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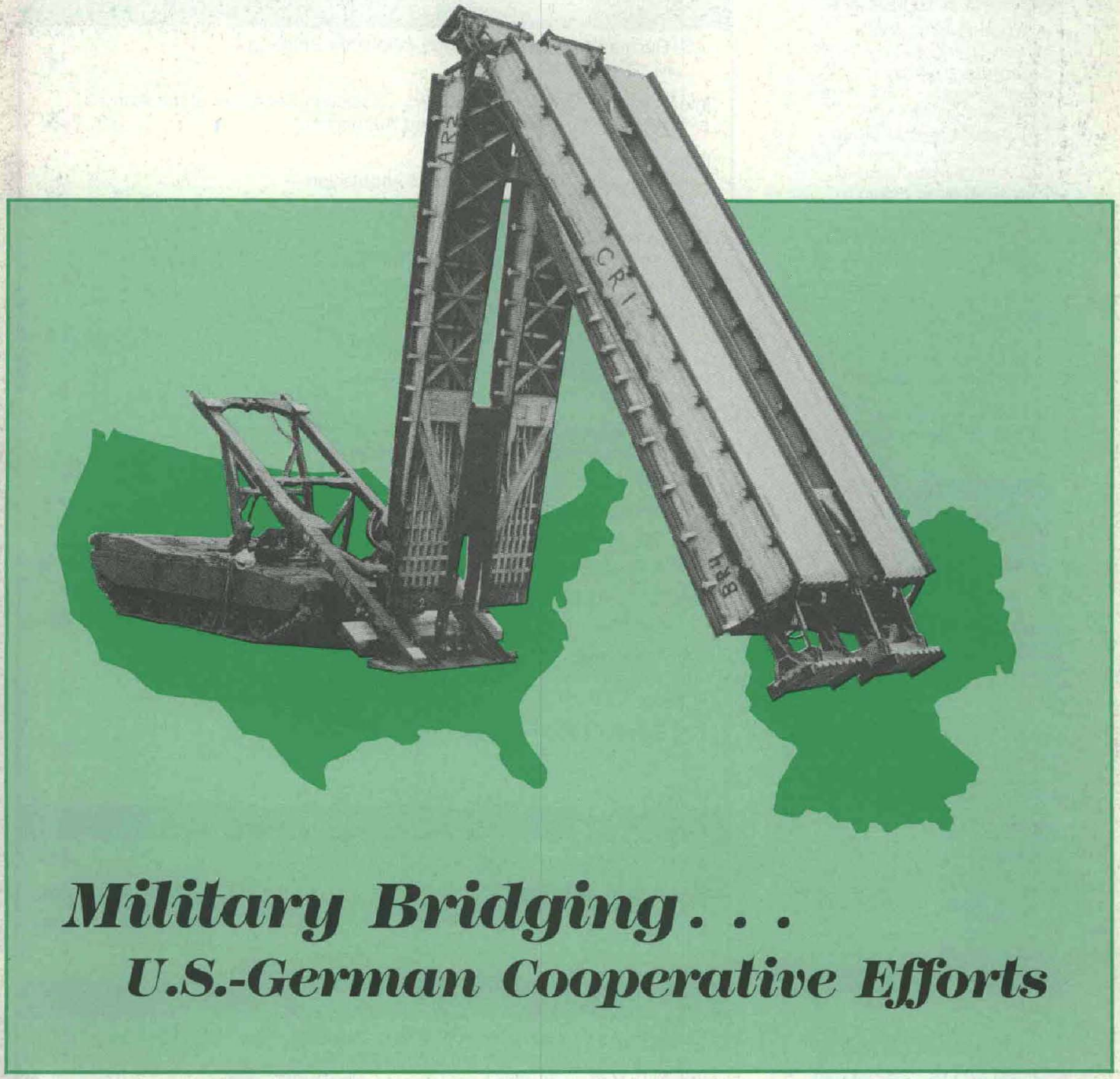
JULY-AUGUST 1990



Military Bridging . . .
U.S.-German Cooperative Efforts

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ARMY Research Development Acquisition RD&A BULLETIN

Professional Bulletin of the RD&A Community

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COVER

The Scissors Heavy Assault Bridge shown on the cover is associated with a feature article on U.S. Army and Federal Republic of Germany cooperative efforts in military bridging which span almost 30 years.

By John V. Kerr

U.S.-GERMAN COOPERATIVE EFFORTS IN MILITARY BRIDGING

Past—Present—Future

Introduction

Mobility on the battlefield has always been a critical concern of military planners. During offensive, defensive or retrograde operations, tactical mobility is a crucial ingredient for success on the battlefield. Wet and dry gaps, both natural and man-made, can significantly degrade the mobility of most land combat systems. Thus, the general need for tactical bridging is well recognized.

In the U.S. Army, and the same is true for most armies, a group separate from the development community establishes operational requirements for equipment and the developer strives to meet these requirements by a variety of technical approaches. One alternative considered in all U.S. Army developments is potential cooperation with allied Armies which can be to the mutual benefit of all. This article highlights the significant cooperation between the United States and Germany in military bridging during the past 30 years — I say 30 years since that is my personal frame of reference.

Past

One of the principal weapons on the modern battlefield is the combat tank. Gap obstacles, both natural and man-made, can effectively neutralize a tank force. Recognizing this, during the 1950s the U.S. Army initiated development of a tank-mounted bridge designed to allow tank forces to cross battlefield obstacles in stride, thereby maintaining the momentum of the attack. This system, designated the Military Load Class (MLC) 60 Armored Vehicle-Launched Bridge (AVLB), was introduced to U.S. forces in Europe during the early 1960s. The MLC 60 AVLB remains today as the U.S. Army's only assault bridge.

During the 1960s, the U.S. producer of the AVLB system had a greater capacity to produce the AVLB than our own defense budget could sustain. This resulted in the first modern day U.S.-German cooperation in bridging when a quantity of AVLBs was purchased and fielded by the German Army. Many of these units remain in service with the Bundeswehr today.

Prior to Russia's introduction of the PMP floating bridge during the '60s, military river crossings required time and labor-consuming on-site assembly of a variety of components into floating bridges. Recognizing the vast improvements afforded by PMP-type bridges, in 1969 the U.S. Army embarked on a program to further exploit this technology. During a three-year period, prototype equipment was designed, built, tested, and adopted by the U.S. Army as standard. This system is known as the Ribbon Bridge (Figure 1). This equipment was designed for MLC 60 and has subsequently been fielded in all active U.S. Army units plus a majority of Reserve and National Guard elements.

During the early 1970s, the decision was made to channel all U.S. Army bridging development into cooperative efforts with the United Kingdom and Germany. The goal of this trilateral effort was to modernize each country's tactical bridging equipment to meet the

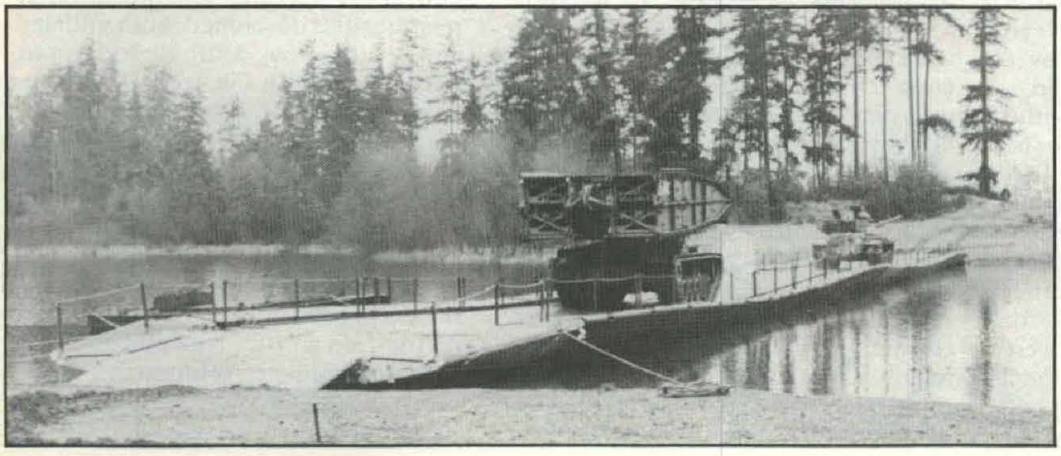


Figure 1.

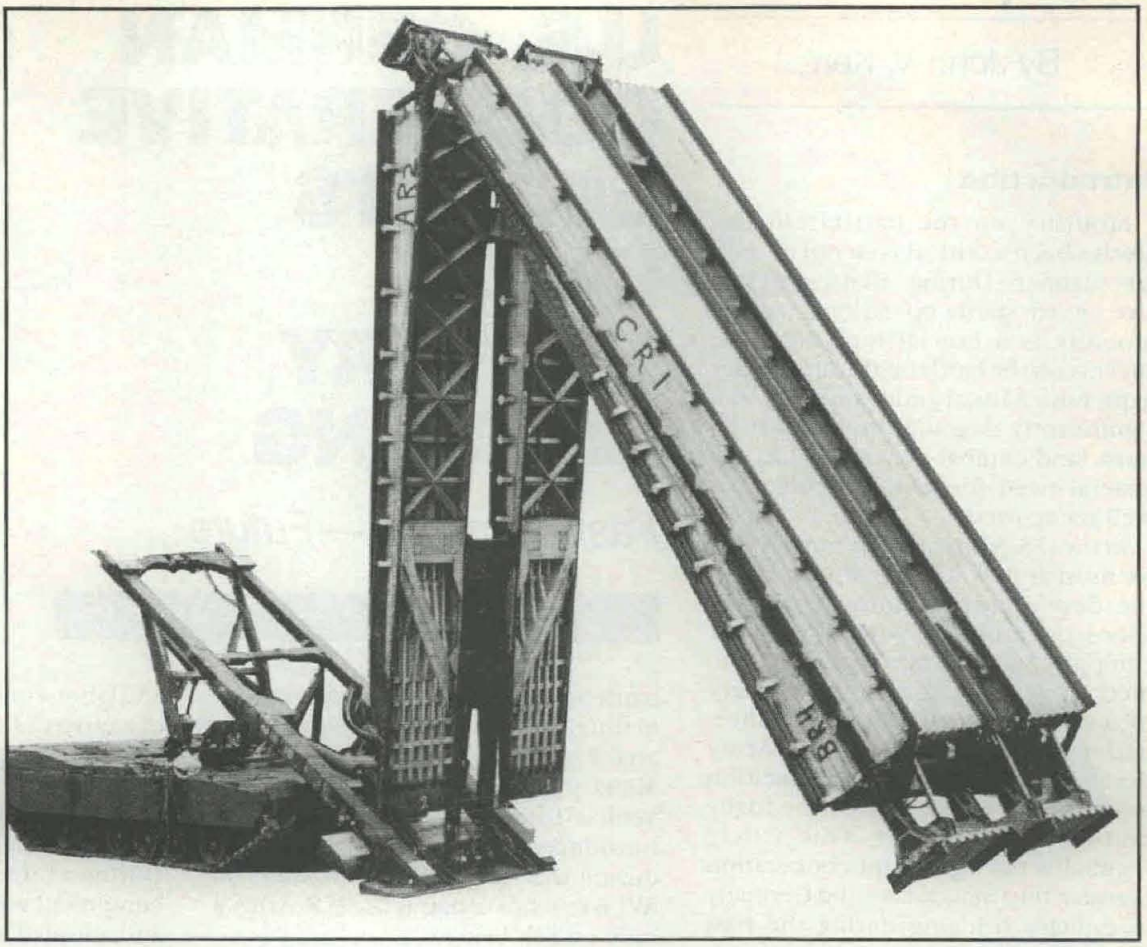


Figure 2. *Scissors Heavy Assault Bridge.*

needs of the future by developing a family of bridges called "Bridging in the '80s", or BR 80.

As envisioned, this family of bridges would use common components to the extent possible for three bridging roles, i.e., assault, dry gap support, and wet gap support. This commonality could reduce procurement, training, and logistics costs and allow interoperability among the roles. For the assault role, the bridge sections were to be transported and emplaced by an armored tank chassis and in the support role by a large rubber-tired transporter. After an initial period of concept study by a trilateral team, hosted in the UK, agreement for a concept to proceed into cooperative development could not be reached. An interim program was devised wherein each country would build and test its own "technical demonstration" prototypes, and then, based on the test data, come together again and select a "final concept" for further development. Prototypes were required to meet stringent operational requirements which emphasized speed of emplacement and reduced manpower.

At the end of the interim program there was still no unanimous agreement on a "best" concept to meet individual Army requirements. The program then evolved into a period of national reassessment. From the U.S. side, the user concluded that they did not want a large, special purpose rubber-tired transport vehicle. Our user also concluded that the BR 80 wet support variant did not offer significant improvement over the Ribbon Bridge that was then in the field with the U.S. Army in large quantities. This left only a requirement for a new assault bridge to be compatible with the M1 family of tanks. The U.S. was prepared to embark on a new assault bridge development; however, at the time, budget constraints prevented other armies from joining in a cooperative program.

In the final analysis, although an equipment goal was not achieved, in my view the overall program was a success simply because it brought our countries and armies more closely together. As an example of this, during this period the German Army made a decision to adopt the U.S. Ribbon Bridge. All U.S. technical data on the Ribbon Bridge was provided to the German Army and it was used as the basis for German industry fabrication of the Ribbon Bridge for the German Army. I doubt this transfer would have happened as smoothly and quickly had not relationships and lines of communication already been in place via the BR 80 program.

One intangible product of the several years of technical effort on the BR 80 program is that technical staffs became known to each other and professional relationships developed, both military and civilian, that continue today and have a profound influence on the bridging development efforts of the countries involved. The most important physical product of the years of US-UK-GE cooperation is the Tri-Lateral Design and Test Code for Military Bridging. This code, which has also been adopted by other international groups, governs the design of bridging for most armies of the free world. This code assures that allied military vehicles can safely cross each other's bridges in times of need and mutual defense. The code is

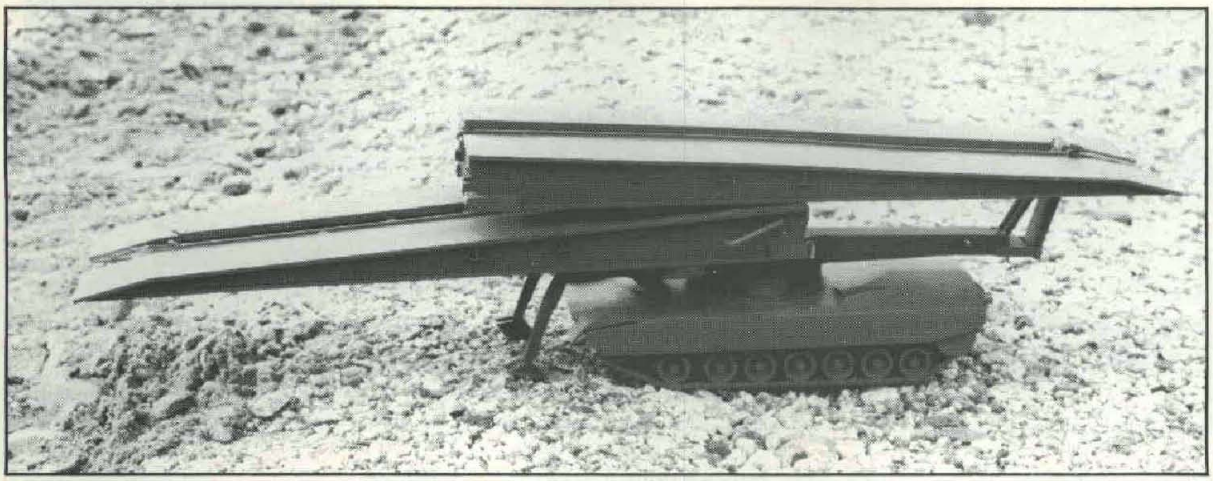


Figure 3. LEGUAN Bridge Model on ABRAMS Chassis.

a living document that is continually updated by a Tri-Lateral Design and Analysis group.

Present

• **Heavy Assault Bridge (HAB).** As noted earlier, at the conclusion of the BR 80 program, the U.S. assessment of its bridging posture concluded that there was a need for a new assault bridge system fully compatible with the U.S. Army's new main battle tank — the M1 ABRAMS. In formulating the operational requirement, the user desired the longest bridge possible while retaining a travel configuration that would not significantly degrade the mobility of the transporter/launcher. In addition, the user desired that the new launcher be able to transport and emplace AVLBs already in the field, and that the launch mechanism be capable of being adapted to the M60 chassis. These requirements were contained in a Request for Proposal issued to U.S. industry. From proposals received, the one selected to pursue for development was the BMY/IMI concept for a 32m double-fold scissors-type bridge. The plan at outset of the contract was to build one bridge and launcher for technical feasibility testing before proceeding into full-scale development.

Approximately a year into the development effort the program was increased in scope to provide for additional systems for evaluation with the intent of bypassing a sequential development effort. The scope change was prompted by an increasingly more urgent field need for a MLC 70 assault bridging capability. A 32m bridge prototype system was built (Figure 2) and had negotiated only limited testing when significant technical problems were encountered in the vicinity of the lifting points at the ramp ends and with the bridge unfolding mechanism. At about this same time, while preparing the ROC needed for a production decision, the user reviewed the bridge span requirements and concluded that a 24m span was the required capability.

In view of the technical problems yet to be overcome in achieving a longer bridge, the decision was made to redirect the scissors bridge development to a 26m (24m span) bridge. This is what is currently being pursued. The bridge will be a mixture of aluminum and high-strength steel. The aluminum curbs will contribute to the load-carrying capabilities of the bridge. The unique tilt-frame launch mechanism requires no welding to the exterior hull and will be connected entirely within the turret well. The bridge will weigh approximately 25,000 pounds.

The U.S. defense budget provides funding each year for evaluation of "foreign" hardware to determine its potential for meeting U.S. Army needs. One facet of this is called NATO Comparative Testing (NCT). The German firm MAN GHH has in production, and is marketing, a 26m horizontally launched bridge (LEGUAN Bridge) on a rubber-tired chassis. At the time the U.S. Army user reduced the assault bridge span requirement to 24m, the requirement for launcher interoperability with the AVLB was deleted. This opened the door for parallel U.S. evaluation of a horizontally launched bridge before making a production decision for a new assault bridge.

Belvoir submitted a proposal for a NCT program to evaluate the LEGUAN bridge mounted on an ABRAMS tank as the transport/launch vehicle. This program was approved for FY 90 initiation. MAN has teamed with General Dynamics Land Systems (GDLS). A contract was awarded to GDLS in March 1990 for two systems. The LEGUAN, and how it will look on the ABRAMS chassis, are shown in Figure 3.

Two scissors bridge systems are being obtained from the HAB development contractor, BMY. These will be tested side by side with the two LEGUAN systems. Plans are to make a production decision for a new MLC 70 assault bridge for the U.S. Army in FY 94.

• **Improved Ribbon Bridge (IRB).** Shortcomings exist in currently fielded Ribbon Bridge equipment in that it will not sustain MLC 70 crossings in fast river currents; cannot accommodate high vertical abutments; and has no built-in flotation when holed or damaged. The current transporter is a 5-ton truck chassis which is overloaded. In view of this, the user issued a revised requirement to correct these shortcomings for future bridge production. A program to do this is well underway. The current roadway ponton design is retained, with the only change being to fill the sections with buoyancy materials (closed cell foam). The bow pontons are being reshaped for increased hydrodynamic performance. The pontons will also be filled with foam for enhanced survivability. The ramp bay is being lengthened to accommodate a 2m vertical bank. The transporter will be on a larger truck chassis (10-ton HEMTT) to alleviate the overload condition. The transporter will also be capable of retrieving a standard NATO PLS Flatrack with a 10-ton load.

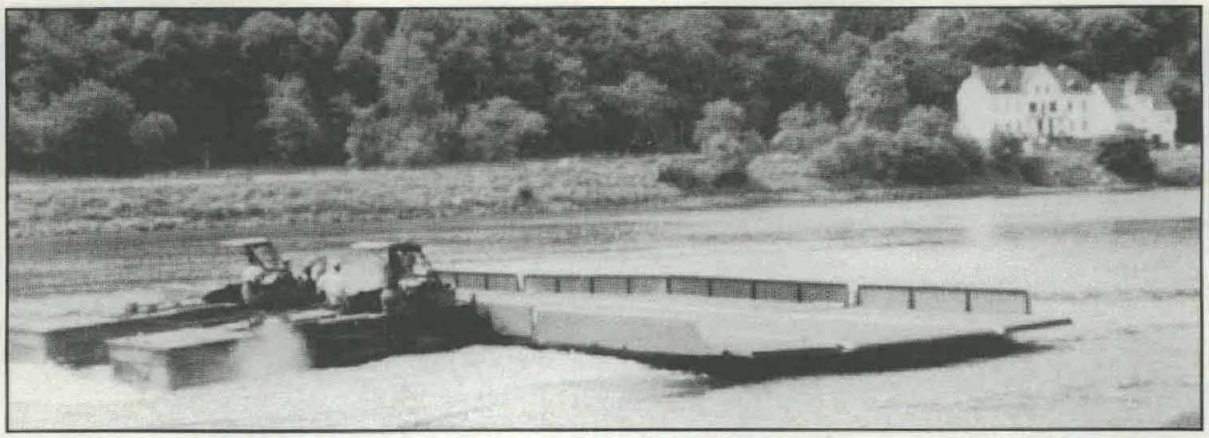


Figure 4. *Floating Float Bridge.*

It is interesting how past exchanges and transfers of knowledge have fostered further cooperative efforts. Noted earlier was German industry production of the U.S.-designed Ribbon Bridge for the German Army. Recognizing the shortcomings that exist with the "standard" ribbon-type bridge due to the weight growth of many main battle tanks, German industry made design improvements to the bridge and demonstrated it to the "world" in 1986. This is the MAN GHH bridge we in the U.S. call the Folding Float Bridge (FFB) 2000 (Figure 4). We now have in place a NCT Program evaluating the FFB 2000. In late September 1989, the U.S. Army awarded a contract to MAN GHH (through its U.S. partner, Southwest Mobile Systems) to supply 12 interior bays, four ramp bays, and six transporters for evaluation. This equipment will be tested side by side with the IRB during 1991-92 and a decision made as to which system best fills the needs of the U.S. Army.

Future

With programs in place to upgrade the U.S. Army Assault and Wet Support Bridging capability, we next turn to Dry Support bridging needs.

