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ABOUT THE COVER:

The U.S. Army Training and Doctrine Command's role in the materiel requirements planning process is the theme of this issue. Specific resources used in this process, as shown on the cover, include threat analysis, mission area analysis, and the Airland Battle 2000 concept.

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The TRADOC-DARCOM Partnership in RDA Planning

By MG J. B. Oblinger, Jr.
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&
MG Orlando B. Gonzales
Director, Development, Engineering, and Acquisition, HQ DARCOM

Critics often ask why it takes so long to field new items of equipment. It is generally agreed that steps can be taken to shorten that time span. Consequently, the Army's Training and Doctrine Command (TRADOC) and Materiel Development and Readiness Command (DARCOM) are forging a linkage to help compress the development cycle while enabling the Army to project requirements further into the future.

The Army's Long Range Research, Development and Acquisition Planning System and TRADOC's Mission Area Analysis Process combine to provide a roadmap of how to get to the Army of the future. They provide a means to consider future implications of current decisions and a way to couple these actions with the Planning, Programing, Budgeting, and Execution System for resource allocation.

Unfortunately, the details of the Long Range RDA Process are not well known to most combat and materiel developers, nor do enough of them understand TRADOC's contributions to this partnership.

The Army's Long Range RDA Planning System evolved from a desire to ensure that the Army fields the most modern fighting force possible for each dollar spent. For many years, the Army did not have a comprehensive, coordinated long range RDA plan. Planning, programing, and budgeting centered on the years covered in the Program Objective Memorandum — POM in Pentagonese. This emphasized the budget year, while long-range projects were highlighted in the Extended Planning Annex, a document developed in a relatively unconstrained and non-rigorous manner. As a result, instability characterized previous RDA programing and budgeting.

In recognition of this defect, the Army, in 1980, launched a program to bridge the planning-programing gap by linking RDA efforts to the development of doctrine, training, and force structure. Decision makers, using a format displaying programed expenditures through the period of the long-range plan, can now see what the development of a particular system is likely to cost 10 or 15 years in the future. Thus, affordability determinations can be made before a project proceeds too far in the development cycle.

The current Long Range RDA Process, while still in its infancy, facilitates timely and systematic modernization. It recognizes that modernization must address a total system that includes materiel, training, personnel, logistics, doctrine, tactics and related system requirements. These components are interrelated and solutions in one area could well cause deficiencies in another.

Only a comprehensive approach to the total system will produce equipment that meshes with the force structure, training, and doctrine. To implement the process, however, DARCOM must understand the needs of the future battlefield, and that is where TRADOC plays a key role.

TRADOC foresees a land battle in which there will be tens of thousands of systems, most of them operated and controlled by junior NCOs or soldiers. TRADOC has looked at current equipment, resulting from R&D of the '60s and '70s, and has, like DARCOM, been sobered by the realization that soldiers operating this equipment may not have been born when development of that equipment began.

The TRADOC-DARCOM partnership is the only viable way to sow the right technological seeds for the '90s and still shorten the development cycle. It is the only way to manage modernization in today's rapidly changing environment and make the most of scarce resources.

Combat Developer's Role

TRADOC's first action was to assess the pace of Army equipment modernization and to formulate a better way to synchronize modernization with the total system. Work done in 1978 revealed that equipment of the 80s, the result of major development work of the 70s, would not fit the force structure and did not mesh with doctrine prescribed by the Airland Battle/Army 86 studies. It was clear that a pure materiel-based concept was not working.

What was needed was a concept-based system from which all requirements of the total system would evolve and would drive the R&D and fielding of materiel. Such a system would address the future environment, national objectives, Army missions, the threat, and advanced technologies. But what would be the analytical tool for developing these considerations?

Mission Area Analysis proved to be that tool. It synthesizes information gained from many individual studies and analyses into a single, internally consistent framework. To facilitate the detailed analyses of the Army's ability to execute

TABLE I

Mission Area	*Proponent*
Close Combat (Heavy)	U.S. Army Armor Center, Fort Knox, KY
Close Combat (Light)	U.S. Army Infantry Center, Fort Benning, GA
Aviation	U.S. Army Aviation Center, Fort Rucker, AL
Air Defense	U.S. Army Air Defense Center, Fort Bliss, TX
Combat Support, Engineering & Mine Warfare	U.S. Army Engineer Center, Fort Belvoir, VA
Combat Service Support	U.S. Army Logistics Center, Fort Lee, VA
Fire Support	U.S. Army Field Artillery Center, Fort Sill, OK
Battlefield Theater Nuclear Warfare	U.S. Army Combined Arms Center, Fort Leavenworth, KS
Nuclear, Biological, Chemical	U.S. Army Chemical School, Fort McClellan, AL
Command & Control	U.S. Army Combined Arms Center, Fort Leavenworth, KS
Communications	U.S. Army Signal Center, Fort Gordon, GA
Intelligence & Electronic Warfare	U.S. Army Intelligence Center, Fort Huachuca, AZ

its wartime missions, the overall battlefield concept has been divided into 12 mission areas.

These mission areas serve as the basis for measuring the capabilities of the force programed in the current Program Objectives Memorandum to fight a successful battle against a projected threat. Each mission area was assigned to a TRADOC center/school for analyses and the prioritization of resulting deficiencies (see Table 1).

