, it will produce full-color maps at the rate of 75 per hour.

The printer, however, won't be limited to copying maps from paper originals. A digital interface planned for the printer will allow troops in the field to produce maps directly from digital data recorded on tapes or disks. Soldiers will also be able to make quick overlays, overprint new information onto existing maps and copy photographs.

Engineer Topographic Laboratories' scientists expect to complete acceptance tests for the new prototype this spring. Current plans call for fielding the printer early in the next decade. It won't replace the lithographic press for printing large numbers of standard maps, but it will help the Army's topographic units produce special purpose maps when and where they're needed.

Personnel...

Lipinski Commands Yuma Proving Ground

COL Robert H. Lipinski, former Chief, Acquisition, Test, and Industrial Defense Base Policy Division, Office, Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA, has assumed new duties as Commander of the U.S. Army Yuma Proving Ground, AZ.

COL R.H. Lipinski

Lipinski entered the Army following completion of his studies at the University of Pittsburgh, where he earned a BS in mechanical engineering. He later earned a masters' degree in business administration at Babson College, MA.

A graduate of the Ordnance Basic Officers Course, he has also attended the Ordnance Officers' Advanced Course, the Command and General Staff College, the Project Manager's Course at the Defense Systems Management School, and the Industrial College of the Armed Forces.

COL Lipinski has served in a wide variety of assignments, including Nuclear Weapons Instructor, Field Command, Defense Atomic Support Agency, Sandia Base, NM; Commander of Headquarters and A Company, 51st Maintenance Battalion, Manneheim, West Germany; Maintenance Staff Officer with the Battalion and 1st Support Brigade Staffs; 1st Logistical Command, Republic of Vietnam, 701st Maintenance Battalion, Fort Riley, Kansas; XM1 Project Manager's Office; and Commander, 85th Maintenance Battalion, Hanau, West Germany.

Among his awards and decorations are the Legion of Merit, Bronze Star, Meritorious Service Medal with Oak Leaf Cluster, and the Army Commendation Medal with Oak Leaf Cluster.

An automotive test rig (ATR) being tested at the Materiel Testing Directorate as the main battle tank for the Republic of Korea shows its kneeling capability made possible by its hydropneumatic suspension system. A second prototype, a fire control test rig, is also undergoing tests at MTD.

Proposed Korean Tank Undergoes Feasibility Tests

Technical feasibility tests on a proposed Republic of Korea Indigenous Tank (XK1) are underway at the Materiel Testing Directorate, APG, MD. Two prototype tanks are being tested as the main battle tank for the Republic of Korea, according to Dave Zupko, a senior test director in the Materiel Testing Directorate's Tracked Vehicle Branch.

The tests are being conducted as a result of a Memorandum of Understanding between the United States and Korea. Korea requested U.S. technical and managerial advisory assistance in the design and development of a modern combat tank which will be manufactured in Korea.

"The tests are designed to measure performance and determine if the prototypes meet the established requirements of the system specification," Zupko said. He added that tests on the two XK1 prototypes will also provide a flow of information on problem incidents arising during the test to guide further development, product improvement and design finalization.

The first prototype, which arrived last November, is an automotive test rig with a full payload, but nonoperational turret. It will be used for all the automotive performance subtests and the endurance and reliability testing.

"The automotive test rig has been subjected to numerous tests such as steering, braking, acceleration and road shock and vibration to evaluate system safety, automotive performance and human factors engineering," Zupko said. The remaining tests for this vehicle include a climatic chamber test, powertrain cooling and the reliability availability maintainability test.

The second prototype, a fire control test rig, arrived in February. It is a fully operational version of the XK1 tank and will be used for all of the fire control subtests.

"The fire control test rig has recently completed an initial inspection. Shortly, it will undergo a full schedule of firing and nonfiring tests for a complete evaluation of the turret fire control system. Also, accuracy firing will be conducted while the tank is moving and while it is stationary," according to Zupko. The XK1 is described as a full-tracked, armored, low profile land-combat vehicle which is operated by a four-man crew including the commander, a gunner, a loader and a driver. The tank is powered by a 1,200 horse power diesel engine driving an automatic transmission.

The unique suspension system is a hybrid design, composed of both torsion bars and hydropneumatic units. This system, according to Zupko, provides a smooth ride over cross-country terrain and permits the tank to kneel down for added depression of the main gun.

A 105mm rifled M68E1 high velocity cannon mounted in a rotatable turret is the XK1's main weapon. Complimentary weapons consist of two 7.62mm M60 machine guns and one .50 caliber M2 machine gun.

One of the 7.62mm machine guns, which is coaxially mounted with the 105mm cannon, serves as the primary antipersonnel weapon. The second 7.62mm machine gun and the .50 caliber machine gun are interchangeably mounted at the commander's and loader's station. They are designated to serve as antipersonnel and soft target weapons and for use in defense against low performance aircraft.

The XK1's armor design protects the crew against antiarmor weapons and other factors while another system protects against chemical, biological and radiological attack.

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