- **Heavy Dry Support Bridging.** The objectives for improving dry support bridging over that currently in the field (Medium Girder Bridge) are to increase span and load-carrying capability while decreasing erection time, size of erection crews, and numbers of vehicles required to transport the bridge and erection equipment. These are indeed very ambitious and, in some cases, opposing objectives.

One of the obvious ways of reducing weight of a structure, while at the same time increasing its performance capabilities, is to utilize advanced materials. This was our approach for a new dry support bridge. During the BR 80 program the German assault bridge candidate utilized some carbon fiber, or organic composite material as we call it in the U.S., to minimize the total weight of the structure. We experimented with composites for the reinforcing element of our long-span dry support variant.

Following the BR 80 program, we built and successfully tested composite bottom chords, bridge web, and tensile elements. These successes led us to resurrect a support bridge idea we had looked at many years ago called the "tri-arch". At the time of the original idea, the concept was not pursued due to the weights that would have been involved using metal elements. With the weight savings and design features offered by composites, we initiated a program to build a full-scale technology demonstrator for the Tri-Arch Bridge. As the detail design progressed on the various elements, engineering necessities of the launching system exhibited many operational shortcomings that would have been difficult if not impossible to resolve. In developing solutions to difficulties encountered during the design phase, the estimated weight per foot of bridge (even with use of composites) had grown to the extent that it was approaching some all-metallic bridges of this type currently under development elsewhere in the world. In view of this, a few months ago we terminated the Tri-Arch concept.

Rather than embark on a new development effort for a dry support bridge, our current plan is to take advantage of programs that are already well along in development. Our "user" indicates that the support bridge requirements are:

- Load Capacity: MLC 70 (tracked); MLC 96 (wheeled)
- Maximum Span: 45 to 50 meters
- No. of Transporters: 3 trucks, 3 trailers
- Crew Size: 10 personnel
- Emplacement Time: 75 to 95 minutes

In looking at other support bridges (existing or in development) it appears that the new German Foldable Support Bridge is a good overall match with the U.S. requirement. The significant shortfall with the German system is that it requires some upgrade of the launching beam design to achieve MLC 70 at a 46m span. We are currently working with the German producer of the bridge (Dornier) to overcome this governing feature of the bridge design. Dornier, along with their German partners, are currently building a second-generation system that will contain many improvements based on lessons learned during evaluation of the bridge by the German Army. Perhaps at a later date it will be possible for the U.S. Army to obtain one of the improved bridges for evaluation.

Summary

During the past two decades, there has been significant cooperative effort between the United States and Germany in the area of military bridging. Much of this has been very subtle and not recognized unless one recounts past and current programs as I have done in this article. Hopefully, this spirit of cooperation will continue to the mutual benefit of both of our countries.

JOHN V. KERR is a civil engineer and chief of the Bridge Division, Directorate for Combat Engineering, U.S. Army Belvoir Research, Development and Engineering Center. He holds a degree from West Virginia University and is responsible for all engineering aspects pertaining to U.S. Army bridging.

INTERVIEW WITH STEPHEN K. CONVER

Assistant Secretary of the Army
for Research, Development and Acquisition

The following interview was conducted with the new ASA (RDA) about one month after he assumed office. He formerly served as a member of the professional staff of the House Armed Services Committee (HASC) where he was principal staff advisor to Congressman Bill Dickinson (the ranking Republican) and the 21 other Republican members of the HASC.

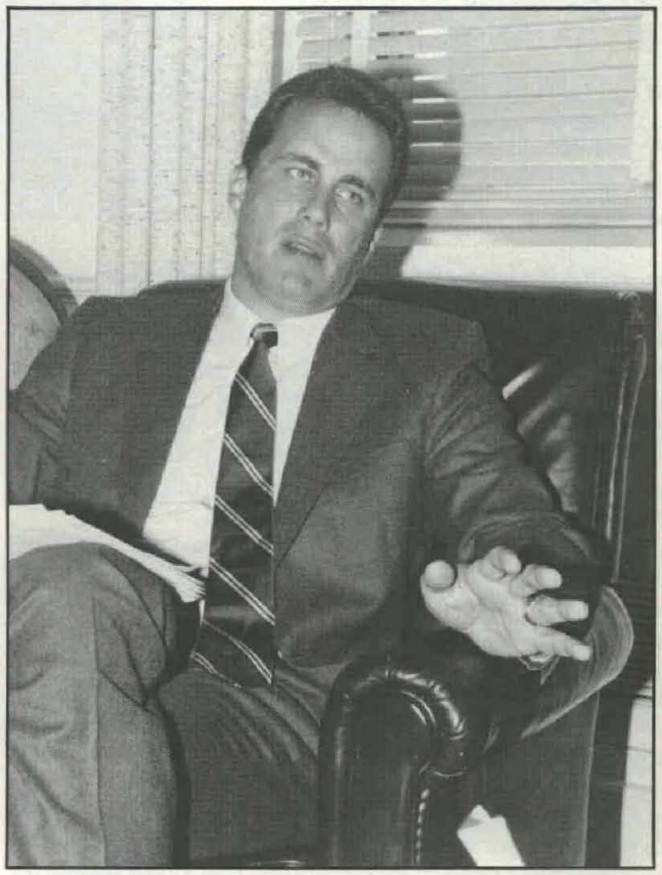
Q. As the new ASA (RDA), how would you describe your overall management philosophy?

A. First of all, I think I am equally job oriented and people oriented. I believe the most important and overriding task is to get the job done, but we must do it in a way that takes into account the job satisfaction we provide the people who work for us.

I am not much for red tape. To the greatest degree possible, I like to cut through the red tape and do what's right in as quick a period of time as possible. I am a strong believer in accountability. With our PEOs and PMs, as well as our contractors, I think we need to make clear what their responsibilities are and hold them accountable to make sure they deliver what they are supposed to deliver. In terms of personal style, I would probably characterize myself as both direct and relatively informal.

Q. Some individuals have expressed concern that efforts related to the recruitment, training, and retention of "Army scientists" have not received adequate attention. Is this concern justified?

A. I haven't been here long enough to know whether it's justified or not. I am aware of a number of things that are being done to improve the situation with respect to both military and civilian scientists and engineers. For example, lab directors will be given the authority to classify and direct-hire for scientific and engineering positions, and we are looking at the possibility of having a separate career ladder for scientists and engineers. In addition, we are trying to put into place personnel practices that will allow scientific and engineering mentors to remain at the bench instead of having



"Another major initiative that we are pursuing that will affect the scientific and engineering community, is the consolidation of laboratory efforts under the Laboratory 21 Study."

"We must achieve an appropriate balance of qualified personnel, and we should aggressively pursue alternatives that serve to provide the Acquisition Corps with a level of professionalism that enables them to carry out their duties — and that means training and education."

to move into managerial positions if they want to continue their careers.

We are also looking at several other initiatives in terms of trying to attract senior retired industry people to come in and serve as mentors in our laboratories. One of the most important actions we are taking in this area is a legislative initiative to allow advanced degrees for civilian government employees in much the same way that our military officers currently pursue graduate degrees. This, however, will require a legislative change and perhaps changes in the way we do business and manage our Acquisition Corps.

Another major initiative that we are pursuing that will affect the scientific and engineering community, is the consolidation of laboratory efforts under the Laboratory 21 Study. I have one personal concern about the way the Army does business with scientists and engineers — namely that uniformed Army officers are discouraged from seeking assignments in scientific and engineering acquisition positions until they reach approximately eight years of service. I am sure there are some very good institutional reasons for doing this, but I need to be convinced that there shouldn't be at least a small number of officers who should be put into acquisition related jobs upon receiving commissions. I'm convinced the Army would accrue significant benefits from such an investment.

Q. Secretary of the Army Michael Stone has proposed a study to improve the efficiency of the Services' laboratory system. Some people believe that a restructuring effort is long overdue, while others contend that such a step is unnecessary. Do Army labs need to be revamped?

A. I understand this issue has been studied for many years, and I think there is a general consensus of opinion that some consolidation is desirable. The Army has undertaken the Lab 21 Study as a way of addressing that issue. This study has been briefed to the Secretary of the Army and the Army Chief of Staff and has been approved in principle. We are now in the process of briefing OSD and putting the implementation plans into effect.

The primary benefits of this study will not necessarily be realized in terms of dollar savings. The real benefits will accrue by virtue of conducting our research more efficiently and effectively with a smaller number of consolidated facilities, which will allow better coordination between various technical disciplines.

Q. As a result of the DMR, the Army has established an Acquisition Corps with military and civilian members. What is your view of the Acquisition Corps and what advice would you pass on to those interested in pursuing a career in materiel acquisition management?

A. The Acquisition Corps is one of the most important facets of improving Army acquisition, and I regard its realization as one of my top personal priorities. It's essential to attract into the acquisition business the very best and brightest talent in the Army, both military and civilian. We must do more to ensure we accomplish that goal. We must achieve an appropriate balance of qualified personnel, and we should aggressively pursue alternatives that serve to provide the Acquisition Corps with a level of professionalism that enables them to carry out their duties — and that means training and education.

One of the major obstacles we face in trying to attract and retain top talent — and this applies mostly to the military — is providing ample career opportunities for them and establishing incentives so they will be drawn to acquisition rather than some other endeavor. My goal is to have a person — who is qualified for both branch duty and acquisition duty — pause and think critically for at least a few nanoseconds at his or her eighth year of service before automatically jumping into specialties other than acquisition.

I would like to make the Acquisition Corps so appealing that we would attract the best and brightest people available. Legislation is currently being drafted in both the House and

the Senate that will address the Acquisition Corps. I am personally concerned that we don't discourage people who are candidates for the Acquisition Corps because of the bureaucratic language we use in talking about it. I know people have a lot of uncertainties about the career implications in joining the Acquisition Corps. For example, what does joining it mean in terms of a person's future opportunity to command an R&D center or a procurement organization? I hope that in the very near future BG Malcolm O'Neill (who is designated as the Director of the Army's Acquisition Corps) and I can send out a very common sense, "plain English" question and answer paper that addresses many of the concerns that have been raised by Acquisition Corps candidates. I am confident that such a paper would put fears to rest in terms of the advisability of joining the Corps.

Q. Do you feel that adequate funding will be available for the Acquisition Corps?

A. Yes, I am confident that funding will be available and legislation will buttress our efforts.

Q. What improvements in the Army's acquisition process do you intend to pursue during your tenure?

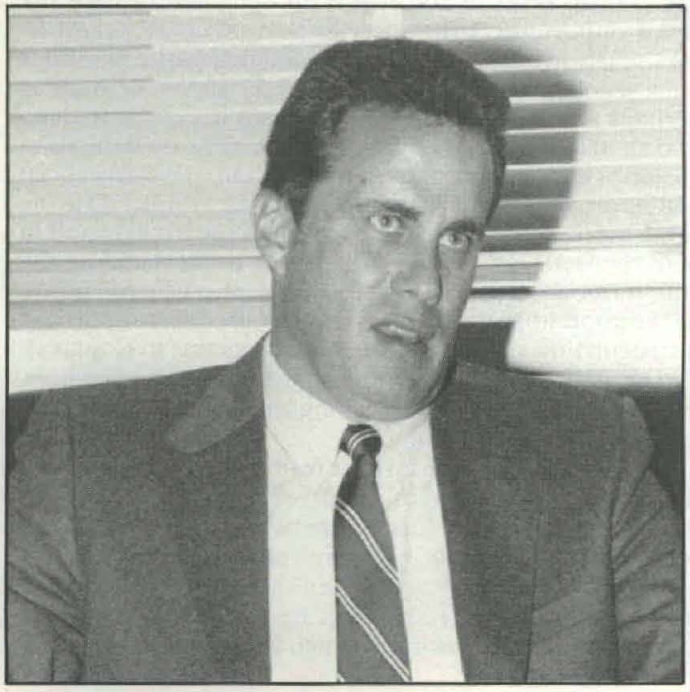
A. My main priority is to manage the major acquisition programs of the Army through the PEO and PM structure. That is my first and foremost responsibility. There are numerous other initiatives we might have, but I think that ultimately they will all be in support of the notion that we must do a better job in managing the major acquisition programs.

I think it is important for us in the acquisition business to participate and contribute in a significant way to both the budgeting and the requirements processes. In the budgeting process, we in SARDA must be advocates for the acquisition business and make sure that Army acquisition budgets which go forward to OSD and the Congress are both adequate and executable. Therefore, we are working hard as major participants in the Army budget process to make sure we achieve those goals in terms of the Army POM and the President's budget as it pertains to Army research, development and acquisition.

The requirements process is a little bit more difficult. At the outset, I would say it is not appropriate for the acquisition community to challenge the users in terms of the validity of the requirements or to question the things they believe are needed to carry out wartime missions. However, we do have a role to play in that process, and I think that role involves making sure that the users' requirements can be met in a way that is affordable and technologically achievable. I envision the model for the requirements process as being one where the users state what they believe they must have, and then we in the acquisition and those in the cost community weigh those needs against what is technologically achievable and affordable. I believe that necessitates an iterative process in which user needs are adjusted until we end up with a final requirement document that is well-balanced in terms of affordability and effectiveness.

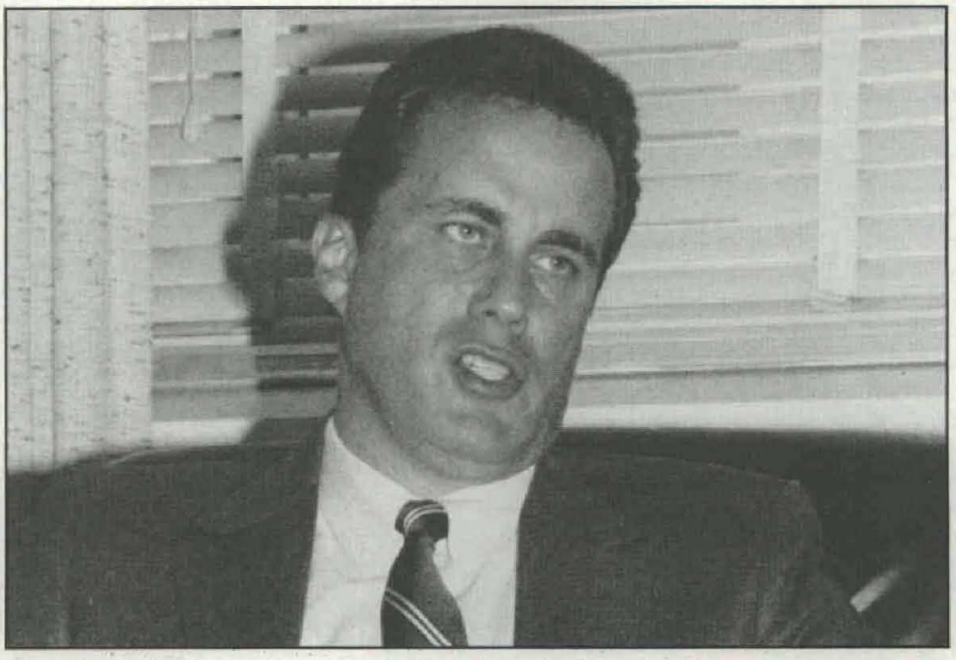
Q. Recent political changes in Eastern Europe have obviously been reflected in the President's proposed budget. What impact do you think these changes will ultimately have on the materiel acquisition community?

A. I think the political changes in Europe, the Soviet Union, and the rest of the world will manifest themselves in two ways that relate to RDA. First, I believe the public and Congress will insist that we devote less of our national resources to defense in general and to acquisition in particular. While much of the focus will be on reducing strategic systems, I think many of the reductions will also fall on the conventional side where the Army's primary responsibilities lie. In fact, if we look at the guidance we are getting now



"In the budgeting process, we in SARDA must be advocates for the acquisition business and make sure that Army acquisition budgets which go forward to OSD and the Congress are both adequate and executable."

"If there is an area in which we must make sure we are not overmatched by the Soviets or any other potential adversary, it is in survivability and lethality."



from OSD in terms of top line funding, in the coming years Army RDA will absorb major reductions. Our objective, as I mentioned earlier, will be to minimize the impact of potential reductions and to ensure that whatever we end up with is executable.

The second way that the political climate changes will manifest themselves is that we will have to have different types of forces — not significantly different, but noticeably different from the kinds of forces we have now. As General Vuono mentions in his "Army of the Future" presentation, future Army forces will have to be versatile, deployable, and lethal. Forces will be lighter and that means more deployable. In the case of Army aviation, that means self-deployable to Europe or at least smaller and lighter aircraft that can fit into fixed-wing transport aircraft.

All of our weapon systems will have to be versatile — capable across the entire spectrum of conflict. This will include not only high-intensity warfare but also the lower end of the scale of conflict, such as special operations, counterterrorism, anti-drug efforts, and others. We no longer have the luxury of being able to afford single-purpose weapon systems that are applicable only to high-intensity battlefields and some other specialized purpose.

Finally, even though our forces will be lighter, they must retain their survivability and lethality. If there is an area in which we must make sure we are not overmatched by the Soviets or any other potential adversary, it is in survivability and lethality. In our tanks, helicopters, artillery, and other lethal systems, we must never lose our edge.

Q. Having served on the staff of the Secretary of the Air Force and also as an Air Force commissioned officer, how would you compare, thus far, how the Army conducts business with that of the Air Force?

A. I find there are probably more similarities between the Army and the Air Force than there are differences. However, there are some differences in process and in style. The process differences that are most evident to me involve the way the budget is put together.

In the Army, the emphasis in the budgeting process appears to be on the force structure and personnel end-strengths. The budget is put together in a way that seems to focus on these areas.

In contrast, the Air Force — which is a somewhat less manpower intensive force — seems to place most of the budget emphasis on the R&D and procurement programs. But, as I said before, the similarities between the Army and the Air Force are more noticeable than the differences.

Q. Is there anything else you want to comment on?

A. I just want to add that I am delighted to have the opportunity to be interviewed by *Army RD&A Bulletin* so early in my tenure. I am also delighted to be here after what seemed like an interminable wait. My background is perhaps a little different from most of the people who go into an RDA job. I don't bring great scientific credentials to the job or great contracting experience, and I have never been a DOD program manager per se. However, I think I do bring some useful skills to the job in terms of my background in both the DOD program and budgeting process and on the Hill. If our acquisition programs are well executed and we have a good story to tell, I believe I can provide a lot of help in articulating and defending those programs to Congress. I've been on board about a month. I am pleased to be here, and I am looking forward to a long and mutually beneficial association with the Army.

I want to emphasize that I have really been impressed with the quality of people in the Army. Secretary Stone and the Chief of Staff, General Vuono, are two of the finest leaders we could possibly have. I am also very impressed with my own staff — from the capable senior military and civilian members to the secretaries. All have been very helpful. Everyone has a great attitude which will certainly make my job a lot easier.

INITIATIVES IN AMC MANAGEMENT OF RESEARCH, DEVELOPMENT AND ACQUISITION

By LTG August M. Cianciolo

Deputy Commanding General
for
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As a result of the Packard Report, the Goldwater-Nichols Bill and the Defense Management Review, the role for the Army Materiel Command (AMC) in the management of Army research, development and acquisition has changed. In addition, reductions in defense spending and troop levels, accelerated by the on-going political/threat changes in Europe, dictate that those of us in the acquisition and the sustaining base work smarter to ensure that the soldier in the field retains the technological superiority and level of readiness required to face unknown future challenges.

A previous edition of *Army RD&A Bulletin* covered the seven missions defined by the Commander of AMC, GEN William G.T. Tuttle Jr., to reflect the new environment and to focus the efforts of AMC in support of the Army (How AMC Accomplishes Its RD&A Missions, Larry R. Israel, May-June 1990). The seven missions are as follows:

- Equipping and sustaining a trained and ready Army;
- Providing equipment and services to other nations through the Security Assistance Program;
- Developing and acquiring non-major (non-PEO) systems and equipment (acquisition related mission);
- Providing development and acquisition support to PEOs/program managers (acquisition related mission);
- Defining, developing and acquiring superior technologies (acquisition related mission);
- Maintaining the mobilization capabilities necessary to support the Army (acquisition related mission); and
- Improving productivity and quality of life.

The article by Larry Israel described in some detail the four missions which most directly relate to acquisition. In this article, I would like to describe some of the initiatives which implement this new direction in the AMC RDA community.

More than ever before, the acquisition community must function as a team; a team under the leadership of the Army Acquisition Executive (AAE). The creation of the PEO/PM structure and the transfer of programmatic and funding responsibility has changed the way AMC must do business. None the less, AMC remains one of the major players in the Army acquisition community, providing primary functional support for PEO systems while retaining management responsibility for over 500 non-executive systems of various types. We, in AMC, are determined to do our part as a responsible team member to support the Army Acquisition Executive.

Toward this end, I initiated a series of off-site Concept of Operation Meetings with HQ AMC senior RDA managers to determine the best way to respond to this challenge. As a firm believer in TQM, I fully expect these meetings to encourage new ideas and innovations in a forum dedicated to an open exchange of information. Through March, a total of four highly successful meetings were held. We have reviewed the new ground rules for acquisition, examined our current processes and identified several important initiatives for implementation.

Clearly, providing matrix support to the major or executive acquisition programs is the critical challenge for AMC. To succeed, AMC Headquarters must become a proactive "broker" between the PM and the Major Subordinate Command (MSC), constantly assessing the support to PEO/PM programs, forestalling disagreements, reporting problems, and offering solutions to the AAE and higher headquarters. Providing adequate quality support and insuring effective communications and coordination throughout AMC, the PEOS and the PMs is one of our highest priorities. A close working relationship is essential given the AMC responsibility in matrix support and in support and maintenance once a system is fielded. It is in the best interest of AMC to do all we can to ensure the success of the PEO managed programs.

Our first initiative is aimed at assessing AMC support to the PEO/PMs. As a "first alert" to ensure that AMC is providing effective support to the program managers, a monthly MSC Command Assessment of Direct Functional Support has been established. After review at this headquarters, the report will become part of the AMC input at the PEO Monthly Status Reviews held by the AAE.

In addition, I have initiated a similar Quarterly Management Report on 335 of the more critical AMC managed systems to increase HQ AMC and AAE awareness of these smaller but still important development programs. This approach will ensure that the AAE receives a comprehensive picture of the progress of all systems under his responsibility. It is our intent to assist the AAE in the management of the Army acquisition process by providing a high level interface between the Office of the AAE and the various acquisition functions performed by AMC.