Mission Area Analysis then, is a detailed application of the concept-based requirements system. It translates elements of the overall battlefield concept into requirements for materiel development which are then placed upon DARCOM agencies. Although the analysis uncovers future deficiencies, Mission Area Analysis results have an immediate impact since they drive the R&D efforts needed to field corrective actions in the target year.

Mission Area Analysis

The analysis procedure involves further separating the mission areas into essential tasks, then evaluating our ability to perform these tasks in the environments we expect to encounter. From this analysis, a series of corrective actions in terms of doctrine, organization, training and materiel are recommended.

Analysis leading to the identification of tasks and missions is the key to Mission Area Analysis. These tasks and missions are derived from Joint Chiefs of Staff publications, the Army Plan, Army Guidance, TRADOC Guidance (such as is found in the Battlefield Development Plan), examination and evaluation of gaming, related studies and, of course, experience.

Tasks are first identified broadly. Then within each task, subtasks are developed which encompass the requirements for operating in any of a number of possible environments. Computer models enable TRADOC to test the ability of the programed force to accomplish these tasks and subtasks based upon predefined measures of effectiveness. Shortfalls in the Army's capability to execute any of the tasks become mission area deficiencies.

The next step in Mission Area Analysis is to analyze the constraints which limit the availability of choices to correct the deficiencies. These constraints may include fund limitations, numbers and skill levels of personnel, difficulty or cost of training, time available to meet projected threat, and the absence of essential technology. DARCOM plays an important role in the latter case by identifying technological opportunities and limitations for each mission area.

The realization that other mission analyses will make competing demands for limited Army resources tempers the conduct of each. Careful evaluation is given to alternatives which would cause excessive organizational turbulence or would require commitment of resources in another mission area.

The procedure for selecting corrective actions starts with those actions which are least expensive and most quickly implemented. Corrective actions which are more demanding in time and resources are examined only when the less costly options do not eliminate the deficiency. The most expensive choice—usually new materiel—is a last resort.

Most of the time, correction of mission area deficiencies will require a combination of actions, and even then correction may not always be straightforward. Successful corrective action in one area—say increasing the number of howitzers — may cause a new deficiency in another area, e.g., ammunition resupply. Before these proposed actions are recommended, the analysts investigate the impacts on the mission area as a whole and then on the entire force.

Factors considered prior to implementation of corrective actions are: ability to accomplish changes within personnel ceilings; compatibility of changes; adequacy of changes in operational concept to support organizational changes; and adequacy of changes in operational concepts and organizations to support new materiel.

Additionally, there are concerns over impact on other mission areas. These include logistics, communications, and command and control. We must also consider the impact on training, the risk in fielding new systems in a timely manner, and the impact on developmental systems.

Integration & Prioritization Of Deficiencies

Once the Mission Area Analyses are complete, integration of the deficiences from each mission area and their prioritization into a single ordered list of battlefield deficiencies begins. This single list will guide the development of programs and the allocation of resources toward correcting deficiencies in order of importance.

TRADOC follows a 4-phased approach for this integration and prioritization effort. During the first phase, the HQ TRADOC staff proponents for each mission area and the center/school which conducted the analysis, prepare a strawman list of significant deficiencies. During the second phase, the proponents prioritize their list of deficencies within the mission area.

During the third phase, four separate General officer panels integrate the prioritized lists for each mission area using the statistical technique or pairwise comparison. Four independently developed lists of integrated and prioritized deficiencies covering all mission areas result from this phase.

In the final or fourth phase, another General officer panel, which includes representation from the TRADOC integrating centers, HQ TRADOC and FORSCOM, aggregate the four prioritized lists from the previous phase. The TRADOC integrated and prioritized list of deficiencies for the future battlefield is the product of this phase.

Corrective actions contained in the Mission Area Analysis will be general in nature. A translation of these actions into specific projects, with milestone schedules suitable to feed programing and budgeting documents, will permit the application of resources to eliminate deficiencies. The Mission Area Development Plan, published annually by each mission area proponent, makes this transition from desired corrective actions to specific projects.

The close working relationship between the TRADOC centers and schools and the DARCOM laboratories makes the Mission Area Development Plan a valuable document. Combat and materiel developers jointly lay out the plan for correcting deficiencies uncovered in the mission analyses.

Preparation of this plan does not require a new analysis. It is simply the tool which structures the programs, combines them in one place, and indicates the source from which they derive. This document permits development of a program for the allocation of resources. Publication of this plan is synchronized with the DA prioritization process that produces the DA Long Range RDA Plan.

The Mission Area Development Plan will contain, as a minimum, an introductory chapter setting forth the scope and purposes of the plan; an overview of the mission area; a summary of the principal analysis from the latest mission analysis; and the prioritized deficiencies and proposed corrective actions identified in the mission analysis; a listing of nearterm POM adjustments to programs that were considered as a "given" in the the mission area analyses; a doctrine development section; an organization or force structure section; a training development section; and a materiel development section.

Battlefield Development Plan

High-level decision makers require summarized information as a basis for allocating resources toward solving the Army's most pressing deficiencies. The Mission Area Development Plans are too specific and detailed to be used by everyone associated with long-range planning.

The Battlefield Development Plan then fills the high-level need. It consolidates results of the individual mission area analyses into a capstone analysis describing the battlefield environment forecast for the Army of the future, the highlights of the doctrine used as a foundation for the analysis, and an assessment of our capability to survive and win on that battlefield.