Our second initiative is designed to take advantage of the acquisition expertise and cross program experience available in the headquarters and to provide the extra attention and effort which the executive managed programs merit. A small core group is being established within the Office of the Deputy Chief of Staff for Development, Engineering and Acquisition at AMC Headquarters which will have access to a broad range of functional experts for the purpose of providing direct assistance to the PMs. In addition, the group will have contractual access to expertise from the private sector. The concept is called AMC "FIRST" which stands for "Functionally Integrated Resource Support Team."

The core group of AMC FIRST will have the ability to instantly mobilize any of several teams of experts to provide special on-site services to selected customers, supplementing normal MSC functional support. Teams will be composed of highly motivated functional experts who will provide assistance, support and assessment, as required.

In addition to PEOs and PMs, "customers" may consist of the MSCs and even contractors, should the need arise. The teams will provide service for high visibility programs, high risk programs and assistance initiated at the request of the customer. In addition, these teams of experts will develop tools and guidance to improve Army acquisition, provide feedback concerning policy compliance, and build a database of lessons learned. The concept is being tested now and is expected to be operational during the fourth quarter of FY90.

As our third initiative, we are expanding and accelerating our Contractor Certification Program. The objective is to ensure that the Army has available a committed, quality contractor support base. During this period of downsizing the military and civilian work force, we can capitalize on modern industrial process controls and management techniques. This will improve both the cost and quality of our military hardware. The key is certification of contractor design and manufacturing processes and management controls so that in-plant Government inspection can be reduced or eliminated entirely. Maximum industry self-governance, coupled with periodic independent external process audits, will enable the Army to acquire improved hardware while industry manages continuous improvements to cost and quality.

To this end, we have developed a draft Military Standard that describes a certified contractor. A contractor will conduct a self-assessment and propose to the government how and when his design and manufacturing capabilities can meet the requirements of the standard. Once certified, the contractor would be given a performance specification, rather than a detailed technical data package. In-plant inspections will be greatly reduced or eliminated. The contractor also will be expected to manufacture world-class hardware with minimal scrap and rework costs and with growing reliability and efficiency. We are working with the Defense Logistics Agency, which administers most of our contracts, and expect to phase in this approach over the next three years.

Our fourth initiative is directed at improving the application and management of the automation support to the acquisition process itself. Over the past few years, the Army has made significant investments in automation tools and capabilities. These investments have provided increased productivity at the action officer level but have not yet benefited the management process itself. Basically, technology has changed faster than we have changed the way we do business. I believe that we can achieve additional gains in productivity just by revising our management process to exploit the technology in place.

As a first step, the RDA databases will be inventoried and reviewed. One way we can accomplish additional improvements is to coordinate and improve accuracy, reliability and availability of the RDA databases that we are now using. A significant amount of time and effort is expended in gathering and storing data in computers without necessarily achieving the benefits of the newer information management technologies or the increased accessibility through networking. The effort is starting at HQ AMC with a users group charged to make a detailed report on the databases currently being used and the information they track. With this information in hand, it will be possible to consider improvement in the acquisition management process, to identify unnecessary overlaps and to determine where consolidation of information will cut costs and eliminate conflicting reports.

Our objective is to find out what we have, to make sure it is useful and accurate and to increase user awareness and knowledge in how to access the information. This is a functional task not a task for the automators although automation tasks are likely to emerge. I believe that automation and electronic communication properly utilized can improve the effectiveness of our new acquisition structure and increase our sense of community. We need to apply the management attention required to make it happen.

Finally, to ensure that our guidance to the field reflects our new approach to acquisition management and support to the PEO/PMs, I have directed that the draft AMC regulation on Matrix support to the PEO structure be reviewed by the attendees of my RDA concept meetings and the resulting revised document be re-staffed with the field. This effort should be completed by July 1990. Developing a new culture takes time, but putting in place the proper policy and guidance is a key first step.

I realize that the implementation of some of these new concepts and ideas will take time and be achieved only as a result of basic cultural shifts. But I also know that the dedicated, hard-working people throughout AMC will, as they have in the past, do whatever is required to develop, field and support quality materiel for our troops.

Combating Obsolescence. . .

TECHNOLOGY INSERTION AND HARDWARE DESCRIPTION LANGUAGE

Extending the Field Life of the TD-660 Multiplexer

By Richard A. Riccelli,
Robert T. Vella, and
Bruce J. Zannetti

Background

Technological improvements in the electronics industry occur at a very rapid pace. What is considered "state-of-the-art" technology today will almost certainly be obsolete in 10 years. Consequently, a number of electronic components that are in production and readily available today may not be in five to 10 years.

A particular Army communications-electronics item is often in service for 25 years, and procurement of spare parts at the end of the item's life-cycle may become impossible due to technology obsolescence. This scenario occurred for the TD-660 Multiplexer. Consequently, the concepts of technology insertion (TI) and hardware description language (HDL) were applied to the TD-660 as a pilot test program in the battle against parts obsolescence.

The concept of TI is simply the replacement of obsolete components of an end item with the latest technology components. Hence, reliability and maintainability of older fielded equipment is increased while simultaneously reducing maintenance cost and spare parts procurement problems. The overall function of the end item remains unchanged after TI. Therefore, an end item updated by TI is capable of operating with older technology equipment.

Hardware Description Language

HDL is a computer-aided design tool that provides a functional description of digital electronic hardware using a computer-generated model. Since the computer model describes the design intent of the item, the use of present technology during redesign is simplified, thus reducing the cost of redesign.

Utilizing a top-down design approach, hardware description language is capable of modeling the end item and subsequent subsections of the end item to levels as low as individual integrated circuits. Should an end item or a subsection of that end item be plagued by parts obsolescence, the description language of the affected subsection would aid in the redesign and implementation of technology insertion.

TI Candidates

In January 1983, Undersecretary of the Army James A. Ambrose issued a challenge to update currently fielded equipment with "state-of-the-art" technology. The challenge became a tasking for the U.S. Army Communications-Electronics Command (CECOM) to identify possible TI candidates.

The TD-660 Multiplexer was identified as an excellent choice for the implementation of TI for several reasons. Since the late 60s, the TD-660 has served as the Standard Army Multiplexer/Demultiplexer Unit for pulse code modulated telephone carrier systems, as well as, being utilized in PATRIOT, SATCOM and Hawk Systems Shelters.

In 1984, the estimated field density of the TD-660 was 10,000 units. While many of these units were scheduled to be replaced by the fielding of Mobile Subscriber Equipment with Digital Group Multiplexers, it was projected that between 1,000 and 2,000 TD-660s would remain fielded in the late 90s. Therefore, the need for long term TD-660 supportability existed.

The physical and electrical characteristics of the TD-660 also lent themselves to partial redesign. The signal processing circuitry of the TD-660 is contained on 10 plug-in circuit panel assemblies. In the early 80s, two types of circuit panels were being utilized in the field. The panel assemblies, refer-

red to as either low series or high series circuit panels, were distinguished by the integrated circuit technology employed. The low series circuit panel assemblies were designed in the 60s and utilized TO-5 integrated circuit devices while the high series circuit panel assemblies were designed in the 70s and utilized dual-in-line package integrated circuits.

Even with the redesign to include 70s technology, parts obsolescence became a problem in several production contracts in the early 80s. These early parts obsolescence problems manifested themselves as panel assembly production delays. These delays were fostered by difficulties encountered in obtaining components or in several cases as test failures caused by parts substitutions, where original parts were no longer available. Consequently, in 1984, CECOM and ERADCOM (now LABCOM) initiated a joint effort for the complete redesign of the TD-660 panel assemblies utilizing the latest TI and HDL techniques.

The ultimate result is a substantial time savings during all aspects of maintenance — from depot overhaul to individual panel replacement in the field.

A market survey was performed to which AT&T Technologies responded with a proposal to perform the reengineering using an early HDL that was being developed as part of the Very High Speed Integrated Circuit Program. In September 1984, a sole source contract was awarded to AT&T. The contract included three phases. Phase I dealt with conceptual design feasibility. The task was to capture the design of the TD-660 using HDL and use that hardware description to redesign the panel assemblies. The new panel assemblies were to interface with the existing end item back plane wiring and power supply. Functionally, the TD-660 was to remain transparent to the changes.

Phase II dealt with prototype development. The task was to develop 10 sets of panel assemblies and demonstrate successful operation. Phase III was the unpriced production option. The task was to produce 800 sets of panel assemblies and perform complete First Article Testing.

Phase I was completed in January 1985. AT&T redesigned the 10 panel assemblies as a functional set as opposed to redesigning each individual panel as a functional entity. This additional design freedom allowed AT&T to achieve a design which drastically reduced the number of required components and manual adjustments. In all, the total number of panel assembly components were reduced by 59 percent (from 1469 to 604). The number of integrated circuits were reduced by 62 percent (from 150 to 60). The number of electrical adjustments required in the field were reduced by 57 percent (from 28 to 12). As a result, the predicted mean time between failure of the unit increased by a ratio of 2 to 1.

In September 1985, Phase II was completed with the delivery and successful demonstration of the 10 sets of prototype panel assemblies. In addition to the advantage of utilizing readily available parts, the alignment procedure of the new design was reduced from one hour to 10 minutes by virtue of reducing the number of manual adjustments. These adjustments were now accomplished automatically within the digital and phase lock loop circuit enhancements of the new design. Previously many of these adjustments had to be performed manually each time a single panel assembly was replaced in the field. The ultimate result is a substantial time savings during all aspects of maintenance — from depot overhaul to individual panel replacement in the field.

Phase III, the production option, was never exercised due to budgetary constraints. Another vehicle for funding a production contract had to be utilized. Additional funding to complete the production option was requested through a Product Improvement Program (PIP). Since the panels had to be replaced simultaneously, it was decided that a Modification Work Order (MWO) would be the most effective way to implement the fielding.

Although the PIP would expedite fielding, it was estimated that it would take more than one year to prepare the PIP package and receive full PIP approval. Rather than delay the program, a decision was made by a Senior Review Board to fund the production effort with stock fund money originally slated for obsolescent panels. When the PIP funding would become available, the stock fund money would be replenished. It was estimated this innovative approach to funding would save the program three years. The PIP called for the modification of 1,103 units to be accomplished at the direct support

level. This represents all the TD-660s that will remain fielded in FY95 and beyond.

A sole source production contract was awarded to AT&T in October 1987. The contract, currently in progress, calls for the delivery of 800 MWO kits, 185 initial issue spare kits and 2,480 individually packed depot spares. The contract also includes technical manual revisions and a complete Level III drawing package. The drawing package will be used in a fully competitive solicitation required to acquire the balance of the MWO kits and spares. Initiation of the procurement is scheduled to begin in the third quarter of FY90.

As of March 1990, AT&T has delivered 85 percent of the production hardware and is currently on schedule with the contract. An early version of an HDL, documenting the redesign effort, was received in September 1985. The Level III drawing package was approved in October 1989. First Article Testing (including Group C Environmental Humidity, EMI and TEMPEST tests) was approved in May 1989. Although First Article Testing was successful, verification of the panels in a shelterized system was deemed necessary to assure no anomalies during fielding. During August 1989, AT&T and the Production and Manufacturing Technology Directorate successfully accomplished this testing at Tobyhanna Army Depot. The reduction in alignment time was also verified at Tobyhanna.

Conclusions

As a result of this pilot program, the following was achieved: The concept of technology insertion and use of hardware description language were proved out as weapons to combat equipment parts obsolescence. The procedural aspects of TI are now documented for future use. The field life of the Army's TD-660, Multiplexer has been extended through the 90s and into the 21st century at a cost of approximately $10M. This equates to a cost of $9K per modified unit. This represents an estimated $21M savings as compared to utilization of a commercial NDI replacement for the TD-660.

Lessons Learned

The success of a TI project hinges upon its rapid implementation. If not implemented in an expeditious manner, the new design begins to suffer from another parts obsolescence condition. There are two ways to combat this. First, since TI is normally implemented later in the life cycle, sufficient kits, initial issue spares and replenishment spares should be procured simultaneously to support the remaining life cycle years. Second, procedural revisions must be implemented to streamline PIP approval and funding cycles. For this TI project, six years transpired from the time of development contract negotiation to projected initial fielding.

Initial experience gained with an early HDL version (pre DOD and IEEE Standard), illustrated it to be a viable design tool in the fight against parts obsolescence. Use of HDL or the later developed Very High Speed Integrated Circuit HDL also forces the designer to optimize the design or redesign in the case of TI. When the design is complete, HDL then documents the designer's intent (i.e., what the components and subassemblies actually do and what input/output parameters are utilized or significant to the design). If redesign is again required, this "design database" becomes the initial redesigning start point, thereby greatly reducing the time and cost associated with any redesign effort.

Hardware description language alone, however, does not stop parts obsolescence. Parts obsolescence is inherent with technological advance. HDL is only another design tool, which can be utilized to redesign circuitry when components are no longer available. HDL also cannot be used as a cost effective replacement for a Level III drawing package.

Since the data within the HDL goes beyond the normal top assembly/schematic level of detail, it is too detailed to allow cost effective "build to print" production. If HDL was furnished to a production contractor alone (in lieu of Level III drawings), the contractor would first have to develop the "Level III overview" before initiating production. It is more cost effective to buy Level III drawings once and to furnish them to all contractors.

In short, HDL is not a production tool. It is a design tool. The optimum utilization of HDL lies in procuring it from the original equipment developer (along with a Level III Drawing Package) for complex equipment with predictably long life cycles and utilizing it as a redesign tool when parts obsolescence sets in.

Contract Update

On March 26, 1990, 175 TD-660 TI MWO Kits were shipped to the 611th Ordnance Company, Miesau Army Depot, Germany. The initial gaining activity will be PATRIOT units. The competitive procurement of the additional 303 required MWO Kits with spares will also be initiated in the third quarter of FY90.

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TESTING HIGH TECH WEAPONS AT YUMA PROVING GROUND

By Chuck Wullenjohn

Introduction

The 20th century battlefield is a complex and dangerous place — just ask the combat veteran of World War II and the soldiers involved in the many other wars and conflicts that have taken place since that time. But the battlefield of the 1990s is more threatening and perilous than ever before.

Today, there are highly sensitive sensors of all types to locate targets and sophisticated electronic guidance systems to guide weapons to them with pinpoint accuracy. Computers compile and generate all kinds of tactical information, at speeds never known before. And modern weaponry is more threatening and destructive than at any other time in human history.

A fundamental component of U.S. warfighting doctrine — AirLand Battle — emphasizes the use of conventional forces in combat situations. But the complexity of the modern battlefield, coupled with scarce future resources and potential numerical superiority of enemy forces, requires the development of weapon capabilities that multiply the effectiveness of U.S. forces to defeat an enemy. At Yuma Proving Ground, AZ, weapon systems making use of highly sophisticated scientific technology are tested and evaluated with the goal of making the conventional Army of the future more effective than ever before.

SADARM

One such program is the Sense and Destroy Armor, or "SADARM", artillery round which is currently under development. SADARM is an outgrowth of smart weapons research which began in the early 1960s. However, unlike smart bombs which saw use during the Vietnam War and more recently in Libya, SADARM is a "fire and forget" artillery round which senses and destroys enemy armored targets. SADARM is primarily designed as a counter battery weapon used to destroy opposing self-propelled artillery pieces.

In counter battery warfare, a variety of highly sophisticated sensors and computers are used to pinpoint the location of enemy artillery batteries. Once identified and plotted, artillery fire is directed against targets to eliminate them. It takes an amazingly short amount of time to compute and identify the precise location of a firing enemy battery.

Full-Scale Development

Now in full scale development, SADARM projectiles are designed for use in 155mm howitzers and the newly deployed Multiple Launch Rocket System (MLRS). SADARM projectiles look like, and are fired, as other rounds. However, each SADARM round contains several sub-munitions that are expelled over the target area to independently acquire and destroy enemy weapons. At several hundred feet above the ground, each sub-munition fires an explosively-formed penetrator to hit an enemy howitzer at one of its most vulnerable locations — at the top. As currently envisioned, 155mm SADARM projectiles will contain two sub-munitions and MLRS projectiles will contain six. Early developmental testing at Yuma Proving Ground has shown SADARM to be a most promising and effective program.

SADARM represents a truly sophisticated use of modern technology to develop a reliable and potent weapon system. Properly testing, it demands personnel of the very highest professional caliber and data gathering and analysis equipment of even greater sophistication than the weapon itself.

The stringent data and accuracy requirements for SADARM testing were developed at the SADARM project manager's office, located at Picatinny Arsenal, NJ. Qualified technical experts at Yuma Proving Ground worked with these requirements to develop equipment and test procedures unique to SADARM. Yuma Proving Ground was a logical place to go, for the test center has many years of round-the-clock weapon and ammunition testing and experience.

Yuma Proving Ground's people are accustomed to designing test procedures to meet the singular requirements of a particular project. In this respect, SADARM was like many others. But SADARM test planning involved devising innovative solutions for what seemed to be — at least initially — daunting problems.

Systems Integration

"SADARM is a unique weapon because of the highly sophisticated level of its systems integration," said LTC Steven Moody, director of Yuma Proving Ground's Material Test Directorate. "What has been done, in reality, is that 'smarts' have been embedded in each sub-munition within the SADARM projectile. The job of our technical testers is to come up with equipment and techniques that can accurately gather data on how SADARM performs."

One of the advantages of conducting weapon testing at Yuma Proving Ground is that there is plenty of land and air space. In the case of SADARM, tests are conducted at trajectory distances ranging from six to 20 kilometers, requiring safety fans up to 70 square miles in size. As one of the

military installations in the United States — over 1,300 square miles in size — laying out a proper fan was accomplished easily.

Test Problems

But before test firing could begin, a number of highly technical test problems had to be solved. According to Yuma Proving Ground's project engineer, one of the most challenging was developing instrumentation capable of tracking the flight of each round. "There is extreme variation in the velocity of the SADARM round. It is going hundreds of meters per second as it leaves the gun and as little as 20 meters per second when the sub-munition descends into the target area," he explained.

"When propelled from the howitzer tube, SADARM rounds travel at a velocity ranging from 200 to 800 meters per second," remarked Arnold Gauna, chief of Material Test Directorate's Geodetic Section. At a pre-determined point during the flight, the sub-munitions are expelled from the projectile and a decelerating device called a RAID (Ram Air Inflation Decelerator), deploys from each sub-munition to significantly slow down its velocity and reduce its spin rate. Within a few seconds, the speed slows 15 times and a parachute deploys over the sub-munition to acquire a uniform descent and spin rate as it slowly drops toward the targeted area. The sub-munition is now fully armed and hunting for its prey.

"The most difficult time for us occurs when the velocity of the sub-munition transitions from 300 meters per second to 20," said Gauna. "To deal with this, we've devised a number of solutions."

Prior to each test, a computer model of the round's projected trajectory is generated using known data, such as the shell's drag characteristics. On the day of the test, additional information — meteorological and firing data — is added to produce as accurate a model as possible. The result is fed into computers and is used during the test by tracking mounts which can be configured with multiple sensors, including video cameras, film cameras, and event detectors. The specially configured mounts — called Kineto Tracking Mounts — track the projectile after it leaves the tube and the sub-munitions after they are deployed from the projectile and maneuver toward the target.

High Quality Data

"We're required to gather extremely high quality test data," remarked Gauna, "so we use the Kineto Tracking Mounts, located about 2500 meters from the target area, to track the progress of each sub-munition. As the round hurtles through the air, they feed a constant stream of data to a bank of computers in our Range Operations Center. These computers, in turn, transmit instructions to remotely operated "slave" tracking units in the target area."

Robert Mai, chief of the Material Test Directorate's Analysis Group, says the "optimal estimation" techniques used to combine various tracking measurements to generate the trajectory of the projectile and its sub-munitions was a major undertaking. "Mathematic and statistical methodology used to combine measurement data from a variety of sources is relatively new," said Mai. "Yuma Proving Ground was among the first test ranges to do it and we are the very first to make use of this methodology in a real-time environment."

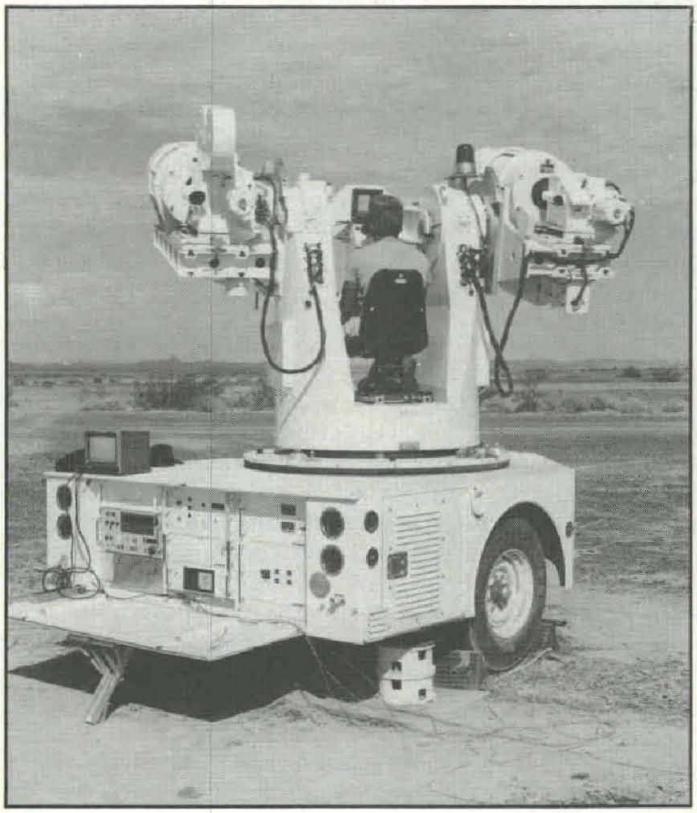
This work involves highly advanced computers performing calculations at a breathtaking pace," remarked Mai. "To give you an idea of the complexity of information we deal with, our computers perform approximately 15 million arithmetic operations per second during the test."

"Believe me, it was no small task to design instrumentation necessary to do the work we wanted," said YPG's project engineer. "And on top of that we need to crunch the data — during the test — to make use of the results almost immediately. This was a really tough nut to crack, but the people working here came up with some great solutions."

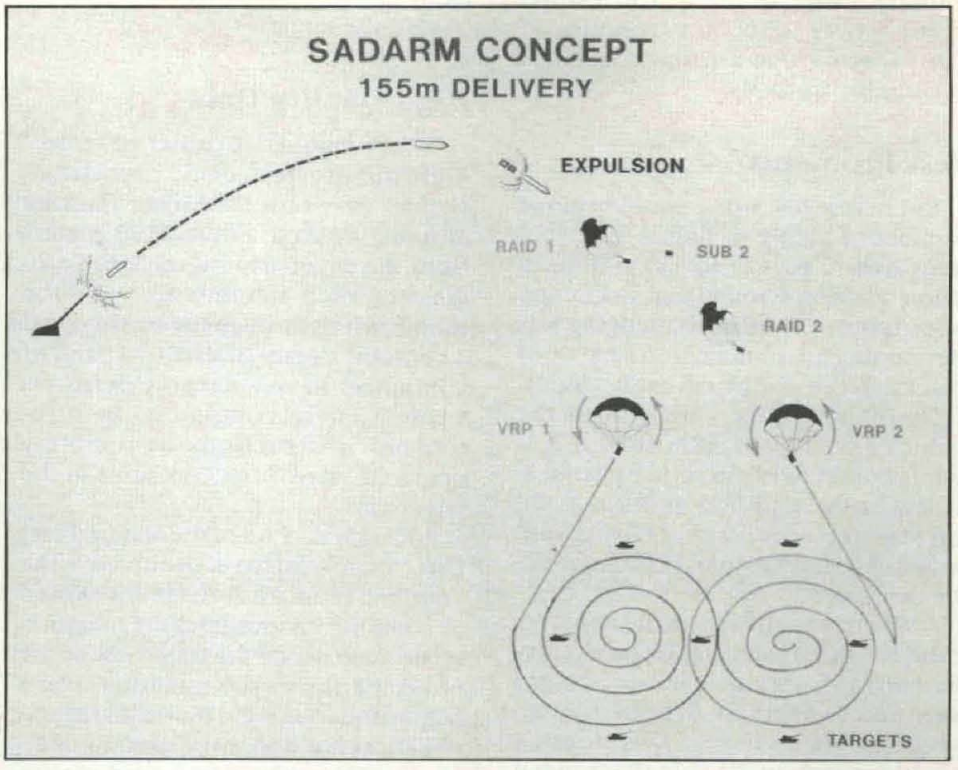
Other Challenges

There were many other challenges that also needed to be addressed to successfully conduct SADARM testing. One of these was devising a method for determining each sub-munition's attitude — how it is aligned in relation to the earth — at the time of firing over the target. Each sub-munition is only 6-inches in diameter and attitude data normally is obtained only for much larger objects.

"Most SADARM testing takes place in a non-lethal mode," said Analysis Group chief Mai. "This means that the



The operator of a Kineto Tracking Mount aligns himself into the proper position prior to the firing of a SADARM projectile many miles away.



SADARM Projectile Delivery: (1) The projectile is fired from the 155mm artillery piece to the left. (2) At a predetermined point, the SADARM submunitions are expelled from the rear of the projectile. (3) A RAID (Ram Air Inflation Decelerator) deploys from the rear of each submunition to slow its velocity and reduce its spin rate. (4) A Vortex Ring Parachute deploys from each submunition after the RAID detaches. The submunition acquires a uniform descent and spin rate as it slowly drops toward the target. Each submunition fires an explosively formed penetrator at a specific armored target when its sensors identify one.

sub-munitions don't actually fire at targets. If they did, it would cost taxpayers millions of dollars more. It's crucial, therefore, that we know the sub-munition is aiming properly as it goes through the firing procedure."

Since the sensors integrated within each sub-munition are programed to attack a specifically designated class of targets, it was imperative that proper targets be developed for testing to obtain realistic results.

Each sub-munition contains two sensors — an infrared sensor to detect temperature differences between the target and the background and a millimeter wave sensor to determine the target's shape. When the sensed characteristics of a target fall within the parameters programed into the sub-munition's "memory," the penetrator is fired and the target is destroyed.

To properly test the system, targets must closely match those programed within each sub-munition. The Directorate of Logistic's Metal Shop at Yuma Proving Ground began fabricating steel shells closely resembling self propelled howitzers in February 1989, to provide appropriate targets. The mock-ups are constructed from bulk one-half inch steel plate which is cut, shaped and wielded into the proper configuration.

To produce the proper heat signature in the target area, Yuma Proving Ground's Electronic and Environmental Simulation Branches designed heat generators to install within each mock-up. The generators raise temperatures at correct vehicle locations, such as at the exhaust system and within the engine compartment, to suitably "mimic" an actual enemy.

Each mock-up takes 10 days and approximately 700 manhours to fabricate, with a final weight of 22,000 pounds. A total of 36 howitzer shells will be completed by the time full scale testing begins.

Firing Table Testing

Firing table testing, involving the firing of over 2,000 actual SADARM and comparison rounds, is scheduled to begin later this year. Future tests might take the system as far away as the wilds of Alaska, in an attempt to replicate terrain conditions likely to be found where the system could be deployed. Safety, reliability and performance tests will ensure the transportability and handling safety of SADARM rounds, as well as their effectiveness. One of these tests will see the SADARM projectile dropped from heights ranging from seven to 40 feet to make sure it won't detonate improperly.

One of the more unusual tests devised for the project involved dropping sample sub-munitions from a helicopter hovering 1,600 feet above a large net. As the sub-munitions were dropped, the parachute deployed and the descent was studied to determine how well the desired spin and descent rate were maintained. Since prototype sub-munitions were quite expensive, this "soft catch" method of testing enabled testers to use the same sub-munitions repeatedly.

Conclusion

The intention of Yuma Proving Ground's test program, as it is for U.S. military test centers everywhere, is to ensure that American fighting forces are provided with the most reliable and effective weapon systems possible. The extensive test procedure developed for the Search and Destroy Armor program is but one indication of this sense of responsibility and professional dedication.

CHUCK WULLENJOHN is chief of the Office of Public Affairs, U.S. Army Yuma Proving Ground, AZ.

SUPPORTING THE ARMY OF THE FUTURE

By GEN William G.T. Tuttle Jr.

The following remarks, which have been edited and condensed to meet Army RD&A Bulletin format, were presented earlier this year by GEN William G.T. Tuttle, Jr., commander of the Army Materiel Command, as the keynote address at the Atlanta XVI Conference in Atlanta, GA. The Atlanta Conference brings together senior representatives from the Army and industry to discuss issues of mutual concern.

I want to focus my remarks on how the Army Materiel Command is positioning itself to support the Army of the future, but first I want to say thank you to members of the defense industry for the part you've played in supporting the Army.

Today's Army is the best we've ever fielded. That's the result of the cumulative efforts of many, many people — from the top-quality soldiers who train hard to stay ready for any contingency — to the people in this room and those you represent. You've worked long and hard to see that those soldiers have the finest weaponry and support equipment in the world.

In particular, you have helped the U.S. soldier stand guard in western Europe as a member of the NATO alliance. The U.S. Army is one of NATO's cornerstones, with our fine Army materiel a visible sign of our commitment and our technological edge. NATO has provided the environment that has led to the remarkable events we've witnessed in eastern Europe in the past few months. Our alliance's precept has been peace through strength, and we've succeeded. We kept the peace. Containment has worked. Our deterrence has worked. As President Havel of Czechoslovakia told the U.S. Congress in February, "you have helped us to survive until today, without a hot war this time but merely a cold one."

On other fronts, too, the Army has proven itself ready for anything, anywhere, and anytime. During the past year we played a continuing and important role in the Persian Gulf. At home we joined our fellow citizens to battle forest fire, hurricane, and earthquake. We're beginning to actively participate in drug interdiction.

In Operation Just Cause we showed what a carefully selected mix of forces can do. The Army and the other services proved themselves to be versatile, mobile, and lethal. They were sent to Panama to do a specific job together. They did it swiftly, professionally, and effectively. And they did so with the weapons and equipment that you provided. These soldiers had good things to say about those systems. Let me quote an Army captain whose brother works at AMC Headquarters. This is a post script from a letter to that brother: "Since you do Army stuff, try to pass this on to the HMMWV head honcho. One of my HMMWV'S was in an ambush (receiving end). All four tires shot out, driver still able to drive another two-plus miles to safety — Awsome vehicle. Saved six soldiers riding on it. Another HMMWV shot head-on, driver's glass shield receiving three-round burst, didn't shatter or crack, saved his face, stayed on course."

That's just one example of the "good stuff" that the Army-industry team has given the soldier.

There's no question that we're entering a new era. To gain some sort of perspective on where we are now and where we're heading, it might be worthwhile to look at where we came from, to look back 10 years to Atlanta VI and the environment of 1980.

The Army Chief of Staff, General Meyer, who sounded the warning about the "Hollow Army," spoke at Atlanta VI about the industrial base and his serious concern about whether it could support the Army. But he also spoke about the Army's plans to field the systems that are now at the heart of our warfighting capability.

General Guthrie pointed out the serious disparity between U.S. and Soviet defense efforts and Soviet moves throughout the world, especially in Afghanistan. It's important to remind ourselves that world tensions 10 years ago, especially between the two superpowers, were real. He noted the sense of urgency we all felt about our ability

to fight and sustain the battle but also noted that Congress was just then debating the defense budget — one that would give us some real growth. We are obviously well past those days of growing budgets, but look at what we did with those resources. No one can call it a "Hollow Army" today.

In sum, the people attending Atlanta VI — and some of them are here today — were faced with a very different and more hostile world environment. The Army did not feel fully confident that it could meet the threats it might face. Fortunately, we were just entering an era of tremendous progress. The soldier and this nation have reaped the benefits of modernized doctrine, superior systems, and greatly improved readiness and sustainment. I think most of us believe that the international environment has changed partly as a result of that commitment to a strong and ready defense.

But we don't have time to dwell on our past successes. We have to build on them. That means reshaping the Army to meet the changing threat, gaining efficiencies through the Defense Management Review and base closures, and living in a budget climate that is quite different from the one General Guthrie spoke of 10 years ago.

The Army will be smaller, but we will still have tremendous responsibilities. To meet those responsibilities, we must be more versatile, more deployable, more lethal, and more sustainable. Those of us in acquisition — within the Army and within industry — must position ourselves to support that future Army.

How is the Army Materiel Command approaching the challenge of positioning ourselves for the future Army?

First of all, we've taken a thorough look at what we do in this post-Goldwater-Nichols, post-Berlin Wall era. We've redefined our missions and refocused them to reflect Army priorities. I'm not going to run through those missions in any detail. We have a brochure available here that does that. But I do want to point out some areas within each mission that industry should be aware of as you do your long-range strategic planning and try to invest intelligently.

I look at AMC as the Army's super division support command. Our number-one mission and first priority is to equip and sustain a trained, ready Army, one that can meet any contingency.

We'll hear an industry panel this afternoon and an AMC/TRADOC report tomorrow morning on one of our most critical issues within this first mission — the reduction of operating and support costs. The more we can reduce these costs, the more resources we can devote to maintaining the necessary OPTEMPO required for the demanding training our soldiers need to stay ready.

I'm really pleased that members of our Army Science Board are studying O&S costs as part of their summer study and look forward to their report.

Our second mission is to provide equipment and services to other nations through the Security Assistance Program. Whether through the Army's foreign military sales or through direct sales, security assistance as a whole will grow in importance. We can have a strong and positive influence on friendly and allied nations — and a very cost-effective one — if we assist them in increasing their own ability to defend themselves and handle regional tensions. An added benefit is the opportunity to reduce the unit cost of some systems and, in some cases, to actually keep lines operating. It's a big program, with sales of $6.9 billion projected for FY90 — which is, by the way, equivalent to about half of our FY90 procurement budget.

Third, is our mission to develop and acquire the Army's non-major systems and equipment — currently a total of 335, not including conventional ammunition.

The fourth mission is to support the Program Executive Officers and their 114 Program Managers. If you were to ask me what I mean by that support, I'd say "soup to nuts' — every sort of support the PEOs and PMs need to develop their systems — lab and engineering support, cost analysis, quality assurance, resource management, legal assistance, personnel support, procurement, standards development, safety, test and evaluation, and much more. Our job is to give them the highest quality support obtainable; for they have the task of bringing to the field our next generation of weapons and support equipment.

One of the changes inherent in our resource uncertainties is that our future developmental programs covered in missions three and four won't always lead to full-scale production. That production decision may come late in development and depend on a number of factors — the superiority of the system on the battlefield, whether or not we can afford it, and the reaction of our adversary. We realize that there are important implications for industry and know that a number of you have questions we hope to answer in the next day and a half.

As an adjunct, I encourage industry to look at the possibilities inherent in international cooperative research, development, testing, and production. We can help pay our modernization bill by cooperating with other nations, especially through industry-to-industry teaming. I know these arrangements can be complex, but they are necessary.

I would also encourage companies to look at the potential for materiel change and product improvement. Right now we're working on 641 projects that total $32 billion, mostly for capability and safety improvements; but with declining RDA budgets, I expect we will focus more on O&S cost reductions.

Mission five covers that new technology — our work to define, develop, and acquire superior technologies for the soldier. While production and fielding will slow down in the early 1990s we still want to keep the tech base as strong as possible, with one to two percent real growth in 6.1, 6.2, and 6.3A.

Our Lab 21 proposal, which is now being reviewed at OSD, is designed to strengthen the tech base. The goal of the Lab 21 Study Group is to lay the groundwork for a world-class corporate lab, one that will be more efficient and productive and one that will be a real source of pride for the Army and this country. Lab 21 is just the first step in reorienting, reorganizing, and maybe relocating our operations to provide the Army with the world's most capable, most efficient, and most prestigious materiel command in the world.

Also falling under mission five is our effort to collaborate with the private sector, other public agencies, and nonprofit organizations to develop technology jointly, with the government retaining licenses for our use while our partners have commercial rights. Since these are cooperative efforts to develop and share intellectual property, they are far simpler to set up than procurements. Right now we have 40 cooperative

research and development agreements in the Army, with others in the works. It's a great program. I encourage any of you who might be interested to contact us.

Our sixth mission is to maintain our mobilization capability, which includes all our planning, war reserves, and standby capacity in supply and maintenance depots, ammunition plants, test facilities, arsenals, and other production facilities. This base and the larger industrial base of which it is a part were a major agenda topic at Atlanta VI; and they're on our agenda again today.

Base closures, realignments, and defense management reviews all have a heavy impact on mission six as we try to keep an adequate base within the Army and balance our level of risk with our resources.

We are equally concerned about the industrial and technology base that you represent. Maintaining the defense industrial base and the Army's own mobilization base doesn't come cheap and is likely to be a controversial issue for the next few years. We need to plan rationally as well as keep the base as warm as possible.

Our last mission really touches on all the others because it covers our work to improve productivity and quality of life. It looks more at how we work than at what we do. Within this mission I would include all of our Total Quality Management efforts.

I'm going down to Orlando next week to take part in Martin Marietta's Orlando/Ocala Plant Ceremony as they receive their official Army Contractor Performance Certification. This is the eighth facility to be certified. I hope others will work toward certification. (CP)2 is a program we're proud of. I think it's proof of your commitment to quality and our satisfaction with that quality — proof you can show when you apply for the Baldridge Award. In my view, future contracts and profits will go to those companies that work hard to stay competitive and to improve the quality of their products. Those who don't make that effort —those who aren't represented here —will find fewer business opportunities.

As for what we're doing internally to improve how we operate, I think we're making progress on several fronts. If we urge contractors to aim for quality and to certify that quality, we can do no less within AMC.

In tandem with our input to the Defense Management Review, we looked at almost 100 U.S. companies — some in defense but many strictly commercial — companies that have made noted improvements in their operations in recent years. We wanted to learn from the Motorolas and the Harley Davidsons of the country. We have a number of process improvements in the works as a result. Our Army Contractor Performance Certification Program is expanding to include process improvements.

In addition, just last month AMC's major subordinate commanders, some of their legal and procurement experts, and I got together at AMC Headquarters for what I called our acquisition warfighting seminar. We took a command-wide look at how we do business to find the best of our "good ideas" — both those we're using now and new ones worth trying. Our overall intent, of course, is to do a better job of developing contracts, administering them, keeping costs down, conducting reviews prior to making awards, and the like. We gleaned over 100 ideas and wargamed over 30 of those ideas. About one third now need to go to the Department of the Army or need more study, but — what's important — we can implement two thirds of them.

As just two examples, we OK'd significant changes in the business clearance review process; and we're encouraging the MSCs to work with related associations to review and restructure their specifications to line up more closely to commercial specs. TACOM plans to have the Society of Automotive Engineers review 25 specifications, 19 standards, and one handbook covering automotive component parts like belts, air cleaners, hoses, and rust proofing and realign them to be consistent with industry practices. We hope that others will follow. We'll do our second acquisition warfighting seminar in August to tackle the next group.

One of the hallmarks of the Total Quality Management philosophy is customer satisfaction. Let me end this rundown of our missions with a program that we're launching that will touch every mission and really benefit the soldier.

Later this month a group of industry leaders and engineers will visit Army units that are using and maintaining the materiel you produce. We're sending the first group — people who have current contracts in our heavy close combat mission area — to Fort Stewart, Georgia, and to Anniston Army Depot. They may get hot, dirty, and tired; but we hope they'll get a real feel for what it's like to use the systems they make. We also hope they'll go away with some great ideas. If these first visits work out, we hope to set up several more in the next year.

Our theme this year is "Facing Tough Issues." In the past decade we were in a "build-up" mode and accomplished a great deal. We needed industry's help, and you were with us all the way — especially when we needed immediate and intensive assistance — the kind of assistance you gave us in Grenada, in Panama, and when we had to get the Pershing into Europe so quickly. Too often people forget that ours is a joint effort for the soldier, but I can tell you that those in uniform here today have not forgotten that fact.

We're now leaving that era of build-up and need to face up to the changes that will come. If I could put all of the challenges we face into one, I'd say that those of us responsible for Army acquisition and sustainment must design our own future. But we can't design that future alone. We need the active participation, the ideas, and the insights of our industry partners. To make sure that that happens, we're working hard to remove not only the barriers to our being smart buyers but also to remove the impediments that hinder our dialogue, impediments that frustrate us all and force you to spend money needlessly to learn what we plan to do. We want to improve our relations and strengthen our communication.

Finally, when we look back — perhaps at Atlanta XXVI — how will we evaluate our efforts? Will we have been the designers, or will we see that other people did the designing for us? Will we have been successful in improving our essential dialogue? Will we be able to show genuine progress in how we acquire Army materiel because of our efforts to work together? And most important of all — will soldiers say good things about the materiel we give them — that it does the job well and keeps them safe?

I'm upbeat about the answers we'll give to those questions. In the meantime, we have a tremendous amount of work to do.

AN ALTERNATIVE TO THE PEO MANAGEMENT SYSTEM:

The Focal Point for CW/NBC Defense RD&A

By MAJ Denise Bachman
and Joseph Cartelli

The recent tide of worldwide political reforms, arms control treaty negotiations, and U.S. deficit reductions are certain to have a major impact upon the Army's budget plans and acquisition practices. These dynamic events will shape and form the cornerstones upon which the Army will conduct business in the foreseeable future.

Well before military analysts were able to clarify the new threat, legislators were making decisions to reduce force structure and spending on various weapons systems. One policy implemented to proactively respond in part, to these pressures, was the May 1989 establishment of the Focal Point for Chemical Warfare/Nuclear Biological, and Chemical (CW/NBC) Defense (excluding medical). It provides a management system for coordinating and executing the critical area of CW/NBC defense. It, too, promises to make a lasting impression in the field of Army acquisition.

Pursuant to this policy, the under secretary of the Army chartered the commander of the U.S. Army Chemical Research, Development, and Engineering Center (CRDEC) as the Army's focal point. The responsibilities acquired under this program encompassed the management and coordination of all research, development, and acquisition (RDA) matters pertaining to CW/NBC defense materiel.

The focal point replaced the program executive office for Chemical/Nuclear matters, which was disestablished in January 1989. Currently, BG David A. Nydam is commander of CRDEC; deputy commanding general, U.S. Army Armament, Munitions, and Chemical Command (AMCCOM); and the Army focal point for CW/NBC Defense.

Unlike a typical program executive officer (PEO), BG Nydam has two distinct chains of command. His focal point charter authorizes direct communication with the Army secretariat, the Army staff, major commands, subordinate commands, other services, federal agencies, and appropriate members of the international community on RDA matters concerning CW/NBC defense.

Notwithstanding, he works for the commander of AMCCOM, and reports through his chain of command on any issue, policy, or problem affecting the military mission for which AMCCOM is responsible. He is responsible for directing the program managers for smoke/obscurants, binary, and NBC defense systems as the focal point; yet, unlike a PEO, the commander, AMCCOM, is the senior rater for these PMs.

BG Nydam is authorized to conduct program reviews and function as the Army program decision authority as authorized in AR 70-1, System Acquisition Policy and Procedures, for non-major CW/NBC defense programs.

Additionally, he is authorized to reprogram 6.1 — 6.3A funds within assigned program elements, and reprogram 6.3B — 6.7 funds within and across assigned program elements up to the limits imposed by Congress.

He is also responsible for setting priorities for mission area programs through the Mission Area Management Plan, Materiel Acquisition Integration Team, and Long-Range RDA Plan (LRRDAP). In this respect, the focal point will facilitate planning, programming, budgeting, and execution for CW/NBC defense with deputy chiefs of staff for Headquarters, Department of the Army (HQDA) and U.S. Army Materiel Command (AMC). He will then ensure all aspects of the program are coordinated for the assistant secretary of the Army for research, development, and acquisition (ASA(RDA)).

The focal point will testify before Congress on the Army's non-medical NBC defense program when requested. He will also support and defend the program and budget plans for CW/NBC defense facility construction and operation.

As the focal point integrates programs across all commands, it is essential that he has oversight regarding all programs in the NBC mission area, as well as related programs in other mission areas, such as tech base, combat service support, and fire support.

He has been appointed proponent for AR 70-71, *NBC Contamination Survivability of Army Materiel,* a responsibility previously assigned to the deputy chief of staff for RDA. This regulation (currently under revision) will delegate to the focal point tasking authority to various Army staffs, agencies and MACOMs.

CW/NBC DEFENSE PROGRAMS

- Retaliatory CW Materiel (incapacitating, lethal, and anti-personnel weapons)
- NBC Defense Materiel (detection and warning; collective and individual protection; and decontamination equipment)
- Smoke/Obscurant Systems (including anti-materiel)
- NBC Survivability (hardness, compatibility, and decontaminability) of all mission essential materiel

In essence, the focal point will review Army programs to ensure that NBC survivability requirements are incorporated throughout the RDA life cycle of all mission essential materiel. This is an enormous undertaking and challenge.