The assessment includes the major packages of deficiences that cut across mission area lines as well as the overall TRADOC list of prioritized deficiencies. The Battlefield Development Plan—often referred to as the BDP, gives the commandants of the TRADOC centers and schools guidance on the relative priority of all deficiencies so that work can be scheduled to overcome the non-materiel problems. It communicates the Army's critical materiel deficiencies to the development community so resources can be effectively marshaled toward their correction. It also articulates to those who prepare the Program Objective Memorandum and defend the Army's share of the DOD budget, the source and priority of the requirements to meet wartime responsibilities.

The Battlefield Development Plan is an annual planning document that will reflect the current updates in the various area analyses and will make adjustments for budgetary changes, new developments, improved threat data, and other new information between major analyses. Its publication influences the Army Plan and Army Guidance so that the deficiencies of various combat and support missions can be understood in the context of all Army needs.

Relative to materiel deficiencies, the Battlefield Development Plan serves as a guide during the annual systems and tech base prioritization processes performed jointly by HQDA, DARCOM, and TRADOC. This process yields the Army Long Range RDA Plan, which in turn influences the DARCOM Long Range RDA Plan.

ARMY RDA PLANNING

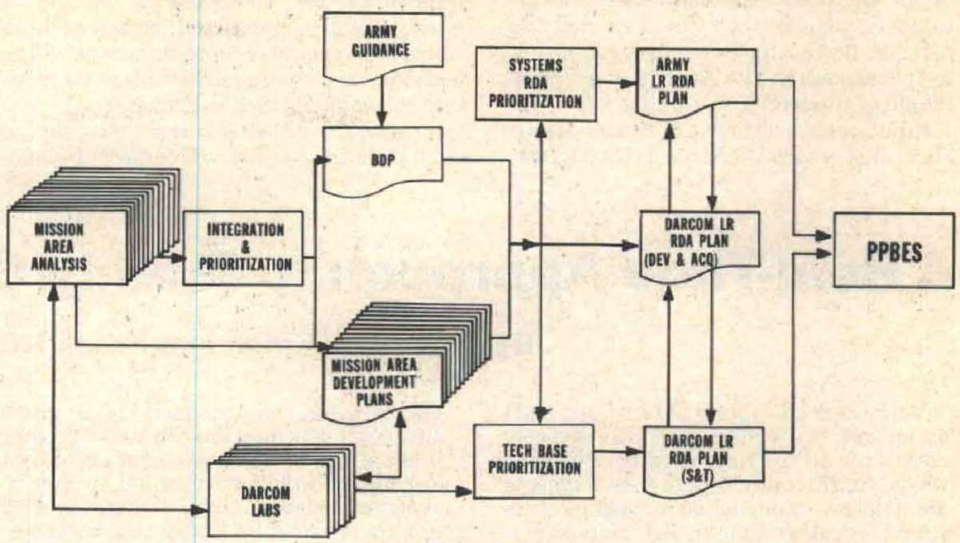

Figure 1

Materiel Developer's Role

Since DARCOM has responsibility for more than three-fourths of all RDT&E performed by the Army, it significantly influences the various processes described above. User needs obviously are not developed in a vacuum; the mission area proponents rely heavily on their supporting DARCOM labs and subordinate commands as requirements are developed. Under the overall direction of Dr. Richard L. Haley, DARCOM's assistant deputy for Science and Technology, the labs play a key role in focusing the necessary effort to develop solutions to deficiencies and in coordinating technology issues.

DARCOM began to address the problems associated with long range RDA planning in 1980, about the same time that the Army staff began work on the DA Long Range RDA Plan. DARCOM's focus, however, was on the emerging technologies necessary to meet the systems requirements of the future. A network of "gatekeepers" was established at each major subordinate command to coordinate the planning of R&D tasks in response to TRADOC's mission area analysis.

The fruit of their labors is the DARCOM Long Range RDA Plan, which is published in two volumes. The *Science and Technology Volume* describes proposed technology products across a wide spectrum of technology and mission areas. It establishes the strategy for focusing technology on identified problems, following the priorities established at an annual Technology Prioritization Conference. It also helps exploit technological opportunities, reduce duplication by subordinate commands and suppress low priority efforts.

The *Development and Acquisition Volume* explains the relationship between the technology base and planned developments and acquisitions. This volume shows the coupling and critical timing for appropriate technologies by displaying against the development schedules for each system included in the DA Long Range RDA Plan. Gaps and inconsistencies in required technology products are identified and advanced system concepts are described for the Extended Planning Annex period and beyond.

Thus, the DA Long Range RDA Plan and the two volumes of the DARCOM Plan complement each other by addressing different parts of the RDA Process and by including different levels of detail. Figure 1 graphically displays the relationship of these plans to the source of concept based requirements.

A key step in translating RDA Plans into funded programs is accomplished at the annual DARCOM Spring Review. This is an intensive management review — led by a core team consisting of senior representatives from DARCOM, TRADOC and the DA staff—which allocates resources against the established investment strategy. Because the entire long range plan as well as the current five-year program resides on a dedicated microcomputer system, we now have the capability to sort, compare and analyze RDA issues in a way that was never possible before.

Considerable interaction between TRADOC and DARCOM allows the selection of appropriate materiel responses to battlefield deficiencies. A coincident benefit from these coordinated efforts is the early identification of science and technology opportunities that appear to have significant promise for improving mission performance. The work done between the mission area proponents and the DARCOM subordinate commands and laboratories ensures that these opportunities are appropriately applied to the needs identified by mission area analyses.

The DARCOM long range RDA planning process has now completed its second cycle and has demonstrated the benefits of a strengthened partnership between user and developer. The RDA program is now more responsive to user needs and it focuses more effectively on our highest priority efforts.

Spreading the Word

The success of the TRADOC-DARCOM partnership to date argues for strengthening the bonds wherever possible. A briefing team with members from both headquarters recently visited the major DARCOM commands and laboratories to identify the roles of each of the partners and each process in contributing to the success of the Army Long Range Planning System.

Additionally, during the first week of May this year, TRADOC, DARCOM, and the Association of the U.S. Army will sponsor a symposium at Carlisle Barracks, PA, to report the results of the recently completed series of area analyses. Industry representatives will be invited to contribute their ideas on ways to correct identified deficiencies.

Assembling the finest innovative minds in the country will cement the technological advantage the United States Army possess over its adversaries — an advantage gained by early and clearly identifying requirements, by implementing a stable and consistent analysis process, and by continuing the close working relationship between the user representative and the materiel developer.

A Real-Time Approach to Quality Control in Welding

By Dawn Blackmon and Frank Kearney

Variations in welding parameters, such as arc current, voltage and travel speed, contribute to the formation of defects in welds. Additionally, other types of defects are related to inadequate welding consumables rather than out-of-limits excursions in progress parameters: loss of or moist shielding gas, or damp electrodes can cause defects in weldments ranging from porosity to cracking.

The U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL, has developed a digital system capable of monitoring weld process variables and providing continuous video or printed output. The system, named the Corps of Engineers Weld Quality Monitor (WQM), also can provide adaptive feedback control of welding parameters, maintaining them between preset limits.

In the area of inadequate welding consumables, the detection of variations in weld-arc chemistry is not a simple matter. Because of the extremely high temperatures involved, a remote sensing method is required. As a subsystem of the Weld Quality Monitor, CERL has developed the optoelectronic method for observing the arc from a suitable distance and noting variations in its composition.

A fiberoptic bundle, designed to withstand the higher temperatures of the welding arc, is used to collect light emitted by the arc in the wavelengths between 3,000 and 12,000 angstrom. The bundle terminates at the entrance slit of a spectrograph, which projects a flat field spectrum onto a 1,024 element linear diode array. This array can be scanned through the 3,000-12,000 angstrom region to observe any sample region 600°A in width. The system has a resolution of approximately .6°A.

The photodiode array interfaces with a high speed analog-to-digital converter, and a large-scale integration 11/23 microprocessor. This high-speed, microprocessor-controlled spectrograph can collect information about the welding arc along with measurements of primary welding parameters, to be used in real time quality control or stored on floppy discs for later analysis.

The intensity of an elemental emission line in the spectrum provides semiquantitative information concerning the concentration of that element in the welding arc. Because so much iron is present, relative iron emission line intensity remains virtually constant. Therefore, by normalizing the intensity of a given elemental emission line with an iron line, fluctuations in the concentration of that element in welding consumables can be observed independent of changes in weld process parameters. Using such methods, CERL research has shown that loss of shielding gas (or reduction in gas flow rate), the presence of hydrogen in the arc, or voids in flux-cored welding wire, may be readily detected.

Presence of diffusible hydrogen in a weld can cause cracking. These cracks (often referred to as cold cracks) can severely impair the mechanical properties of a weld joint and, depending on the composition of the base metal, they can be caused by extremely low concentrations of hydrogen. However, using optoelectronic weld monitoring techniques, hydrogen can be detected in shielding gas in concentrations of less than .25 percent.

In addition, it was found that the intensity of a hydrogen line at 6562.8°A increase linearly with hydrogen concentration when normalized with respect to an argon line at 6752.8°A. This technique has tremendous potential for reducing the incidence of hydrogen cracking during welding operations. Crack repairs can represent 10 to 40 percent of the cost of a finished weld. Since hydrogen cracks nearly always require repair, use of optoelectronic monitoring to prevent hydrogen cracking when welding susceptible materials could result in substantial cost reductions.

Similar methods can be used to measure variations in the rate at which argon shielding gas is supplied to the arc, or to note complete loss of shielding gas. Preliminary results have shown that by normalizing the intensity of an appropriate argon line with an iron line, it is possible to monitor variations in argon flow rate which are likely to produce porous welds.

By selecting from the many argon lines, one of the correct intensity and transition probability, shielding gas flow-rate variations can be monitored through any range, as long as the arc remains stable.

A third application for optoelectronic weld monitoring, whose feasibility has been demonstrated at CERL, is the detection of flux gaps in wires for flux-cored arc welding. In this type of welding, hollow wires filled with refractory fluxes, and sometimes alloy particles, are used.

While manufacturer quality control is generally quite good, gaps occasionally occur. Previously, there has been no practical method for nondestructive detection of this condition. However, by using the ratio of an iron line at 4,583°A to a titanium line at 4,631°A, flux gaps as small as two inches in length can be detected during welding.

Since the wire feed rate may be 15 ft/min or more, the location of a 2-inch void provides very adequate resolution. A marked change occurs in the value of this ratio, when a length of wire lacking flux is welded.