To facilitate the communication between DA/ASA(RDA) and the focal point, a liaison office, comprised of a lieutenant colonel and a civilian, has been established at the Pentagon. Additionally, a one-person focal point liaison office is assigned to AMC headquarters. These liaisons provide DA, ASA(RDA) and AMC current information regarding issues and status of the CW/NBC defense program. Conversely, these contacts provide the focal point with a current source of information regarding the ever-changing Department of Defense (DOD)/DA budget policies as well as congressional inquiries affecting the CW/NBC defense RDA program.

One last major aspect of the implementation of the focal point concept is its impact on joint services, research, development and acquisition in the CW/NBC field. Pursuant to DOD directive 5160.5, the Army is designated as the lead agency for all military services on chemical matters. The establishment of the Army focal point ensures all resources devoted to CW/NBC RDA are identified, coordinated, and prioritized within the RDA community, and that a consistent and coherent DOD position is presented to the secretary of defense and the Congress.

As proponent for AMCR 70-67, Chemical/Biological Defense Equipment Acquisition, the focal point ensures that RDA is not duplicated by the joint services. BG Nydam serves as the Army member of the Joint Logistics Commanders' Chemical Biological Panel, and designates an Army representative to the Joint Service Review Group. The focal point organization will further enhance military capabilities in this joint services support role.

The focal point for CW/NBC defense faces the same demands and budget parrying as other PEOs who are confronted with today's dwindling acquisition dollars. However, a centralized and coordinated program will enable the focal point to develop and foster CW/NBC defense throughout the Army. This mission will greatly benefit not only AMC and the Army, but most importantly the soldier in the field.

MAJ DENISE M. BACHMAN, an ordnance officer, is assigned to the U.S. Army, Focal Point for CW/NBC Defense as an acquisition staff officer. She holds a B.S. degree from Slippery Rock State University, and an M.B.A. from Florida Institute of Technology.

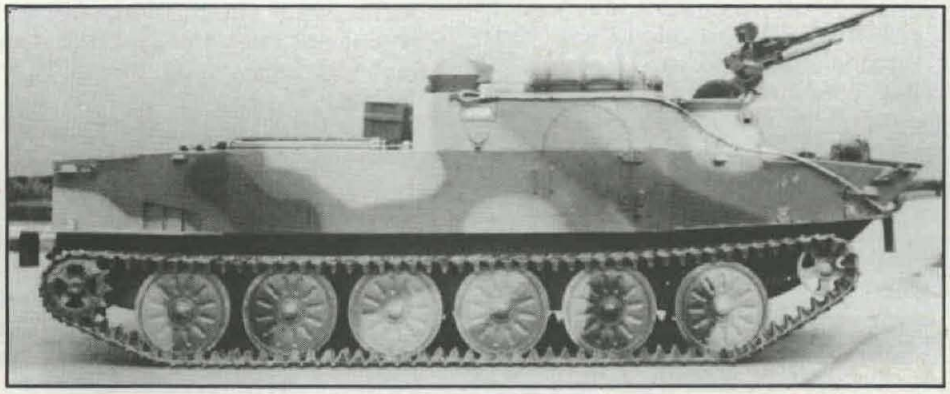
JOSEPH CARTELLI is currently a staff engineer to the U.S. Army Focal Point for NBC Defense. He holds a degree in chemical engineering from Manhattan College.

TYPE WZ 551 SERIES

(Above) This new wheeled LAV was seen for the first time in 1986. It is fully amphibious and propelled in the water by two shrouded propellers mounted on either side at the rear. Perhaps because of the current popularity of 6X6 wheeled vehicle designs it is gaining wide acceptance. Variants include: APC, a number of infantry fighting vehicles (IFV), ambulance, and possibly a 4X4 anti-tank and 8X8 122mm Self-Propelled Howitzer (SPH) version.

TYPE WZ 523 SERIES

This armored personnel carrier (APC) was first seen in October 1984. It is replacing the aging and obsolete Type 56 APC (a copy of the Soviet BTR-152). It is fully amphibious and propelled in the water by two water jets at the rear. No variants are known to exist except possibly a 4X4 version, although others are anticpated.



TYPE 77 SERIES

(Above) Introduced in the early 1960's, this chassis is similar in design to the Soviet BTR-50 PK APC. It is also known as the WZ 211 chassis and is used for the Type 63 tank. It is fully amphibious being propelled in the water by two water jets at the rear. It is currently produced in two versions: a type 77-1 that has three loading ramps to enable it to carry an 85mm type 56 gun, and a type 77-2 that has no loading ramps. Shown is the type 77-2 APC. Variants include: command, ambulance, fuel resupply, and cargo versions.

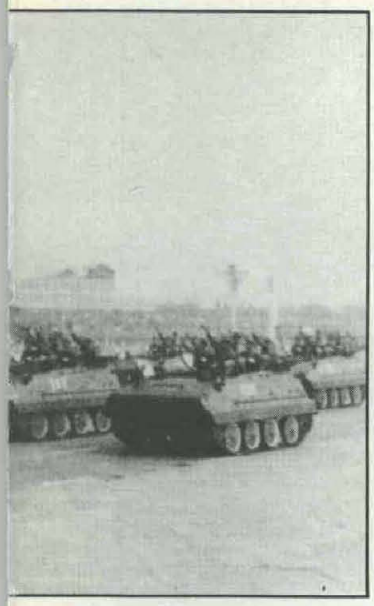
CHI
LIGHT A
VEHICLE

Editorial Note: The following i Bulletin series on foreign techn and text were provided by Robe specialist at the U.S. Army Foreig Charlottesville, VA.

The People's Republic of China has openly advertised a vast and complex array of Light Armored Vehicles (LAV). Considerable confusion often exists over where certain vehicles fit into the overall scheme of things. The Chinese have done little to reduce this confusion since they often change vehicle designations as they mix and match vehicles into different families in order to test foreign sales appeal.

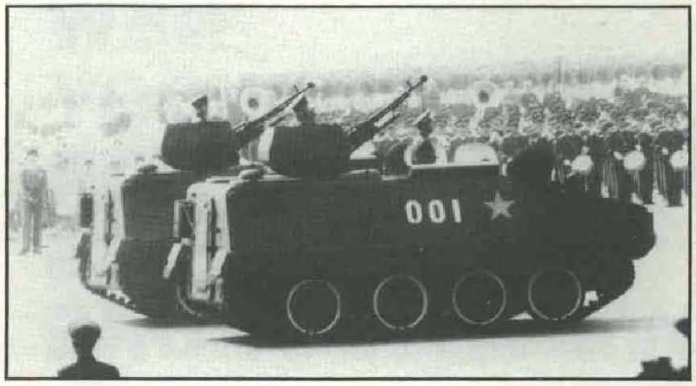
The accompanying photographs are intended to provide an overview of the type of families (called "series" by the Chinese) into which these LAV fit.

The photographs reveal the recognizable differences in basic chassis design including the major distinction between wheeled and tracked and the difference between axle and road



TYPE YW 531 SERIES

(Near Left and Right) Introduced in the late 1960's, this chassis is also called the type 63 or K-63 and is seen in significant numbers in the Chinese military. It is amphibious being propelled in the water by its tracks. Variants include: APC's, 122mm SPH, 130mm Multiple Rocket Launcher (MRL), 82 and 120mm Self-Propelled Mortar (SPM), anti-tank, command, ambulance, and psychological operations version.



NESE RMORED FAMILIES

s part of a continuing Army RD&A ological developments. The photos rt Nelson, an intelligence research gn Science and Technology Center,

TYPE YW 531 H SERIES

(Left) Introduced in 1986, this series includes the type YW 534 that looks identical but is slightly larger. This chassis, also designated H-1, appears to be the backbone of the modern Chinese LAV fleet. It is now designated as the "Type 85" Series. Variants include: APC's, IFV's, 122mm SPH, 85 and 120mm SPM, 130mm MRL, Armored Recovery (ARV), maintenance, command, and ambulance versions.

wheel spacing. Each of these basic chassis can be equipped with a large variety of armaments, including turrets, guns, etc. The photos include only systems that are currently in production. In some cases, for example, for the WZ 551 chassis, an 8 by 8 122mm self-propelled Howitzer (SPH) version has been advertised. Although this is not known to have been produced, it might be difficult to recognize this as coming from the same chassis series since it would have an extra axle and greater overall length.

This information has been primarily compiled from a large assortment of open source publications and advertising brochures and from analysis of the photographs and technical data accompanying them.

TYPE WZ 501 SERIES

(Above) Introduced in the mid-1980's, this is essentially a copy of the Soviet BMP-1. It is amphibious being propelled in the water by its tracks. Variants include: a variety of IFV turret and gun combinations, an APC, anti-tank, command, and ambulance version.

NEW TECHNOLOGY FOR LOGISTICS OVER-THE-SHORE

Integrating Modular Pontoon Systems with Air Cushion Technology

By Brian David

Figure 1.
Modular Pontoon Causeway Section (on left) and Bolted/Welded Causeway Section (on Right).

Introduction

Getting the beans and bullets to shore when port facilities are unavailable for offloading supply ships, is what Logistics Over-The-Shore (LOTS) is all about. Port facilities are usually prime targets in time of war and can be easily interdicted. Also, most underdeveloped regions of the world lack deep-water ports and adequate lift facilities required for offloading deep draft supply ships.

LOTS involves the discharge of military equipment and supplies from offshore strategic sealift vessels and transportation of these items ashore with lighterage. LOTS provides the unified commander with the ability to move cargo over the shore or unimproved beaches that are in close proximity to road networks and cargo staging areas.

Improved lighterage, cargo transfer, and air cushion technologies can provide tactical advantage despite enemy control or damage to deep-water port facilities.

According to the Army's Posture Statement FY90/91, "Strategic sealift is required for 95 percent of our force deployment and resupply." In many theaters, the major portion of these forces will be delivered during a LOTS operation. Cargo and supplies delivered during a LOTS operation include: fuel and fresh water, wheeled and tracked vehicles, pallets, and containers.

The Belvoir Research, Development, and Engineering Center (BRDEC) Marine Development Team is currently developing three new and innovative marine systems for application to U.S. Army LOTS missions: the Pontoon Air Cushion Kit (PACK); the High Sea State Container Transfer System (HISEACOTS) and the Air Cushion Fly-on/Fly-off Platform.

Mission Problem Areas

The LOTS operation has historically been hampered by three problem areas: shallow beach gradients, cargo offload in high sea states, and unfavorable surf or current conditions. These three areas have a major influence on the effective and safe transfer of men and materials to shore. Our current capabilities to conduct any kind of productive LOTS operation where these conditions exist is questionable. However, things appear to be turning around.

The LOTS mission has received increased attention lately. Both the command and logistics community supports new LOTS equipment. One of the Army Plan (TAP) mid-range objectives is to continue strategic mobility and deployment initiatives in the LOTS area. Also, improving the LOTS capability has been identified as a major logistic supportability goal in the Army Technology Base Master Plan (ATBMP).

Pontoon Air Cushion Kit (PACK)

Approximately 90 percent of all usable beaches in strategically located

areas of the world have beach gradients of 1:60 or flatter. (A 1:60 gradient is one in which the beach level drops only one foot for each 60 feet toward open water.) Given this high probability of a flat beach gradient to work across, certain types of Army lighterage become marginal performers because they cannot be brought close enough in-shore to drop their loading ramps on "dry" beach due to their loaded draft condition.

The U.S. Army and Navy presently utilize modular pontoons, which are bolted and welded together, to construct field-assembled causeways, causeway ferries, warping tugs, and Roll-On/Roll-Off (RO/RO) discharge facilities for use in LOTS operations. The U.S. Army in May 1989 awarded a contract for the acquisition of commercially available quick-lock ISOLOG modular pontoons. These modular pontoons are compatible with International Standards Organization (ISO) container dimensions for transport by containerships. Figure 1 shows a typical 80 foot by 24 foot causeway section made up of ISOLOG modular pontoons.

The PACK has been designed for the purpose of outfitting the Army's modular pontoon causeway sections with a cushion skirt system and autonomous air-supply unit for critical amphibious operations. The PACK will also be used for floating causeway emplacements over shallow beach gradients. The air cushion skirt system enables the barge to support its own weight and that of the equipment to be offloaded with a cushion of pressurized air, thereby eliminating the problem of lighters grounding far offshore when operating over shallow beaches.

The PACK system can be installed on, and removed from, a modular causeway section on the deck of a ship or on land. It requires no modification to the causeway section; the skirt system and air-supply units attach directly to the pontoon's locking mechanisms and deck fixtures. It is transportable in a standard 40-foot container.

The PACK is equipped with two lift-air, skid mounted, supply units that use commercial centrifugal fans and diesel engines to provide the pressurized air for the skirt system. A PACK equipped causeway section can carry the Army's heaviest piece of equipment (the 90.5 ton (140-ton capacity) beach crane) for transportation to the beach.

Army watercraft assets such as the Lighter, Air Cushion Vehicle — 30 ton (LACV-30) can be used for moving the PACK to the shore. Model tests conducted in September 1989 at the U.S. Naval Academy, using a one-eighth scale PACK model, confirmed that the PACK, loaded with the 90 ton crane, could be pushed to the shore using the LACV-30 as the prime mover. The Lighter, Amphibious, Resupply Cargo — 60 ton (LARC-LX), soon to be displaced by the Army's newest high speed air cushion lighter, the Lighter, Amphibian Heavy-Lift (LAMP-H), would make an effective

Figure 2.
Artist's Rendering of the Packloading Containers Alongside a Crane Ship.

tow vehicle, giving the older lighter a new lease on life.

The PACK will provide the Army the ability to install and operate the modular causeway system over 90 percent of the worlds LOTS beaches. The PACK represents a low cost, logistically supportable materiel improvement for the modular causeway system that will significantly enhance current LOTS capabilities.

A full-scale PACK technology demonstrator is currently being fabricated and will be delivered for testing in March 1990. A U.S. Army Training and Doctrine Command (TRADOC) sponsored Concept Evaluation Program (CEP) test is scheduled for August 1990 at Ft. Eustis' 3rd Port in Virginia. Planning is also underway to include the PACK in the FY91 J-LOTS III exercise. Figure 2 gives an artist's rendering of the PACK loading 20 foot containers alongside a crane ship.

High Sea State Container Transfer System (HISEACOTS)

Offloading of containers and heavy outsized equipment in high sea states or large ground swell (waves identified by their long wavelength and low steepness that arrive from distant storms), is severely limited by the extreme movement of the lighter relative to that of the crane ship, and the pendulation motion of the cargo.

Current LOTS offloading operations virtually cease in sea states three or above. (Sea state three is characterized by a wave height of 3 to 5 feet from crest to trough.) Unfortunately, a study conducted by the Naval Coastal Systems Center showed that sea state three or higher is likely to occur 75 percent of the time for strategically located LOTS sites worldwide.

A lack of synergism can best describe the weak link in the LOTS high sea state/cargo offload operation. Individually, all of the Army's lighterage and sealift crane ships can operate and maintain adequate headway in sea state three. However, the system fails to be productive when they are required to interface for offloading cargo. Figure 3 shows offload productivity decreasing sharply for sea states greater than one during the J-LOTS exercise in October 1984.

The HISEACOTS is designed to stabilize the ship/lighter interface in high sea states or ground swell. It will enable cargo offload operations to continue in sea states up through three combined with a crane ship roll of four degrees.

The HISEACOTS consists of a 120 foot by 56 foot platform, moored to the crane ship, that is made up of ISOLOG modular pontoons previously discussed. This platform is outfitted with a gantry crane designed to mitigate cargo heave and pendulation motions.

The gantry crane is designed to transfer containers weighing up to 50,000 pounds, by using a friction bar truss assembly that both orients the container and reduces its pendulation. The gantry crane is also fitted with a spar assembly that consists of two hydraulically-activated outrigger arms. The spar is designed to mate with the HISEACOTS-designed container slings.

The arms of the outrigger have been designed to be operated differentially which allows for an effective amount of container-spotting capability which is especially critical for eccentrically loaded containers.

In the final phase of the loading operations, the gantry crane, which is mounted on a slide-rail system, is moved into position over the lighter, and the outrigger arms are lowered until the container comes to rest on the deck of the lighter.

The gantry crane weighs approximately 20,000 pounds and is of modular construction for road, rail and sealift transportation. Additional reductions in motion are gained by taking advantage of the amphibious capabilities of the air cushion lighter (i.e., LACV-30, LAMP-H, PACK).

By flying onto the platform, the lighter is no longer in relative motion with the crane ship. The HISEACOTS can be deployed by containership, although a fully-assembled delivery via a SeaBee barge ship is more likely. Figure 4 shows an artist's rendering of the HISEACOTS with a LACV-30.

Significant increases in productivity (40 percent) and safety are anticipated with the HISEACOTS. These improvements are mainly due to: reduction of time consuming lighter/cargo ship mooring procedures; reduction in lighter roll/heave motions when stationed off-cushion on the larger ISOLOG platform; reduction of cargo heave/pendulation; increased standoff distance from the flare of the cargo ship to avoid contact with the LACV-30/

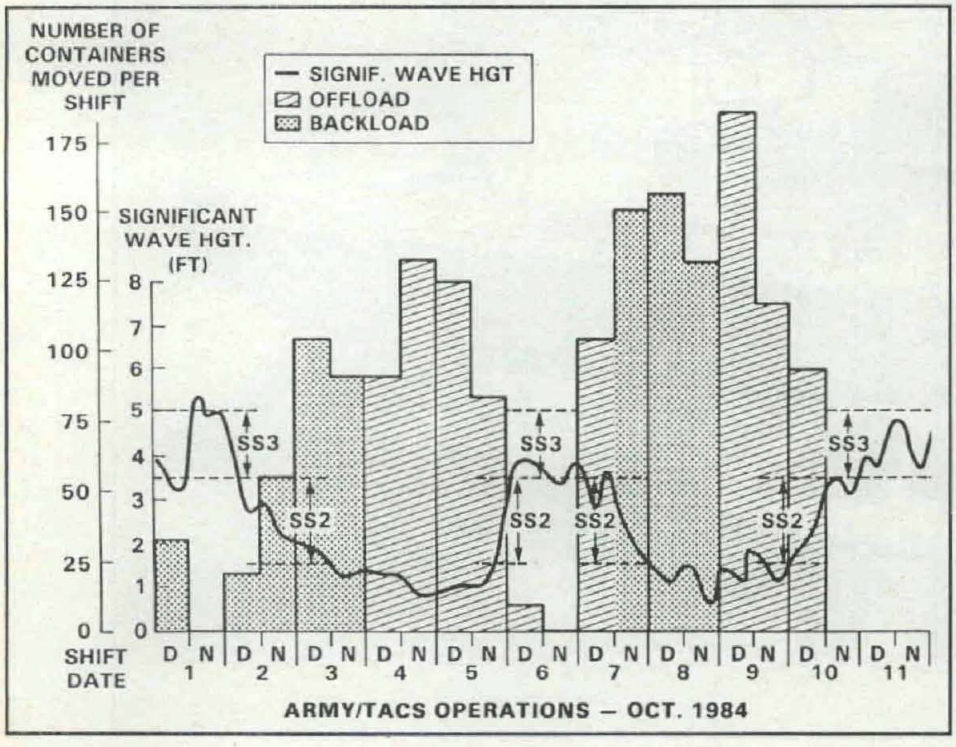


Figure 3.
Cargo Offload Productivity Decreasing Sharply for Sea State Greater than Two.

LAMP-H air propellers; and preloading of a container onto the gantry crane when the loading que is empty.

Land based tests at Fort Belvoir on the gantry system are scheduled immediately upon completion of the structure. A full-scale operational technology demonstration of the HISEACOTS is envisioned for the FY93 J-LOTS III exercise.

Fly-On/Fly-Off Platform

An alternative role for the HISEACOTS is that of an air cushion fly-on/fly-off platform for aiding RO/RO transfer of wheeled and tracked vehicles from the Army's RO/RO Discharge Facility (RRDF). The RRDF is designed to provide a vehicle transition between a commercial RO/RO ship and displacement lighterage.

Current RO/RO operations are limited to conventional displacement lighters. This is attributable to the vulnerability of the air cushion skirt system, the lightweight aluminum construction, and the poor maneuverability of most air cushion vehicles.

Operating without the gantry crane, the HISEACOTS platform performs two functions which allow the safe transfer of vehicles from the RRDF to the air cushion lighter: the platform aids in the positioning and mooring of the air cushion lighter; and the platform supports the air cushion lighter during the vehicle transfer. This effectively couples the two systems and virtually eliminates relative motion between the platform and the air cushion lighter during the transfer of vehicles.

The air cushion fly-on/fly-off platform is expected to be used without disrupting displacement craft RO/RO operations. Also, the air cushion platform will act as a breakwater and in some instances improve offloading operations in higher sea states for conventional lighterage operations at the RRDF.

The Air Cushion Fly-On/Fly-Off platform will give the U.S. Army and the Navy a first time capability for safely and effectively offloading RO/RO onto air cushion vehicles from the RRDF.

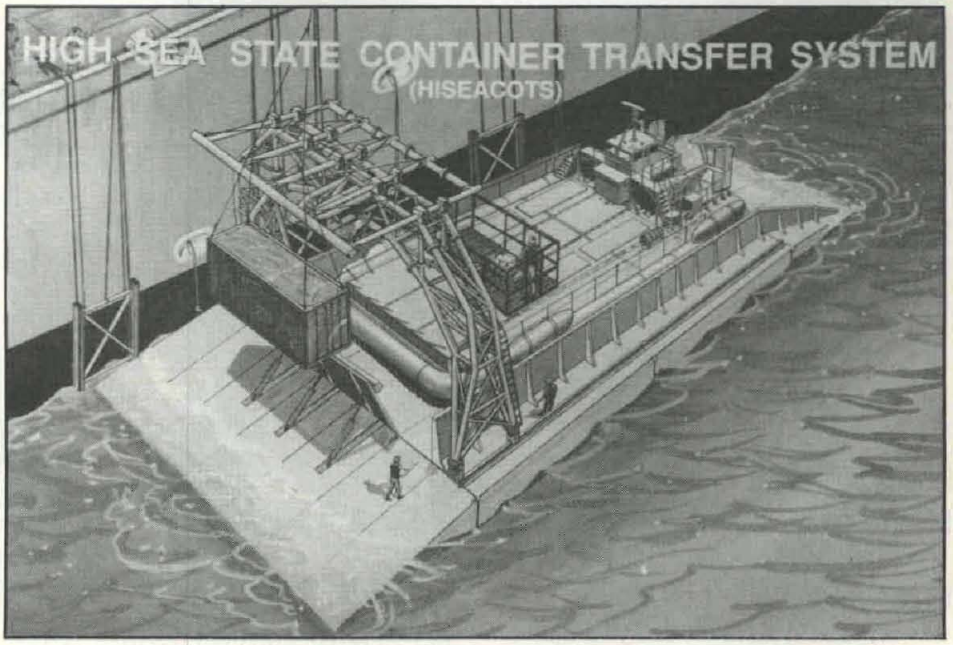


Figure 4.
The HISEACOTS and the U.S. Army LACV-30.