CERL research has indicated the feasibility of using optoelectronic monitoring methods to spot three common weld problems during real time: the presence of hydrogen, loss of shielding gas, and voids in flux-cored wire. The great sensitivity of the optoelectronic spectrograph, and the broad range of wavelengths it can be scanned through, suggest that these are only a few of its possible uses.

The work described was done with expensive, complex laboratory equipment which is not really suited to an industrial environment, since it requires considerable maintenance. However, development of techniques using simple interference filters with narrow passbands for the observation of wavelengths of interest has begun. This will reduce costs and decrease the sensitivity of the equipment to a shop atmosphere. Hardware and software will automatically calculate ratios of interest and alert the operator to possible weld defects.

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TRADOC and The Technology Base

By MAJ John Holmes and MAJ Stan Smeltzer

The battlefield of the 21st century is conceived to be a "high technology" clash. Weapons and support systems for fighting on this battlefield may well utilize fringe-of-the-art technology and beyond. To be prepared to fight and win in this environment, the Army is incorporating more advanced technology into its modernization programs.

The major effort underway to ensure the Army exploits the advantages of emerging technologies and integrates them into its systems is the Army Technology Base Program or tech base. Incorporating useful new technology into Army systems requires a dynamic program management that includes: a modernization program which gives direction, provides funding, and insures the competition to keep our technology advancing faster than that of our potential adversaries; and a core of scientists and engineers from industry, government laboratories and academic institutions to produce the technology.

The mission of the tech base is to keep the Army on the leading edge of technology and gain battlefield leverage by applying advanced technology to its weapons and support systems. This goal is accomplished by responding to the objectives defined by The Army Plan, Total Army Goals, and current Airland Battle Doctrine, as well as the emerging Airland Battle 2000 Concept.

The Army Plan provides policy and resource planning guidance which will shape the development of the Army through the turn of the century. It is the Army's blueprint for the future. For the near term, emphasis is being placed on acquiring the newest high-technology systems such as the Advanced Attack Helicopter and the Abrams Tank (M1). The plan also provides focus for mid-term enhancements such as new thrusts initiatives, artificial intelligence, robotics, and directed energy weapons.

The Total Army Goals, as outlined in The Army Plan, are broad expressions of purpose which will allow the Army to achieve common ends by insuring that policy development and resource allocation are consistent with stated plans and priorities. It provides an integrated cross-functional approach to focus longer range planning strategy.

The Airland Battle Doctrine and the Airland Battle 2000 Concept provide guidance on how the Army envisions fighting and winning on future battlefields. While the published Airland Battle 2000 Concept is, at present, general in nature, further development of this concept by the TRADOC centers and schools, supported by the Army's tech base community, will identify opportunities where technology can solve future system requirements.

Traditionally, the dynamic forces of materiel, training, organizations and doctrine have competed on an equal basis to influence the direction of the modernization process. In fact, in years past, materiel tended to drive the development of the other three. To change that, the Concept Based Requirements System (CBRS) was initiated. This is a system by which operational concepts, the basic ideas on how to fight, are developed first, then, from these ideas spring the doctrinal, organizational, training and materiel needs of the Army.

The system refocuses the direction of past decades from a materiel oriented flow of research and development, equipment, doctrine, training systems and organizations, to a *new concept-oriented flow* of analysis, and identification of needs that results in a simultaneous development of doctrine, organizations, training systems and materiel.

Once the broad operational concept is developed and approved, it is turned over to a study group at the proponent TRADOC center, school, or agency to conduct a functional Mission Area Analysis. Such an analysis is an assessment of the capability of a force to perform assigned battlefield tasks within a particular functional area, and is designed to discover deficiencies in doctrine, organizations, training and materiel, and to identify means of correcting these deficiencies, stressing first doctrinal, training, and organization solutions, and then, materiel solutions. The materiel development community supports TRADOC in these mission area analyses by proposing advanced technology solutions to future Army needs.

These policy and guidance tools are central to the development and management of the tech base program since they define the operational arena and requirements for new technologies. Defining new technology requirements is an important part of the modernization effort. However, it is only a part of the effort. The overall effort involves the total systems approach to satisfying requirements which looks at materiel, training, personnel, logistics, doctrine, and tactics.

When the analysis is complete, and the need for new equipment is identified as all or part of that deficiency resolution, the tech base must be ready to support it by identifying and stimulating emerging technologies.

In an era when complex systems compete for the same dollars, a system of meaningful priorities is an essential tool for decision making. In TRADOC, the prioritization process, a three-tiered effort rank-orders the individual tech base products in the DARCOM Long Range RDA Plan (LRRDA). The DARCOM LRRDA Plan is described in an earlier article in this issue, "The TRADOC-DARCOM Partnership in RDA Planning".

Initially, prioritization is performed at the 15 TRADOC proponent schools, utilizing Mission Area Analysis deficiencies as their guide. Then, the schools input is evaluated by TRADOC integrating centers (i.e., the Combined Arms Center at Fort Leavenworth, KS, the Logistics Center at Fort Lee, VA, and the Soldier Support Center at Fort Benjamin Harrison, IN).