The ISOLOG platform will be compatible with all of the services fielded and developmental air cushion lighterage for increased LOTS productivity and flexibility.

A joint Army/Navy technology demonstration of the Fly-On/Fly-Off modular pontoon platform is scheduled for August 1990. A joint Army/Navy test of the Fly-On/Fly-Off platform is also planned for J-LOTS III in 1992.

Conclusions

With rapidly changing world events and increased third world military capability, our national strategy requires a modern and mobile strategic land force for deterrence and defense. These changes emphasize the need for a LOTS capability to resupply our forces in areas of the world where adequate port facilities are either inadequate or nonexistent.

The PACK, HISEACOTS, and Air Cushion Fly-On/Fly-Off Platform will ensure that the Army can operate over shallow beach gradients and in high sea states to resupply our soldiers anywhere in the world.

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NEW CONCEPT FOR ALLOCATING ARMY INVESTMENT FUNDS

By Dr. Kenneth J. Oscar

Introduction

With the present commitment of the administration and the Congress to reduce military expenditures, the Army faces a great challenge in ensuring there will be sufficient funds available to develop and procure the vehicles and weapons needed on tomorrow's battlefield. In my view, we will meet this challenge successfully only if we change the way we allocate our funds.

Size of the Force

The mission of the Department of Defense is to maintain adequate, well-trained and equipped military forces to defend the United States and its allies against hostile action. The budget required to achieve that mission depends upon the size of the force, which in turn depends on the likely threat it must be ready to contend with and the geographic area to be defended.

The number of sailors and airmen required to meet assigned missions is in direct relationship to the number of ships and craft needed, which in turn, is also directly related to the area to be guarded. The Navy, for example, is required to defend the waters of the Atlantic and Pacific, two large ocean masses. It must also protect the Mediterranean, and the smaller waters near the Middle East and Central America. This great expanse of sea dictates the number and types of ships required — aircraft carriers, cruisers, destroyers, submarines.

There is also a need to have a certain number of vessels for contingencies and for repair and maintenance. While it is often debated whether it is better to have a few large aircraft carriers or a larger number of smaller ones, and there are numerous views concerning the exact ratio of submarines to cruisers or destroyers, there is a general agreement on the total size of the fleet required. Currently that number is 600 ships which, of course, dictates the number of Naval personnel needed to man and support them.

There is a similar construct for the Air Force. The vast airspace that must be defended determines the number of aircraft that the Air Force has to have available. As with ships, the number of airplanes dictate the number of Air Force personnel required to man and support them.

This relationship in the Army is not as straightforward. The Army defends land masses. Land, however, is not as homogeneous as airspace and sea. Land is dotted with towns and cities, not to mention smaller bodies of water, forests, mountains and hills. There are also political boundaries, and areas in close proximity to various threats. In the case of the infantry, the number of soldiers dictates the number of rifles required, not the other way around.

Tanks and armored personnel carriers can go quite a bit faster and cover more area than soldiers on foot, but are limited in trafficability. The Army has fire support, helicopters, artillery, multiple rocket launchers, and indirect fire weapons of all types and ranges.

Because the Army does not have large self-contained ships but rather numerous small vehicles, logistics support is a tremendous problem requiring trucks and other vehicles to continuously pass ammunition, fuel and other supplies forward.

As with the Air Force and Navy, the areas to be defended dictate the size and composition of the Army — however, the correlation between equipment and the number of soldiers is not as direct. It is clear that to cover a given area, a certain number of task forces or battalions or divisions are required. The exact number of soldiers and equipment in those units depends a great deal, however, on the location of the battlefield, type of terrain, or the strategy of the leaders.

The Army is much like a police force in a town. The ideal is to have a policeman walking a beat, but one cannot afford that many; so some ride in cars and are able to cover even larger areas but not as thorough or able to interact as well. It is clear that there is an optimum mix needed.

Makeup of the Army Budget

The Army budget consists of three main parts. The first includes salaries

and benefits of the active force and retired soldiers. This is, by far, the largest portion of the budget and is fixed by the size of the current and retired force.

The second part of the budget provides for the upkeep and training of soldiers and the operation and maintenance of their equipment. Again, this portion is determined by the number of soldiers and number and types of equipment requiring upkeep and maintenance, and the amount of necessary training, ammunition, fuel, etc.

The third and by far the smallest segment of the budget is for investment and is divided into two parts. The first is for procurement. It is used to buy new equipment and parts and presently equals $14 billion a year. The second part supports the research, development, testing and engineering (RDTE) and is about $5.4 billion a year. These funds are to develop and test new equipment or to improve equipment already in use. This appropriation is also to reduce equipment costs when possible.

There is careful scrutiny at all levels of the Army, Defense Department, and Congress over how the investment funds are divided and spent. Much debate is centered around what hardware to procure and what products should enter into development "for future enhanced equipment." In reality, much of the RDTE and procurement investment funds are not spent to improve current equipment but to replace old equipment as it wears out in the field.

The decisions as to how the Army's RDTE appropriation is spent are made much the same as with your household budget. You buy a new car because your present car has worn out. Or perhaps you buy it because your technology has produced a new car that offers much better performance and fuel economy, and you decide it is worth investing in the new vehicle before your old one wears out. You may also decide to buy it because of a change in perceived threat from your neighbors. They may have just bought a new luxury car and you feel that to keep up with them, you must counter their threat by purchasing a new car sooner than normal.

As with your home budget, the Army has only a certain amount of money available each year for the purchase or development of new equipment. The ideal, of course, would be to replace the equipment with the most modern hardware possible each time it wears out, and do it at a rate that would ensure a reasonable price and keep the plants running continuously.

But often the threat changes rapidly and forces us to continually buy new equipment before the old equipment has worn out. Unfortunately, our technology push and desire for the optimum performance sometimes also force us to do this. Because we have a fixed amount we can spend, we do not always have enough money to completely replace all the old equipment. For example, we may introduce a new helicopter slowly to keep our per year cost down, and it may be many years before we buy enough to completely replace the old ones. Meanwhile, we may product-improve or enhance the capability of the old helicopter to keep pace with certain threats, or safety or survivability improvements that we have learned.

On occasion, we introduce new equipment so fast and in such limited numbers that we often have three or four generations of equipment in the field and two or three different types of models of each. This considerably increases our maintenance and training costs.

One of the key problems the Army faces is how best to allocate its scarce RDTE and procurement resources. How much of these funds should be devoted toward air defense versus artillery or armor, and when should we replace equipment before it is worn out to gain the technology advantage or to keep up with the changing threat?

New Method for Resource Allocation

The key to allocating the Army's procurement resources is to quantify three key factors for each type of equipment on the battlefield. First, we need to know each piece of equipment's predicted life expectancy. We then need to add this up for all equipment in the Army to get the minimum cost of replacement. This portion of the RDTE and procurement budget is fixed much like the other two major categories of maintenance and soldier pay. Once we identify the amount of these funds, we know how much is left in the procurement and RDTE accounts which is discretionary. This discretionary money can then be allocated to improve existing equipment or introduce new hardware sooner than its normal wear-out time. The decision to replace it early is based on one of the previously mentioned reasons. Either the threat has changed and the fielded equipment is not adequate to meet it, or technology has advanced so that we can improve the equipment and enhance its performance. In either case, the result would be improved performance of our fielded equipment because of a threat.

Each of these performance gains would yield a reduction in the overall sustainment cost which can be balanced against the cost of procuring equipment earlier than its normal wear-out rate. For example, if technology yields a truck which can carry more cargo, not rust out as quickly or get more miles per gallon, it would ultimately mean these new trucks would decrease our sustainment costs. We should then be able to balance the cost of introducing new trucks with improved performance earlier than normal into the fleet versus the reduction of total life-cycle support costs. The same is true of a weapon. If technology allows us to make a cannon or tank that will shoot farther or pierce an enemy tank better, we should be able to calculate in a war game how this improved performance would allow us to reduce the size of our force, the number of tanks and personnel, which would, in turn, reduce our sustainment cost. We then could again figure the ratio of introducing tanks earlier than the wear-out rate versus the reduction of the sustainment cost. The same is true for countering a new threat, if the enemy should develop a new antitank missile capable of piercing our tanks at a greater range, this would mean we would need to replace tanks faster on the battlefield and increase our cost.

The decisions as to how the Army's RDTE appropriation is spent are made much the same as with your household budget.

One of the key problems the Army faces is how best to allocate its scarce RDTE and procurement resources.

If we could introduce a new tank with a better armor, it would cost us a certain amount of money to do this ahead of our normal tank replacement rate. This increased cost of replacing the tank earlier than normal can be calculated against the reduction in support cost in the long run. Each technology improvement would yield an increase in battlefield performance.

The cost of introducing these new improvements early can be calculated. These increases would all be offset to some extent by reductions in sustainment cost of the replaced systems. The ratio would be different for each type of equipment, depending on the reduction in sustainment cost, how close the equipment is to wearing out anyway, and a number of other factors. These ratios can then be used to decide where to allocate the discretionary funds over the minimum that is required to replace each of the various categories of equipment as it wears out.

If such a strategy is not followed, we will buy equipment each time the threat changes slightly or technology offers a small improvement and will not provide money to replace worn-out hardware. Eventually we will not be able to afford to replace worn-out equipment at all, and we will go bankrupt.

Budget Allocation Proposal

I propose that each project manager determine the funds required to both replace equipment as it wears out and maintain serviceable equipment currently in use. This calculation will vary with each type of equipment. Commercial hardware that is readily available from numerous vendors — such as computers, trucks or radios — may be best acquired on multiple-year contracts to minimize cost and obtain the latest technology.

In the case of unique military items such as a tank where there may only be one or two vendors, it may be necessary to buy the equipment slowly over time to keep the factory operating and avoid expensive close-down and start-up costs.

Each of the estimates would be tallied to determine for the Army the overall minimum amount of funds required to maintain the current capability of fielded equipment and to replace it as it wears out. The remainder of the allocation would be discretionary and would depend on the merits of each proposed improvement.

Each proposal to replace or improve an item prior to its wear-out would be required to show the cost over minimum which would be necessary to replace this equipment early, fully describing the benefits in performance it would yield. The proposals would need to determine the reduction in sustainment cost due to the performance increase. These figures would then be audited by TRADOC, using tactical war games when appropriate.

All these ratios with inputs from the developer would be compared and allocation made according to the return on investments. From time to time, technology will yield a whole new type of equipment which must be added to the force and will replace no current piece of equipment. In addition, TRADOC may propose a new force structure or way of fighting or different equipment ratio on the battlefield that will also require changes to the base case. This could be adapted to change the current minimum sustaining rate which would, in turn, change the amount of discretionary funds available from year to year.

I propose this new fund allocation method replace the current practice of treating every line in the procurement budget as a new capability and evaluating the battlefield performance independently each year, with no account of the optimum replacement rates or real minimum costs for new equipment.

This current policy is like trying to continue to buy rental property without setting funds aside for upkeep. In due time, you cannot afford to keep your home in good repair and are forced to go bankrupt. The Army is currently continuing to buy new high-tech helicopters, weapons, tanks, etc., but cannot afford to replace its current equipment which is wearing out. This new proposed method would first account for upkeep of current equipment and then use a consistent methodology to evaluate which hardware to replace early.

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By Richard Schaffer,
Professor Charles H. Helliwell,
and Professor Joseph Murtha

UNIVERSITY RESEARCH INITIATIVE PROGRAM IN ADVANCED CONSTRUCTION TECHNOLOGY

Introduction

The U.S. Army owns approximately $175 billion worth of facilities located on over 200 major installations worldwide. These installations consist of over 12.5 million acres of real estate. The Army owns over 39,000 miles of paved surfaces, 27,000 miles of utility lines, and 1.8 billion square feet of building space. Over 60 percent of the Army's $175 billion physical plant is over 30 years old and over 30 percent of the facilities are obsolete. They do not meet today's quality standards.

The Army has a strategy to revitalize its facilities to meet these requirements. A critical element in this strategy is driving down the annual repair and maintenance costs to free money for revitalization.

In FY87, the Army spent $4.1 billion on operating and maintaining its installation infrastructure. The largest portion of this funding (about 40 percent) was spent on maintenance and repair activities. Operating Army facilities accounted for another $1.2 billion (27 percent) of the funding and another $1.1 billion (25 percent) was spent on engineering services in support of installation operations. This represents six percent of the Army budget in FY87. Yet, this funding can address only 80 percent of annual repair and maintenance costs and has resulted in a backlog of validated new construction needs of $20 billion.

The Army infrastructure funds must be more productive. This translates as "The U.S. construction industry must be more productive!" Eighty-five percent of the design and 100 percent of the construction are performed by the U.S. construction industry under contract to the Army. Clearly, the productivity of the U.S. construction industry has a direct impact on the ability of the Army to provide the facilities required to perform its readiness, training and mobilization missions, and the productivity of this industry is dependent upon the vitality of its technology base.

Research that is of the large scale, sustained, fundamental, high-payoff, long-term character is required to achieve the quantum leap in technology needed to revitalize and better support the U.S. construction industry. Such large-scale research must be given time and stable funding to achieve fulfillment. It is high risk but can and does provide high-payoffs.

Advanced Construction Technology Initiative

Under the University Research Initiative, four broad objectives were identified to enable advancement in the technologies necessary for facilities modernization. The first objective is to significantly advance the construction science and technology base through innovative basic research investigations and to infuse this advanced knowledge and technology into construction engineering.

The second objective is to increase the number and quality of American students with advanced education and training in construction technology. The establishment and improvement of university-Army-laboratory cooperation is a third important ingredient, and fourthly, the necessary research equipment must be provided.

The approach to achieving these objectives was to establish, under a full and open competition procurement process, one or more centers of excellence in advanced construction technology at degree granting institutions of higher learning. As a result of this process, centers were established in 1986 at the University of Illinois at Urbana-Champaign and Massachusetts Institute of Technology, each to be funded for five years. Each center established a program for acquiring and building state-of-the-art instrumentation, graduate fellowships, restricted to U.S. citizens and exchange of information/personnel between the centers and the pertinent Army laboratories. The funding profile is shown in Figure 1.

Research Contents

The overall purpose of the basic research investigations in this program is to discover, synthesize and apply knowledge needed to promote fundamental, long-term improvements in U.S. construction productivity and capability. Such research entails high risk and requires close interaction and cooperation with both industry and Army laboratories to insure that effort is focused on those topics which have greatest likelihood of success for innovative applications to construction.

To capture recent advances in relevant emerging technologies and harness them for construction applications, the research efforts are focussed on five

primary areas of endeavor: automation and robotics, advanced materials and applications, computer-aided construction, non-destructive test and evaluation and special technologies of Army interest.

Automation and Robotics

Research in the area of automation and robotics will take advantage of the increased cost effectiveness of robotics and remote-controlled and automated machinery which has resulted from the continual rise of labor costs in traditional construction and the decline in the cost of microprocessors, electronics and mechanical components required for automation. Typical research tasks are the assessment of automation potential using current and emerging technologies and the development of prerequisite technology for automated systems, e.g., quality assurance and recording as-built conditions.

A recent accomplishment in this area has been the design and fabrication of a robotic device, called the "studmaster" (see photo) which automates the welding of shear studs during construction of industrial buildings. The MIT fabricated prototype is currently under option to a tool manufacturer who is evaluating the technology for commercial application.

Advanced Materials

The use of advanced materials for construction offers a particularly attractive means for improving the productivity and technological capability of the construction industry. Examples of current research topics are advanced ceramics from fly ash for building construction, high performance cementitious materials, optimum design methods for structural sandwich panels, and fiber reinforced structural ceramics for construction.

Computer-Aided Construction

Artificial intelligence and knowledge-based systems promise more efficient coordination among job phases, reduction in design error, more timely and useful information for decision support, and will accelerate automation on the job site. Interactive analytical and simulation environments can enhance and accelerate design verification and consideration of constructability issues. In this area, major on-going research tasks are computer-aided object representation and virtual construction, quality in design for constructed facilities, and imaging and 3-D metric vision systems for automated construction siting.

The research project on virtual construction, for example, is providing a simulated world within the computer in which the designer can explore and evaluate new designs in much the same way we today build and test scale models, but with the agility, immediacy, and convenience of pencil and paper. Tools such as this, for the first time, offer the potential for achieving revolutionary changes and enhancements to the traditional design-to-construction process.

Non-Destructive Test and Evaluation

The use of non-destructive test and evaluation methodologies are necessary for quality assurance and control of manufactured construction components/materials, automation of the construction process itself, improved management and maintenance of constructed works and lower costs on maintenance and repair. Example research topics are forced dynamic response monitoring for non-destructive evaluation of damage in structures, electromagnetic sensing of concrete, masonry building non-destructive evaluation, and scattering of waves by objects and voids within concrete decks and layered pavements.

An example of an accomplishment in this area is the development of new

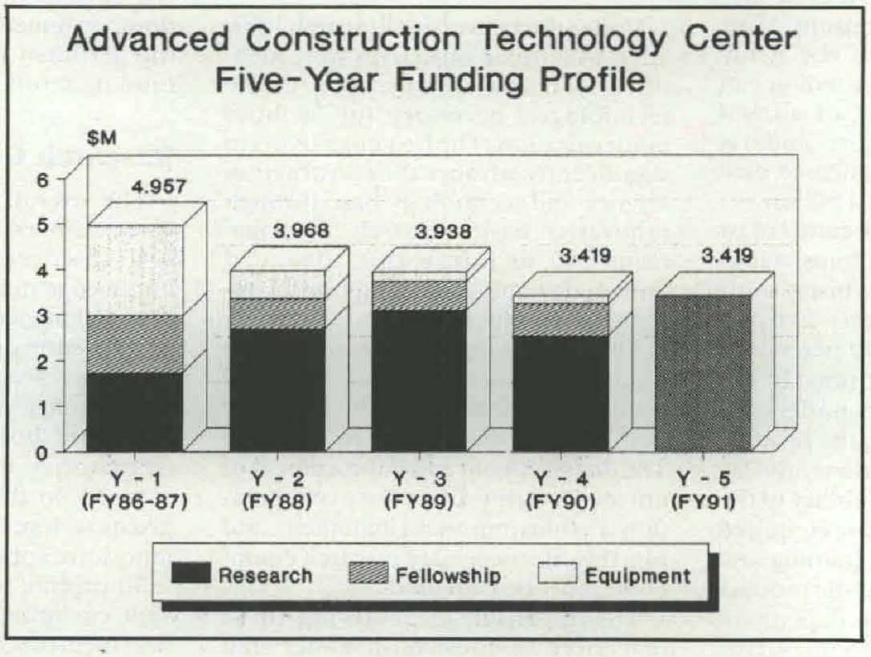


Figure 1.

instruments for measuring the electromagnetic properties of concrete from placement as a slurry to the completely hardened state. A nondestructive test sensor for field operation has resulted from this research.

Special Technologies

There are areas of special interest to the Army which lie outside the four major thrust areas described previously. One is involved with the electromagnetic threat to the Army and the special problems this presents to the Army's construction community. Another is the issue of soil stabilization for construction purposes.

Fellowship Program and Graduate Education

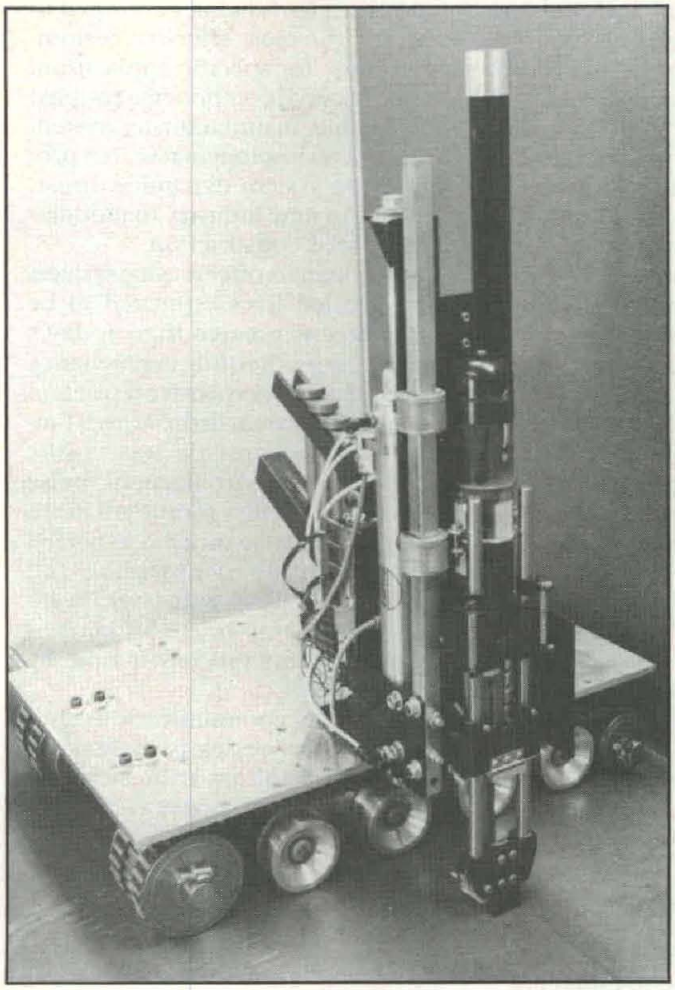
An important component of the advanced construction technology initiative is a prestigious graduate fellowship program in science and engineering which is relevant to advancing the construction technology base in the U.S. The near-term objective is to create a cadre of well-educated manpower having a clear understanding of innovative construction technology and the ability for implementation. The objective also calls for populating and energizing the U.S. construction technology industry so it can reclaim its former preeminent position in the international community.