Final coordination is conducted at HQ TRADOC where the integrating centers present their priorities to a board chaired by the Systems Management Directorate in the Office, Deputy Chief of Staff for Combat Developments with members made up of the combat developments technical advisor and individuals from each of the Combat Developments Mission Area Directorates. The product of this board is a unified TRADOC prioritization of the tech products contained in the DARCOM LRRDA Plan which becomes a decision making tool at the DARCOM tech base lab reviews.

An executive review of the DARCOM laboratories' programs and LRRDA Plan is conducted on an annual basis. An executive review board is chaired by DARCOM with voting principals from OCDSOPS, ODCSRDA, DARCOM and TRADOC. At this point, TRADOC priorities will be integrated with those of HQDA and DARCOM to develop an Army technology-base investment strategy. This process acts to stabilize and give direction to the RDA Program.

Thus far, the Tech Base Program has been discussed from the Army user perspectives. But, what about the private sector—the industrial and academic players? What are their roles, how do they interface with the Army combat developer, and how are their efforts managed as part of the Tech Base Program?

The role of industry and academia is vital to the tech base effort. Trained scientists and engineers carry on very important research. Although most of the university research is funded under the University Research Program by the Army Research Office (ARO), a field activity of DARCOM, some university programs are also funded directly by individual Army laboratories.

TRADOC is expanding its effort to inform colleges and universities of areas in which technology can enhance the battlefield. Presentation of the Airland Battle 2000 Concept briefing to universities is intended to focus the future needs of the Army where research in promising technologies is ongoing.

TRADOC also informs industry of its needs through DARCOM sponsored Advanced Planning Briefings for Industry (APBI). The briefings serve as a forum for the exchange of ideas on Army materiel needs and available technologies to meet these needs, and insures an effective Army-industry dialogue. In return, some 300 private companies who are also engaged in Independent Research and Development (IR&D), which directly benefits the Army, submit annual IR&D Plans to DARCOM.

TRADOC, along with DARCOM, evaluates and reviews these plans. The review of IR&D programs by TRADOC centers and schools provides a better understanding of the usefulness of new technologies. This understanding enables the TRADOC and DARCOM to select and accelerate programs which will more effectively resolve current deficiencies and move us more quickly into the future.

Another agency, The Defense Advanced Research Projects Agency (DARPA) is a product oriented, quick reaction, rapid turn around capability for DOD to push technology to solve difficult defense problems. Their products are demonstrations of how technology can solve needs. Normally, considerable follow-on development is required by the Service. TRADOC uses the information to increase its understanding of technological solutions available for specific requirements.

Private companies and individuals who have developed some new technology which is useful to the Army can submit their ideas to the Advanced Concepts and Technology (ACT) Committee which has members from DA, TRADOC and DARCOM. The ACT was established as a means to screen and fund unsolicited proposals for advanced technology. Many of these proposals have resulted in new Army systems or major changes to existing systems.

Well, there it is—the Technology Base Program. It involves industry, government and the academic community working together to keep the Army's equipment technically ahead of our potential adversaries. It ensures that the Army's need for advanced technology is met using an efficient, competitive program. The technology base goal is to meet the changing needs of the Army for the battlefield of the future.

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New Gonorrhea Vaccine Undergoes Tests in Korea

A new vaccine against gonorrhea, developed by the Walter Reed Army Institute of Research (WRAIR), Washington, DC, in collaboration with the University of Pittsburgh, is undergoing tests in Korea with innoculations of volunteers. Testing started in January.

The vaccine is effective against new penicillin-resistant strains of gonorrhea, the most prevalent veneral disease in the world. Over a million cases occur yearly.

The vaccine was developed by COL Edward Tramont, a nationally known immunologist in WRAIR's Department of Bacterial Disease and the infectious disease consultant to the U.S. Army Surgeon General.

The Department of Defense's interest in the new gonorrhea vaccine stems from the increasing number of strains resistant to penicillin and other antibiotics. Victims of the disease may require treatment in hospitals whose beds are needed for more serious medical problems, military spokesmen said.

The vaccine tests in Korea have been designed to ensure scientific validity and satisfy legal requirements. Before volunteers will be accepted for innoculation, they must have received full briefings from physician-researchers and then sign detailed consent forms.

Preliminary tests on 265 volunteers from Walter Reed Army Medical Center, Washington, DC, Fort Bragg, NC, and the University of Pittsburgh, PA, have shown the vaccine to be safe and to produce immunity under laboratory conditions. The Food and Drug Administration approved the vaccine's safety.

The vaccine works by blocking the organism from attaching itself to human cells, thus allowing it to be washed away during urination.

The tests will help determine the vaccine's length of immunity. (This article initially appeared in *HSC Mercury*, February 1983)

Army Plans First Conference On Artificial Intelligence

Image understanding, intelligence fusion, robotics, and expert systems are among the topics to be discussed at the first Army Conference on Application of Artificial Intelligence to Battlefield Information Management, 20-22 April, at the Naval Surface Weapons Center, White Oak, MD.

Sponsored by the Army Electronics R&D Command, and the Army Research Office, the conference is designed to bring together practitioners, theoreticians, and potential users of artificial intelligence to consider existing technologies and future applications of artificial intelligence. Deputy Under Secretary of Defense for Research and Enginering (Advanced Technology) Dr. Edith W. Martin will be the keynote speaker.

Additional conference information may be obtained from: Vicki Mayhew, Battelle Memorial Institute, 2030 M Street, N.W., Washington, DC 20036 or Telephone (202) 785-8400.

How Many, Of What, By Whom? Documenting Force Modernization

By COL G. F. Kaiser

An aspect of force modernization which is not very well understood by either combat or materiel developers is how the Army documents wartime requirements and peacetime authorizations for equipment and personnel needed to field new materiel systems.

The whole array of related acronyms BOIP, QQPRI, TOE, MTOE, and TDA is enough to discourage more than idle curiosity by the uninitiated. Many believe the subject of documentation is too complicated to fully comprehend because it involves the interrelationship of three major Army automated systems—The Basis of Issue Plan, the Table of Organization and Equipment, and the Army Authorization Documentation.

The truth of the matter, however, is that the documentation systems are not so difficult to understand once you can appreciate what each is designed to do. Furthermore, they provide a significant amount of pertinent information to the Army and a useful means for translating modern operational and organizational concepts into the Army's tactical organizations. To fully understand force modernization it is therefore important to know something about documentation.

The primary document used to determine Army-wide requirements for a new materiel system is the Basis of Issue Plan. This plan comes in two versions, tentative and final. Tentative versions are developed early in the life cycle of a system. They are submitted as a "package" with the materiel requirements document to HQDA for approval and subsequent consideration prior to the decision to proceed into full-scale engineering development.

The plan becomes a critical document because it is the only source which tells the Army which organizations require a new item, how many items each organization requires, and perhaps most importantly, the personnel and associated common and developmental item equipment changes required in each organization to accommodate the new system. This information, when applied against the Army's force file for any given year, will produce numbers of people and things required in wartime to carry out the prescribed operational and organizational concept. No other document or system does this.

The importance of automation of document development is best realized when the Basis of Issue Plan addresses a particular system having wide application throughout the Army. For example, it is relatively easy to compute requirements for M1 Abrams tanks or SGT York guns. This can be done with a hand-held calculator.

It is substantially more difficult, however, to compute requirements for Sincgars Radios, High Mobility Multi-Wheel Vehicles, and Commercial Utility Cargo Vehicles which are located throughout the force structure.

The Univac 1180 computer at the TRADOC Data Processing Field Office, Fort Leavenworth, KS, is programed to identify and compute these requirements. Input from the document development proponents throughout the Training and Doctrine Command, the Army Communications Command, the Health Services Command and HQDA is used to determine how many new items are needed and in what type units.

Not only do tentative Basis of Issue Plans provide us with the ability to scope Army-wide requirements as part of the decision process to advance into full-scale engineering development, but they also serve many other useful functions.

First, they provide a basis for programing procurement dollars for each system in the outyears of the Army program. Second, they serve as a planning document for those long lead actions, such as military construction or stationing, that require information on future requirements up to five years in advance. Third, they alert the training base to what new training or modification of existing training will be required to prepare operator and maintenance personnel to support the new system.

Additionally, Basis of Issue Plans identify, for the personnel community, those changes in Military Occupation Specialty (MOS), Additional Skill Identifier (ASI) or Speciality Skill Identifier (SSI) that will be required to establish, in the Army's force structure, the manpower spaces necessary to support the system through its life cycle.

They also identify equipment required by the training base to train these soldiers.

Lastly, tentative Basis of Issue Plans identify requirements for associated support items of equipment or related items of equipment such as trucks, radios, and generators necessary to support a particular system. Although not glamourous like the new major end item, the associated support items of equipment can become extremely critical to successful fielding of the new system.

A tentative Basis of Issue Plan is so labeled because it is based on the best information available at the time it is developed during the demonstration and validation phase early in the system acquisition cycle.

As the system matures in the development cycle and substantial new data become available prior to Operational Test II, the plan is amended. If not, following OT II, test results are used to substantiate or modify the original data and the plan development cycle is repeated in a final version.

Final plans provide basically the same information found in tentative plans but are different in that the data are supported by test results or other analyses. Final plans are also used for some different purposes. Most important, the final version's data are used to change the Table of Organization and Equipment (TOE) for each organization affected by introduction of the materiel in the force structure.

Application of approved issue plans to TOE modernizes the model TOE to recognize the requirements associated with the new system. These tables then become the basis for the user major Army commands to develop their authorization documents (Modification Tables of Organization and Equipment-MTOE).

Final plans are also used by Army installations and other activities to change their authorization documents (Tables of Distribution and Allowances — TDA) to enable them to requisition the equipment required to train or support the system. This chain of events is the lifeblood of an orderly and systematic process for providing the users the lead time and authority to requisition the personnel and equipment they are supposed to have to support a new system.

The final basis of issue development process often adds associated support items of equipment based on results of operational testing. Tests verify or update annual maintenance man-hour data and these are used to more accurately compute requirements for maintenance personnel. The completed version also generates the final MOS decision on what MOS, ASI, or SSI the Army is going to recognize to operate and maintain the system.

Lastly, final plans are used as the basis for updates of Initial Issue Quantity and subsequently Army Acquisition Objective computations, which represent the total number of a certain item needed to equip the units in the Army force structure as well as sustain that force and specified allies in wartime.

Documentation development requires

the involvement of many agencies in the Army. Within DARCOM, the project managers or materiel development commands develop Basis of Issue Plan Feeder Data, based on the operational and organizational concept provided to them by the combat developer. The materiel readiness commands take this information and develop the initial personnel requirements information.