During the first 30 months of this initiative, a total of 95 graduate students, 79 being U.S. citizens, have received financial support at the University of Illinois. Twenty-nine students were recipients of the prestigious Army fellowship award, which is restricted to U.S. citizens. Out of this population, 46 M.S. and six Ph.D. degrees have been awarded.

At the Massachusetts Institute of Technology there are 51 students currently enrolled in the construction technology program, 34 being U.S citizens, and there have been 13 S.M. (sciences master's) and three Ph.D. degrees awarded to date. Seventeen of the U.S. citizens are recipients of the Army fellowship award.

Equipment Acquisition Program

Approximately $2.7 million has been invested at the centers for upgrading and establishing new state-of-the-art research equipment for executing research investigations. Such equipment runs the full gamut of computers and computer-related equipment, specialized lab equipment for research as well as advanced more general purpose laboratory equipment. As a result, the laboratories of the University of Illinois at Urbana-Champaign and the Massachusetts Institute of Technology are adequately equipped to execute leading edge research in appropriate construction-related fields.



The "Studmaster" automates the welding of shear studs.

Leveraging

It is particularly encouraging to observe how these two centers have begun to attract other students and funding sources, building on the capability generated by this initiative. This is of crucial importance if the centers are ever to become self-sufficient and nationally renowned focal points for construction technology issues.

For example, at the MIT center the experience and capabilities established and stimulated by this program have led to enlarged research sponsorship. A program in Innovative Housing Construction Technology sponsored by a consortium of six materials manufacturing firms was established at $225,000 annually. The New England Transportation Infrastructure Research Consortium at MIT is funded at $400,000 annually and a program on Intelligent Data Bases and Design Systems sponsored by an international consortium of computer and construction firms is funded at over $1 million annually.

The equipment grant to the University of Illinois provided the genesis of a new computer-based network with the purchase of eight Apollo computer workstations. Apollo subsequently donated 10 more workstations and mainframe computers valued at $150,000. Additional grants from other sources have now provided an additional 52 workstations for the network. Thus the success and visibility of this

construction research center played a vital role in transforming an obsolete computer system into a major modern research and teaching facility.

Research at the University of Illinois in soil reinforcement required the development of major unique laboratory facilities. Contract funding for these facilities has been augmented by $172,000 from the University for the construction of the research equipment. These facilities and the current work attracted Schnabel Foundation Co. to seek cooperative R&D efforts requiring these facilities and extending the efforts under this initiative. The company is providing approximately $190,000 for cooperative work on soil nailing using this new facility.

Impact on the Construction Community

The construction technology centers continue to actively pursue information exchanges, technology transfer and technical interactions with the construction community. Investigators have made 149 presentations to date on research supported by this initiative at appropriate technical conferences and symposia and 54 publications on research supported by this program have appeared, or are scheduled to appear, in refereed scientific/technical journals.

Benefits to the Army

The scope of the research at these two centers encompasses three important Army thrusts included in its Technology Base Master Plan, i.e., material science, system dynamics, and communications and information processing. The research is in the disciplinary areas of physical science, chemical science, mathematical science and engineering sciences.

In material science, ceramic based construction and rehabilitation materials being researched will lead to lightweight bricks and "cement blocks" employing the waste ceramic material, fly-ash. Ceramics imbedded with fibers will lead to "smart" materials, that is, materials which will transmit distress signals when subjected to excessive stress, strain deformation, temperature, etc.

A computer program to design construction-applicable fiber-reinforced ceramics is being developed to determine the most effective customized ceramic for specific application. Ceramic material components coupled with flexible manufacturing system fabrication technology, a research program in the system dynamics thrust, will lead to a new industry in modular manufactured construction.

Novel polymers offer roofing systems with extended lives estimated to be 30-40 percent greater than today's single ply roofs. (Roofing maintenance is the second most expensive repair and maintenance account in the Army!) Ion-plated coatings provide less costly, more efficient electromagnetic pulse protection for facility rooms. All in all, the material science thrust is expected to decrease costs of providing and maintaining facilities with large inventories in the Army by 30-50 percent and construction and repair time by 50 percent.

Research in communications and information processes is in sensors, detection mechanisms, artificial intelligence and non-destructive evaluation technology. This research will lead to affordable and precise automated diagnostics for condition assessments of existing facilities and for real-time diagnostics of facilities in construction.

Real-time diagnosis would mitigate all rework costs which occur when assessment is done after the construction is completed and found to be out-of-specification. The automated diagnostics will lead to tactical decision aids (TDAs) in resource allocations for maintenance and repair which require the status of the deterioration of a facility.

Current TDAs exist which can improve the productivity of repair and maintenance dollars by 500 percent, if the condition assessment can be affordably made. Through sensor generated images and with sensor fusion, the cost of condition assessments can be reduced by at least one order of magnitude.

Research in this thrust has also resulted in the invention of an advanced non-metallic electro-optical electromagnetic field sensor that is orders of magnitude smaller than the current sensor. This eliminates interference in measuring shielding effectiveness of equipment and structures. (This is a breakthrough for which a patent is pending; it is of great interest to many other Army commands including the Army Aviation Systems Command.)

Research in system dynamics is directed to computer-aided construction and concurrent design and construction. The Japanese have established that computer-aided construction can increase construction productivity of automatable operations by 50 percent. Increasing the productivity of coordinated-robots is a virgin field for research in this area.

Advancement in robot coordination requires improvement in high resolution, high fidelity vision systems. To date, research has reduced geometric distortion by 50 percent, thus improving speed and accuracy by 50 percent for automated operations. This research will lead to an order of magnitude increase in construction productivity.

This research program presages the technological revolution in the U.S. construction process. A phenomenal increase in productivity is made possible by this research, whose output will make it possible for the Army to revitalize its facilities within the available resources.

No other alternative is available.

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This article was edited and submitted by Dr. Robert E. Singleton, Army Research Office.

THE GLOBAL POSITIONING SYSTEM

Providing soldiers with a Fast and Accurate Method for Positioning and Orientation on the Battlefield

By Jackie L. Bryant

Today's soldier can use space-age technology to find position and assist in navigating on the battlefield. The Global Positioning System (GPS), being developed by the Department of Defense and implemented and operated by the Air Force, establishes a highly accurate, three-dimensional position of any platform equipped with a GPS receiver.

The U.S. Army Engineer Topographic Laboratories (USAETL), located at Fort Belvoir, VA, is involved in ongoing research and development of new GPS applications. These applications will provide a quality survey tool for the Corps of Engineers' civil works and military communities. USAETL's efforts address relative positioning — determining the precise position of an unknown point relative to the position of a known point.

There are two different types of relative positioning — static and kinematic. GPS static positioning performs many types of land surveys faster, with higher accuracy and at lower cost than conventional surveying techniques. Kinematic surveys find the position of moving platforms, as well as stationary points. Stop-and-go kinematic surveys do just what the name implies. By using a stationary known point, a moving platform stops, determines its position and moves on. A full-kinematic survey finds the position of continuously moving platforms, such as dredges, boats or aircraft.

For the Corps, USAETL provides hands-on training and conducts demonstrations of GPS relative positioning techniques to district offices. Since 1985, USAETL has assisted Corps engineers at 22 district offices in using GPS to establish positioning control on 450 points with centimeter-level accuracy.

"Whenever possible, the training is done in conjunction with an actual project the district is working on. This makes the training more realistic, and the engineers take a greater interest in the results," said Dale Jarvis, a geodetic technician in USAETL's Precise Survey Branch.

Through the Repair, Evaluation, Maintenance and Rehabilitation Research Program (REMR), the Corps develops technology to maintain and extend the service life of the nation's infrastructure.

Last year, USAETL completed the development of a Continuous Deformation Monitoring System (CDMS). This five-year effort, funded through REMR, uses GPS technology to automatically conduct geodetic surveys and to detect small deformations in large structures without operator assistance.

In August 1989, a three-month field demonstration of a prototype CDMS was conducted at the Dworshak Dam in Idaho. "This is the largest concrete straight-axis gravity dam in the western world, and one of the largest dams the Corps of Engineers has ever built," said Carl Lanigan, project engineer, Precise Survey Branch. The system can detect structural deformations in the 5-millimeter range in 3-D.

"Conventional survey methods take a long time to perform and require significant manpower. They can take up to two weeks to complete one survey," Lanigan said. "This is one of the reasons deformation surveys of large structures are only performed every six to 18 months, or not at all unless structural problems are suspected.

"The CDMS can survey a structure 24 times a day, is controlled by two personal computers and can produce survey results in a matter of minutes instead of weeks," Lanigan said.

With the CDMS, GPS antennas are installed on the structure at points where deformation monitoring is needed. Two antennas are mounted on stable control points near the structure and remain throughout the life of the project. These points serve as a reference to determine movement of all other points.

A GPS receiver is located near each antenna. A communications network of fiber optic cable or telephone modems link the receivers to two personal computers, located at the site.

The first computer automatically signals the equipment when to begin, for what length of time to operate and when to end data collection. The raw data are downloaded to the second computer for post-processing. A third

Photo by Dick Farrity, USAETL

Carl Lanigan, project engineer for the Continuous Deformation Monitoring System mounts a GPS antenna on a tripod before conducting a survey.

computer can be linked to the project site and accessed remotely by phone for off-site observation and analysis. All data and the processed results are stored on cassette tape.

"The second computer combines the most recent post-processing data with the data of a previous survey, compares the two and reports apparent movement of the monitored points," Lanigan said.

With the development of the CDMS, expensive and time-consuming conventional surveys of large structures may eventually be eliminated.

Another effort that has the potential to save a large amount of money is the Corps' Dredging Research Program. Each year, the Corps spends more than $40 million on dredge and hydrographic surveys. In support of this program, USAETL conducted an experiment to determine if GPS could be used to position moving platforms, such as hydrographic survey boats.

USAETL engineers conducted a three-day test at White Sands Missile Range, NM. One GPS receiver was located on an established control point at the test site. Another GPS receiver was mounted to the test facility's high-speed sled, which moved continuously on a track during the experiment.

"Right now it's possible to position a moving vessel within five to eight meters using conventional survey methods if on-shore control is established," said Lanigan. "The data from the White Sands test proved that with GPS it's possible to position a moving platform to within two centimeters."

USAETL's Precise Survey Branch is developing a system and designing a communications network which will use GPS satellite signals to position moving platforms in real time with decimeter-level accuracy. A prototype system is anticipated in 1992-93.

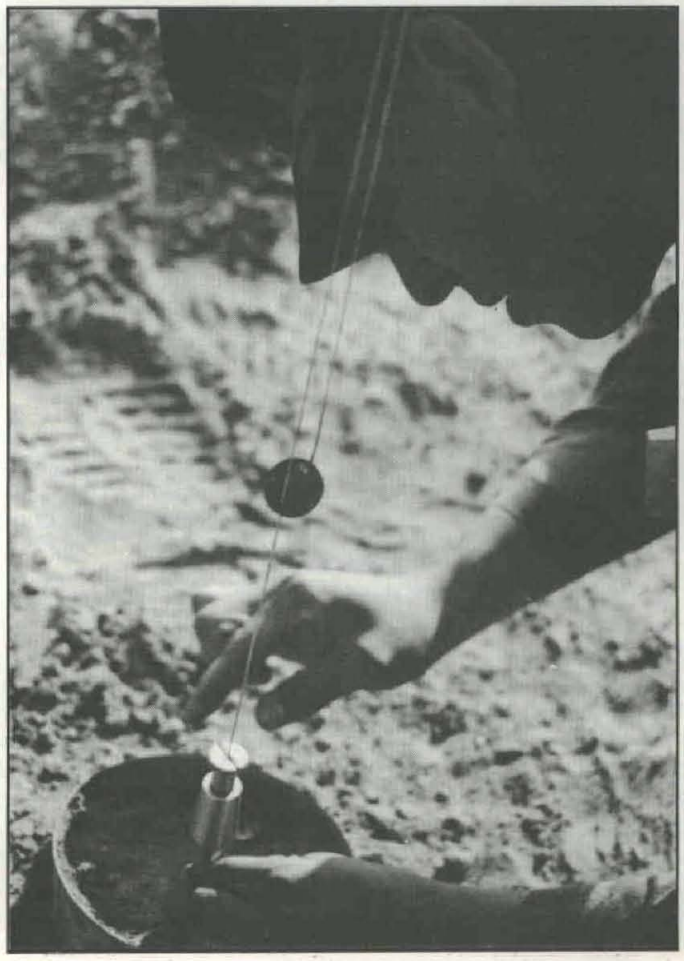
"The hardware and software for such a system may have to be combined with an inertial system to account for momentary losses of GPS satellite signals, which dredges and hydrographic survey vessels experience while traveling under bridges or when obstacles block the signals," said Fred Gloeckler, electronics engineer, USAETL Survey Branch.

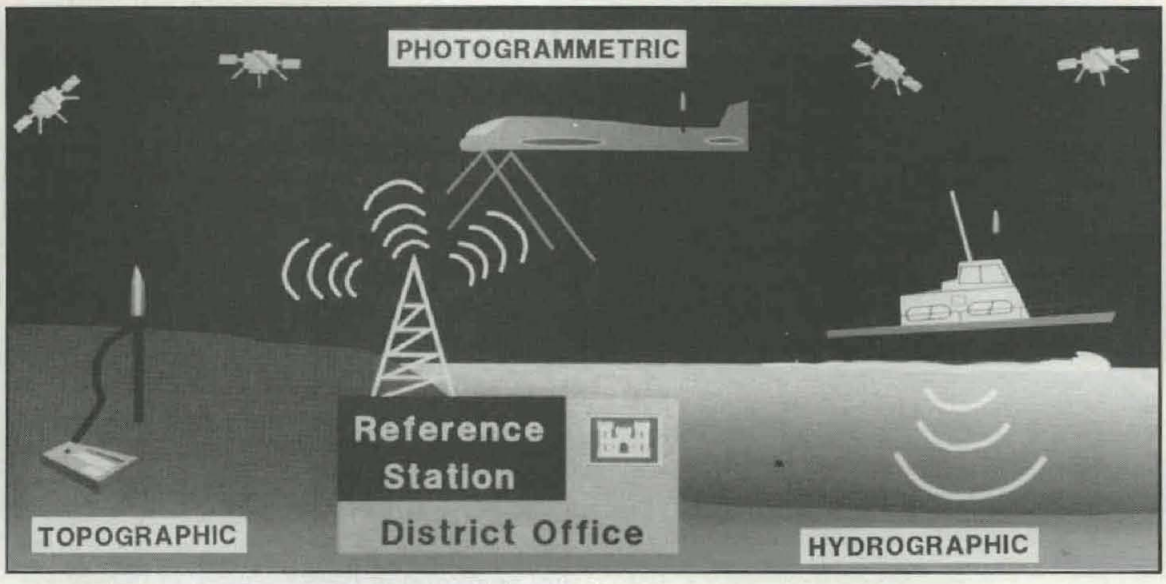
"This may make the system more expensive, so USAETL is looking into other types of positioning aids, like atomic frequency standards and barometric altimeters. They will allow the system to recover its accuracy quickly when GPS signals are reacquired. "The need for on-shore control will be greatly reduced, and dredge positioning and hydrographic surveys will be more precise and less expensive," Gloeckler said.

USAETL has made considerable progress in providing high-precision positioning accuracy with GPS for the civil works community. It also continues to support the Army's effort to integrate GPS technology with existing military surveying devices.

Currently, artillery surveyors establish control points using the Position

Clockwise, from left: *Helicopters approach a GPS antenna during Team Spirit '90 exercise at the air assault strip in Yoju, Republic of Korea. • PFC Rudy Ramierz, 29th Engineer Battalion, centers a tripod over a control point during GPS training as part of Team Spirit '90 exercise in the Republic of Korea. • A helicopter approaches a GPS antenna during Team Spirit '90 exercise at the air assault strip in Yoju, Republic of Korea.*
(Photos by Sally Frodge, USAETL)





An artist's concept of the multiple uses of kinematic GPS surveying.

and Azimuth Determining System (PADS), which is an inertial surveying device developed by USAETL. Control points also are established with conventional survey techniques.

At the request of the U.S. Army Field Artillery School, Fort Sill, OK, USAETL demonstrated GPS technology and provided training to members of the 1st and 3rd Armored Divisions (Artillery) in Germany.

To demonstrate the advantages of GPS positioning to the 1st Armor Division, a PADS was used to establish two control points. "The results of this comparison demonstrated for the soldiers that relative positioning can improve positional accuracies from the 10-meter range now provided by PADS, to the three to five meter range using GPS," said Bryn Fosburgh, physical scientist, Tactical Positioning Branch, USAETL.

According to Fosburgh, the artillery surveyors were interested in GPS not only for its positioning capabilities, but also for the waypoint navigation option-finding interim position points along the navigational route.

"Since PADS doesn't have the option to enter waypoints, the PADS operator must rely on a known control point to initialize the system. The GPS could provide information to the PADS operator that would aid in finding the known control point. The located control point could then be used to initialize PADS," Fosburgh said.

If no control point can be found, a PADS integrated with GPS could use point positioning to establish a control point for initializing the system. Point positioning determines a position without a known control point.

Other demonstrated techniques using GPS included precise relative positioning with accuracies in the one to two centimeter range and azimuth determination with accuracies in the one-mil range.

While in Germany, USAETL engineers also provided GPS receiver and software training to the 649th Engineer Battalion (Topographic). On a demonstration project, field work was completed within one-hour and data reduction was accomplished in 45 minutes. "Topographic surveyors estimated that it would take two to three days to complete the same project with conventional survey methods," Fosburgh said.

At the request of the 29th Engineer Battalion, Fort Shafter, HI, USAETL provided training and GPS equipment in support of Team Spirit '90 in the Republic of Korea. Battalion soldiers were trained to use the GPS hardware and software, and were instructed in various GPS surveying techniques.

"The engineer surveyors presently use Doppler receivers and conventional survey equipment to establish control points. Doppler stations take approximately two to three days to collect data and at least 60 days to post-process the data," Fosburgh said. "Using GPS provides positions with accuracies within three to 10 meters in real time and post-processed positions with relative accuracies within a few centimeters in one to two hours."

Another application using GPS is USAETL's development of the Azimuth Determining System (ADS). ADS is a project funded by the Army Space Technology and Research Office, U.S. Army Laboratory Command. The system will provide artillery soldiers with a device which would meet the Field Artillery School's requirements for a 0. 5 to 2 mil azimuth capability for use by forward observers, howitzers and target acquisition devices.

USAETL's work to develop the ADS and other military applications of GPS technology is providing soldiers with a fast and accurate method for positioning and orientation on the battlefield. On the battlefield, saved time translates into a force multiplier and saved lives. Positioning with GPS for the civil works community also will be faster. Turning operations that now take days and weeks into operations that can be done in real time or just minutes also translates into a tremendous financial savings.

JACKIE L. BRYANT is a writer-editor at the U.S. Army Engineer Topographic Laboratories. She has a bachelor's degree in speech education from Baldwin-Wallace College in Berea, OH.

OER SENIOR RATER PROFILES

The following information is extracted from the 1989 Senior Rater Update, a publication developed and produced by the Evaluation Systems Office, U.S. Total Army Personnel Command, Alexandria, VA.

Status of the OER System

DA selection boards continue to report that the OER system is still very healthy and is providing the information required for their deliberations. A special DA review of all profiles indicates, however, that there are still too many senior raters who have developed noncredible profiles, thereby diminishing the value of their input to selection boards. **Noncredible profiles are those which, for any grade, have more than 50 percent of the ratings in the top box or when the top box is unmistakably the most frequently used box** (The annual DA Form 67-8-2 has been annotated to indicate those profiles which exceed the DA criteria). All senior raters are encouraged to take a close look at their profile and, if warranted, restart their profile and adopt a more credible senior rating philosophy.

What the DA Selection Boards Are Saying

"The DA Form 67-8 remains a very effective barometer for measuring performance and potential. Each section of the OER has special meaning particularly the job description, potential block, and senior rater input." *(1988 CSA COL CMD Board)*

"A major difficulty was caused by the tendency of some . . . senior raters to overly use the top block. A disservice is done to an officer that is in a key position and the board is not able to determine how he performed." *(1988 CA COL CMD Board Member)*

"Too many senior raters invalidate their rating, hurt the good officer, and injure the Army by allowing less deserving officers to be grouped with the excellent officers. The senior leadership must set the example and cause the senior commanders to provide realistic profiles." *(1988 MSC COL CMD Board Member)*

"The senior rater who placed the majority of ratings in the top block did not do his/her officers any favors. . . I chose not to do the rater's job and therefore, called such ratings 'center of mass'." *(1988 SSC Army Board Member)*

"Hand selected officers. Some senior raters are using this comment or similar comments to justify the rating of all officers in the senior rater's profile top block. Such raters lose their credibility and penalize their best officers." *(1988 CSS COL CMD Board)*

Do You Answer the Question?

The very simple (but not easy) question asked of senior raters is: Who are your best officers? That's what selection boards want to know. Too many senior raters do not answer the question, rather they lump together their good officers with their best officers by developing a "top box center of mass." This is an abrogation of responsibility on the part of senior raters and their vote with the selection board is lost! Some good advice to follow from experienced senior raters in the field is to establish a center of mass, e.g., the 2nd box, wherein you place the vast majority of your officers and then reserve the top box for your very best, and lower boxes for those that don't quite measure up to standards.

Center of Mass Not a Killer

Too many officers are under the mistaken impression that unless they receive all "above center of mass" reports from their senior rater, their chances for selection are greatly diminished. Nothing could be further from the truth. Even our toughest selection boards (BG, COL CMD, LTC CMD) select many officers with center of mass and some with even below center of mass reports in their files. For example, the average 1988 LTC CMD selectee had a file which consisted of 51 percent center of mass reports. One selectee had only three top box checks out of 11 OERs. However, with recent reduced selection rates, officers who receive nothing but center of mass reports from a number of different senior raters may be at risk — center of mass is where the cutting edge of selection is.

Did You Know?

On the average, only one out of every five successful company commanders will go on to command a battalion and only one out of every five successful battalion commanders will go on to command a brigade. **Who knows which one better than the senior rater?**

Senior Rater Profile Restart

Senior raters may discuss their profiles and/or restart their profiles by contacting the Evaluation Systems Office, TAPC-MSE, AV 221-9659/9660 or Commercial (703) 325-9659/9660. **Shifting senior rater philosophies without a DA accomplished restart is a dangerous**

business, for the senior rater risks sending the wrong message concerning those senior rated subsequent to the shift. Restarts are normally accomplished on the first day of the month nearest to the date the senior rater telephonically contacts DA. It should be noted that senior raters have the option to restart all grades across the board, or if desired, only selected grades. NOTE: If you submit a written request to restart your profile, please include your phone number so that we can contact you to discuss restart details.

Senior Rater Focus on Potential

The role of the senior rater is to provide the capstone evaluation with the primary focus on **potential**. If the senior rater simply reiterates what the rater has already said about performance, the senior rater may do a disservice to the rated officer. The senior rater's evaluation should include an overall recommendation for promotion, schooling, assignment, or command, as appropriate.

Box Check/Narrative Disconnect

This is an area of concern at just about every selection board. Too often, the senior rater will say great things about the rated officer in the narrative and then provide a box check/profile combination that places the officer below the center of mass. In other words, the words do not match the box check/profile. This calls into question the senior rater's ability to tell the rated officer "like it is." In extreme cases, this practice may warrant successful appeal by the rated officer.

Date Your Signature

Too many senior raters are not entering the date when they sign the OER. This can be critical if the senior rater has restarted the profile because profile restarts are keyed to the senior rater signature date. If, for example, the senior rater fails to date the signature and a clerk in the PSC enters an arbitrary date, the report may have the wrong profile applied. **Bottom line: Always date your own signature.**

Three Separate Profiles?

A senior rater may have up to three separate senior rater profiles. The key is the component of the rated officer. The profile for active component rated officers is maintained by TAPA. The profile for Army National Guard and USAR officers, not on extended active duty, including members in the Active Guard/Reserve (AGR) Program, are contained on separate profiles maintained by the National Guard Bureau Personnel Center (GUARDPERCEN) and the U.S. Army Reserve Personnel Center (ARPERCEN), respectively.

How Senior Rater Profiles Are Determined

This question often comes up in discussions with the field. OERs are batch processed as they are received from the field on a daily basis. All OERs from a particular senior rater received free of errors will be processed the same day. For example, if a new senior rater rates five captains (who may have various thru dates on their OERs) in the second block, and sends all five OERs to TAPA in the same envelope (thus ensuring that they are received together) with no errors, the profile on each OER will be the same — O-5-O-O-O-O-O-O-O. On the other hand, if the same five OERs are received one by one on five consecutive days, the profile on the first OER will be O-1-O-O-O-O-O-O-O, the second will be O-2-O-O-O-O-O-O-O, etc.

(P) Officers

Promotable officers (except warrant officers) serving in positions authorized the promotable rank are required to have the "P" annotated to their rank in the grade block (Ic) on page 1 of the OER. When evaluating, senior raters should compare such officers to officers of the promotable rank. This is important because the profile applied to the OER is based on the grade block. Bottom line — if CPT(P) is listed, then the officer will be profiled as a MAJ, but if CPT is listed, then the officer will be profiled as a CPT.

Keep Track of Your Profile

Some good advice to follow from experienced senior raters is to **plan ahead or you will lose control of your profile!** As soon as possible after assuming senior rater duties, note on paper exactly where in the profile you would place all those you senior rate right then. As you gain more knowledge, adjust the list throughout the rating period. When the time comes to senior rate, you will be in control and able to communicate better to selection boards. If at any time you need an official update on your profile, you may telephonically contact the Evaluation Systems Office.

Comments About Marital Status and Spouse

An interim change to AR 623-105, dated Oct 26, 1988, states:

a. Any evaluation comments favorable or unfavorable, shall not be based solely on an officer's marital status. For example, "LTC Doe and his wife make a fine command team", or "As a bachelor, MAJ Doe can quickly react to this unit's contingency missions" are not permitted.

b. Evaluation comments shall not be made about the employment, educational, or volunteer activities of an officer's spouse. For example, "Mr. Doe's participation in post activities is limited by his civilian employment", or "Mrs. Doe has made a significant contribution to soldier morale by her caring sponsorship of the hospital volunteer staff" are not permitted.

c. There are limited circumstances, involving actual and demonstrable effect on the rated officer's performance or conduct when comments about a spouse may be made. These comments must be focused on the rated officer's actions, not those of the spouse. For example, "CPT Doe continued outstanding, selfless service, despite her husband's severe illness", or "COL Doe's intemperate public confrontations with his wife were detrimental to his status as an officer" are permitted.

THE OER SUPPORT FORM

The following information is extracted from the Officer Evaluation Guide, 7th edition, dated September 1989. The guide is developed and produced by the Evaluation Systems Office, U.S. Total Army Personnel Command. It is available to all officers upon request, by writing to CDR PERSCOM, ATTN: TAPC-MSE, 200 Stovall Street, Alexandria, VA 22332-0442, or by calling AV 221-9659/9660, or Commercial (703) 325-9659/9660.

The primary purpose of the DA Form 67-8-1, Officer Evaluation Report (OER) Support Form is to encourage two-way communication which leads to the rated officer having a clear understanding of the duties and responsibilities, and what is expected in terms of performance at the beginning of the rated period. It also allows the rated officer to participate in the objective setting process.

Beginning of the Rating period. Within the first 30 days of each rating period, a face-to-face discussion must occur which results in the establishment of the rated officer's duty description and major performance objectives. This provides an initial guide for performance which may be subsequently changed or modified as appropriate. For those officers who cannot accomplish the face-to-face discussion within the first 30 days because of geographical separation between the rater and rated officer, correspondence and telephone conversations may be used as alternatives. These alternatives will be followed by a face-to-face discussion at the earliest opportunity.

This objective setting process may be accomplished in one of three ways. You may develop the objectives yourself and give them to the rated officer; you may develop them in a joint setting with the rated officer; or you may task the rated officer to develop and provide them to you and then discuss them together. Your method depends entirely on the situation, your leadership style, the experience of the rated officer, etc.

Remember, these objectives are only a guide for performance and they are to provide for the major thrust and direction of the rated officer's performance. They should not necessarily be all inclusive. The rated officer is still expected to accomplish those things normally associated with the duty position and expected of an officer of a given grade and level of experience.

As a result of this initial face-to-face discussion, the rated officer will complete a working copy of the DA Form 67-8-1 which reflects the date of the discussion as verified by the initials of both the rater and rated officer (Part III). A working copy of the OER Support Form (with Parts I through IVb completed) will be provided by the rated officer to the rater. The rater will, in turn, provide a copy of the rated officer's support form to the senior rater early in each rating period. This is intended to provide the senior rater with the information to permit an understanding of the performance objectives throughout the period, and a base from which to evaluate at the end of the period.

During the rating period. The rated officer is required to maintain an OER Support Form throughout the rating period. The communication process should be continued during the rating period to update objectives or to provide further direction as necessary. This gives you the excellent opportunity to coach/counsel the rated officer and to provide the benefit of your knowledge and experience. As changes in duties or objectives occur they should be annotated to the working copy of the OER Support Form.

End of the rating report. At the close of the rating period the rated officer provides to you a completed (Parts I through IVc) OER Support Form. This is the rated officer's opportunity to highlight major accomplishments and remind the rating officials of significant contributions which took place throughout the rating period. You should use the information of the rated officer's performance to complete the rater portions of the OER. Comments in Part V of the support form are optional. Part V is primarily designed to report any unresolved disagreement between you and the rated officer concerning the duty description and/or major performance objectives. It is not the place to evaluate the officer. Whether or not comments are made, you must sign and date the form. Your signature does not indicate concurrence with Part IV, but it does indicate that you have reviewed the rated officer's comments.

Army Develops New Skin Decontaminating Kit

The U.S. Army Medical R&D Command's (MRDC) Medical Materiel Development Activity has announced development of a skin decontaminating kit intended for individual application to remove and detoxify persistent chemical warfare agents and some toxins. Recently transitioned to the production and deployment phase, it is designated as the Decontaminating Kit, Skin: M291.

The new resin-based system is an expendable, nonrepairable item that was adopted for military use in November 1989. The active component, Ambergard™ XE-555 decontaminant resin, is a formulated blend of reactive and sorptive polymeric resins developed specifically for skin decontamination applications.

The M291 consists of a flexible wallet-like carrying pouch containing six individual decontaminating packets, enough to do three complete decontaminations of the hands, face and neck. Each foil packet contains an applicator pad filled with 2.8 grams of Ambergard™ XE-555 resin powder.

Designed to replace the M258A1 Personnel Decontaminating Kit and the M58A1 Training Aid for skin decontamination, the M291 is non-toxic and will be used by all Services for both training and during wartime. In addition, the M291 is not hazardous to the environment and may be transported, stored and distributed without special handling requirements. Safety and ease of use are two of the notable advantages of new kit when compared with the currently fielded M258A1.

Development of the M291 by the MRDC, under contract with the Rohm and Haas Co., began in 1985. A market survey determined that no off-the-shelf product was available which met joint Service needs. A competitive evaluation of six candidate resin blends developed under MRDC contracts resulted in selection of Ambergard™ XE-555 resin as the active component which best met military requirements for safety and effectiveness. The M291 is regulated by the U.S. Food and Drug Administration as a medical device for military use.

In November 1989, a Milestone III In-Process Review transitioned the product to the production and deployment phase. The technical data package will be transitioned to the U.S. Army Armament, Munitions, and Chemical Command for fielding, materiel management, and follow-on competitive procurement.

Composite Test Vehicles Refuse to Die

In 1987, 10 specially prepared composite test-bed vehicles began field tests at several Army bases to help U.S. Army Tank-Automotive Command (TACOM) engineers determine the maximum extent to which lightweight, nonmetallic composite materials would be suitable for military use.

Now, three years later, all 10 vehicles are still running. And, according to project head Donald Ostberg in TACOM's RDE Center, their performance record clearly indicates that composites — currently limited to three tactical-vehicle families — have many other potential applications. The High-Mobility Multipurpose Wheeled Vehicle (HMMWV) features a fiberglass-reinforced plastic nose section and doors. One version of the Commercial

M291 Skin Decontaminating Kit

Utility Cargo Vehicle (CUCV) has a composite hood-and-fender assembly.

The test-bed vehicles are standard-production CJ-7 Jeeps whose sheet-metal body components — doors, fenders, hoods, grills and floor pans — were replaced with fiberglass-reinforced plastic ones by RDE Center technicians.

TACOM sent the vehicles to Army facilities in Maryland, Arizona, Hawaii, Michigan, Alaska and Panama, where they would see a wide range of climates and terrains, and asked the users to subject them to normal use until they became unserviceable. The users were also asked to maintain records of how and where the vehicles were used as well as on all damage and repairs.

"Officially, the tests ended a year ago," Ostberg said. "But at that time all the vehicles were still running, so we told the test sites to continue using them. Throughout the period, a lot of the metal components on the vehicles failed, but we have had no problems with any of the composite bodies.

"What is noteworthy about this," he continued, "is that the composite components were made of low-cost materials — probably not what we would recommend for production parts requiring high-impact strength. Yet they demonstrated the suitability of composites in just about any kind of military environment you could ever dream of."

The success of the Jeep tests has led to other materials research efforts now under way. Perhaps the most significant of these are two aimed at investigating the feasibility of using composite materials in Army cargo trailers to increase their payload capacity and give them greater mobility.

According to the RDE Center's Luis Hinojosa, who is directing the trailer projects, metal Army trailers currently have a payload-to-weight ratio of approximately 1:1.5. He said the research objective is to demonstrate that composites — which weigh about 50 percent less than steel yet provide excellent strength properties — could increase that ratio to 3:1. "Our goal," said Hinojosa, "is to prove that the technology is available to make composite trailers feasible in all weight classes."

TACOM is currently focusing its attention on heavy- and light-duty trailer applications. In the heavy class, the California-based San Diego Aircraft Co. conducted a one-year study for TACOM to determine the feasibility of building a composite version of the Army's 62-ton M747 trailer. Hinojosa said that study, whose objectives were to use advanced composites in attaining a mass-producible trailer with a payload-to-weight ratio of 3:1, concluded that such a trailer would be practical.

In the light-duty class, durability tests are planned at Aberdeen Proving Ground, MD on two 3/4-ton composite trailer prototypes now being built by Loral Defense Co. in Arizona. Hinojosa said that except for metal axles and other suspension components, these prototypes, which are being patterned after the M101 trailer now used with the HMMWV, will be made entirely of composite materials.

Other research now under way in the combat vehicle arena includes evaluation of composite road wheels, an engine air-cleaner assembly, and a driver's seat for M1-series tanks.

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

USAMRDC Works on Hemorrhagic Fever Vaccine

A disease contracted by 13 U.S. Army Reserve soldiers who became ill in January and February of this year while in Germany for REFORGER has been diagnosed as Hemorrhagic Fever with Renal Syndrome (HFRS). Although new diagnostic tests developed by the U.S. Army Medical R&D Command (MRDC) have led to the recognition of sporadic HFRS cases among the German population in recent years, this incident represents the first recognized outbreak of this disease among U.S. soldiers serving in Europe.

During the Korean conflict of the 1950s, more than 2,000 United Nations soldiers came down with a mysterious illness that puzzled Army physicians. The World Health Organization now calls Korean Hemorrhagic Fever and similar diseases caused by related viruses Hemorrhagic Fever with Renal Syndrome (HFRS). The virus causing the disease was isolated from the lung tissues of field mice and identified as Hantaan virus in 1976 by MRDC contractor Dr. Ho Wang Lee and collaborators in Seoul, Korea. Mice and rats are the primary hosts of the virus and the source of infection in humans.

An Army physician familiar with the symptoms of Korean Hemorrhagic Fever from an earlier assignment in Korea diagnosed the disease in the 13 REFORGER soldiers whose symptoms included kidney failure.

Investigators at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) have been studying HFRS and the family of related viruses that cause it in order to protect soldiers who deploy to areas where it commonly occurs. Eighteen U.S. Marines came down with the disease in 1987 during a training exercise in Korea, and two of them died.

The Korean Army experiences a significant rate of HFRS cases each year, and U.S. forces in Korea also suffer several cases annually.

USAMRIID conducted field trials of ribavirin, an antiviral drug, in the People's Republic of China, at the request of the Chinese government, to establish the efficacy of ribavirin for treating HFRS. The trial was conducted in Wuhan Province, from November 1985 until April 1987, in collaboration with the Hubei Medical University.

Under the protocol, approved by the U.S. Army Surgeon General's Human Subjects Research Review Board and the U.S. Food and Drug Administration, 244 patients were treated with ribavirin or a placebo. The test results indicated that the drug was effective in treating HFRS. The results will be submitted to the U.S. Food and Drug Administration as part of a new drug application, to license

ribavirin for treatment of HFRS.

During the ribavirin efficacy trial, rapid diagnostic tests were developed and validated for HFRS and it was this same test that was instrumental in the diagnosis of the REFORGER patients.

Scientists at USAMRIID are also developing a vaccine that could be administered to soldiers before deployment to an area where the risk of exposure to HFRS is high. The vaccine would be available for use by the general population in areas where the disease is a public health problem.

AMC Revises Sources of Expertise Pamphlet

AMCP 70-18, *Sources of Expertise During the Army Materiel Acquisition Process* is being revised and updated. Initial publication in June 1989 was a first in that software on two floppy discs was part of the hard copy document and used to enhance the utility of the hard copy. The revised AMCP is intended to produce the first official document that is not published in hard copy, but utilized strictly through a centralized data base.

AMCP 70-18 facilitates action officer searches for sources of expertise to provide guidance and advice for specific concerns on an Army materiel acquisition program. With over 600 line items, the pamphlet is expected to be tripled in size with automation providing real time access to up-to-date information. Software techniques will allow for easy search and provide additional products such as proponent lists.

Activities currently listed in AMCP 70-18 will be contacted directly by mail for corrections and additional line items. Other Army activities that can provide guidance and advice and wish to be listed in the pamphlet should provide the following:

- **Area of Expertise:** three fields of 25 characters each.
- **Proponent Organization Address:** three fields of 35 characters each are provided for organization title, i.e., major command, subordinate command and activity. A fourth field of 14 characters for Organization Symbol, a fifth field of 30 characters for an optional street address and a sixth field of 32 characters for city, state and Zip Code.
- **Phone Numbers:** Both commercial and AUTOVON.
- **Reference Documents:** three fields of 20 characters each for a maximum of three references. A single reference can use more than one field.
- **Key Words:** four key words/phrases of up to 20 characters each. Send information to: Gerald Malakoff, ATTN: AMCDE-AR-A HQ, U.S. Army Materiel Command Alexandria, VA 22333-OOO1, AUTOVON 284-8843 or Commercial (202)274-8843.

Besson Awards Cite Procurement Excellence

The Frank S. Besson Memorial Award for Procurement Excellence was presented earlier this year to three individuals at the Atlanta XVI executive conference in Atlanta, GA.

Named in honor of the Army Materiel Command's (AMC) first commander, the award honors outstanding performance by members of the AMC contracting and acquisition work force. It consists of a plaque and a $1,000 Savings Bond and is given to one individual in each of three categories — civilian, military, and intern.

This year's presentations were made by GEN William G.T. Tuttle, AMC CG, and LTG Lawrence F. Skibbie (USA Ret.), president of the American Defense Preparedness Association.

Patricia S. Silsby, a branch chief and contracting officer with the Army Laboratory Command's Installation Support Activity, was cited for her management and execution of the Army's High Performance Computing Research Center procurement. The contract, awarded to the University of Minnesota, provides for research in high performance computing. This work will contribute significantly to maintaining our nation's technological standing in the world. Her exceptional ability to plan and execute a major procurement action was evidenced by the fact that she managed to adhere to a tightly compressed schedule while successfully defending a protest prior to award.

MAJ William N. Phillips, U.S. Army Aviation Systems Command, (AVSCOM) was recognized for achievements in competitive contracting, reducing procurement leadtime, and management of the UH-1 Aircraft Retirement Program, while serving as chief of maintenance and overhaul, Directorate of Procurement and Production. He orchestrated procurement of UH-1 flight simulator services, resulting in cost savings of more than $4.8 million through competition. His innovative acquisition planning resulted in reduced leadtime and the award for repair of three armed OH-58D aircraft within seven days and 26 AH-1 aircraft within 30 days.

Karen C. Corder, an AMC contracting and acquisition intern in AVSCOM's Directorate of Procurement and Production, was cited for excellent and innovative acquisition abilities while assigned as a materials evaluator and negotiator with the Army Helicopter Improvement Program/Saudi Arabia 406 Scout Should Cost Team. She served as a project team leader for the foreign military sales acquisition of the Maintenance, Supply and Services Project. This effort culminated in the award of a complex $42 million cost-plus-award-fee contract to provide services in Saudi Arabia.

Scientists Accept Overseas Fellowships

Two scientists from Harry Diamond Laboratories have accepted fellowships to pursue research abroad in the fields of optical processing, target recognition and neural networks. They are Dr. Joseph Mait and Dr. James Cole, both of the Optical Processing Branch of the Target Sensors and Signal Processing Laboratory.

The University of Erlangen-Nuernberg has invited Mait to spend six months as a visiting scientist in the Lehrstuhl fuer Angewandte Optik (Applied Optics Group).

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According to branch chief Dr. John Pellegrino, this group is recognized throughout the world as a leader in the field of optical signal processing. The group is headed by Adolph Lohmann, inventor of computer-generated holography.

During his time in Germany, Mait will hold a position equivalent to that of senior associate professor at an American university. He will work closely with and supervise graduate students on a project concerned with the design of holographic elements for generating optical interconnects.

The university extended the invitation to Mait because of his earlier association with the group and his recent research accomplishments. The position will be funded by Germany's National Science Foundation.

Cole will spend a year as a guest scientist at the Nippon Telephone and Telegraph (NTT) Basic Research Laboratory in Tokyo. The NTT lab is doing fundamental research in computer vision, pattern recognition, neural networks, and implementations via optical computing technologies.

Cole will investigate the incorporation of complex weights into learning algorithms for target recognition and their potential in neural network structures. The experience gained in these fellowships will be applicable to both men's work at Harry Diamond Laboratories.

Tobyhanna Designs New Test Devices

Two devices which will improve the reliability of a recently issued weapon and its ammunition have been built at Tobyhanna Army Depot, PA. Working with engineers from the Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ, depot personnel built three hard-mount firing stands and 10 Mann-barrel test fixtures for the new MK-19, Mod, 40mm grenade machine gun.

Both devices will be used in tests designed to improve the readiness of the weapon, cut maintenance costs, and facilitate the production of lower-priced parts by the manufacturer, says Roy Reymann, a mechanical engineering designer with the center's Future Weapons Branch.

The firing stands are for live-fire experiments to assess and improve the weapon's performance by allowing engineers to measure and analyze forces which act upon the gun when fired. The Mann-barrel devices will be used in ammunition development, acceptance testing and malfunction investigations for the high-explosive, dual-purpose 40mm ammunition used in the MK-19/3.

LETTERS

Request for Information and Assistance

Recently, the members of the 72nd Support Brigade were issued the Bag, Carrying Protective Ensemble, NSN #8465-01-216-6259. The dilemma we face is that we have not been able to find any documentation on how the MOPP Ensemble is to be stored in the bag or how to wear the bag on the ALICE Pack or the Web Gear.

Our office has had approximately 15 calls per day from soldiers and units wanting to know how this piece of equipment works. This command regularly receives your publication and has found many articles that were excellent and of great training value. We are requesting your assistance in this matter. Is there someone on your staff who could provide us with a reference or start point?

Thank you for your cooperation and assistance. The POC for this matter is the undersigned at (517) 782-8274.

WILLIAM L. DEETZ
MAJ, TC, MI ARNG
Training Officer

Editor's Note: MAJ Deetz welcomes any assistance that *Army RD&A Bulletin* readers might provide. He can be reached on the above phone number or by writing to the Michigan Army National Guard, Headquarters, 72nd Support Brigade (Troop Command), 100 Armory Court, Jackson, MI 49202-3399.

Explosive Ordnance Disposal Article. . .

I read with interest your article about newly fielded robots for EOD work (March-April 1990 issue). One thing, it hardly ranks as RD&A news; the British Army has possessed such a device, built on similar lines from available parts for at least 25 years, and used it with great success in Northern Ireland.

Indeed, I remember that the first model was constructed using Chieftain Tank Fan Belts as the tracks!

Perhaps a case for more exchange on standardization by the NATO partners?

DAVID D. KAY
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