Feeder data are screened through the DARCOM Equipment Authorization Review Activity to insure the correct nomenclature is being used and that associated support items of equipment are correctly identified.

The DARCOM Materiel Readiness Support Activity, which provides point to point contact with HQ TRADOC, combines the feeder data with the personnel requirements information and forwards it to the combat development community.

HQ TRADOC automates the information and sends it to the proponent document developers. They then develop the issue plans and return them to HQ TRADOC through the TRADOC Integrating Centers who iron out differences.

HQ TRADOC sends these documents to the interested major commands to solicit their TDA (installation and activity) requirements. When they are returned the documents are staffed within HQ TRADOC, and the Soldier Support Center-National Capital Region develops a proposed MOS decision. The documents are then packaged and sent to Office, Deputy Chief of Staff for Operations and Plans, Department of the Army for approval.

It should be evident that the Army's systems for determining requirements and authorization for new materiel systems is a detailed process involving many agencies. Many have said that the process takes too long, that it is too complex, and therefore we need to change it. On the other hand, those who use the products are not willing to accept any less data than now being received. So the next time you need to know how many of a particular materiel system an organization requires for war, remember that the Army's documentation developers are working hard within an established process to provide you with the answer.

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APG Nears Completion of Tests on New Heavy Tactical Truck

One of the Army's new eight-wheel drive trucks, the Heavy Expanded Mobility Tactical Truck (HEMTT), is nearing completion of its initial production item testing at Aberdeen Proving Ground, MD. The trucks will be fielded after testing is completed.

The HEMTT, made by Oshkosh Truck Co., WI, is a versatile 10-ton truck capable of traversing rough, cross-country terrain. Its leaf spring and tube shock suspension system is designed to carry a maximum cargo bed load of 10 tons over all types of terrain. Driven by a powerful V-8 diesel, 445 horsepower engine, made by the Detroit Diesel Co., the HEMTT includes a four-speed automatic transmission, power steering and air brakes. The vehicles cost between $130,000 and $150,000.

The five types of HEMTTs undergoing various phases of testing at Aberdeen are the M977 Cargo vehicle with a light duty crane on its rear, designed to lift 2,500 pounds with the crane; the M978 Fuel Tanker, designed for fueling aircraft and other Army vehicles, holds 2,500 gallons of fuel; the M983 Tractor version, intended to haul semi-trailers for the Patriot and Pershing missile systems, the Pershing version having a crane capability of lifting 14,500 pounds; the M984 Recovery vehicle, basically designed for pulling out other vehicles that are stuck or broken down, can lift 30,000 pounds, approximately the weight of the front end of a HEMTT; and the M985 Cargo vehicle, primarily designed for supporting rocket pods for the Multiple Launch Rocket System, has a heavy-duty, materiel handling crane capable of lifting 5,400 pounds.

According to Mr. John Hagerman, test director, APG Materiel Testing Directorate, of the 18 HEMTTs at Aberdeen, eight of the vehicles are undergoing crane testing and tanker pump testing, and ten are endurance vehicles scheduled to log 20,000 miles each.

Performance testing is also being done on the crane and pump vehicles. They went through tests such as climbing a 60 percent slope, measuring electromagnetic interference, crane and speed capacities, towing resistance, fording, cold room testing, and braking.

All trucks were tested with their full-load capacities, and additionally were tested at Phillips Army Airfield for air transportability in a C-130.

Heavy Expanded Mobility Tactical Truck-M985 Cargo Vehicle

We Don't Go It Alone!

By LTC John T. Undercoffer

How to cooperatively fight any future war has been a continuing subject of study between the U.S. Air Force Tactical Air Command (TAC) and TRADOC since 1975. This close relationship between TRADOC and TAC will help fulfill the goals of fostering closer interservice cooperation, resolving issues between the two Services, clarifying tactical roles and responsibilities for systems development, and directing greater attention to the effects of force structures and mixes.

This unique interaction between the two separate Service headquarters is successful simply because of the desire of the two respective commanders to harmonize appropriate joint Service activities for improved combat capability. While this arrangement exists on a daily basis and is facilitated by the close geographical location of the two headquarters in Hampton, VA, representatives of both the Navy and Marine Corps frequently participate in studies and programs which are of special interest to them.

To provide for daily management of joint programs, a separate staff directorate has been formed and jointly manned by the two headquarters. This activity, titled the Air Land Forces Application (ALFA) Agency, has as its primary mission the management of development of improved joint concepts and procedures in support of the Airland Battle. The agency is a small one, consisting of five officers from each command headquarters, with the directorship vested in a colonel, whose Service rotates annually between TAC and TRADOC.

A General Officer Joint Action Steering Committee was established to provide executive guidance to the agency and to define ongoing and planned activities. The Deputy Chief of Staff (DCS) for Plans is the HQ TAC representative, while the DCS for Doctrine is the TRADOC representative, and the agency works directly for them, being charged to reflect the interests of both headquarters in a joint manner.

Quarterly meetings are conducted to guide the progress of joint efforts, with representatives of the other Deputy Chief of Staff offices of each headquarters attending these meetings and actively participating in shaping the list of joint activities and goals. Further guidance is provided by the commanders of TAC and TRADOC who meet several times each year in what are called, in local staff jargon—"Eight Star Meetings," to review the accomplishments of joint work. They discuss current issues, develop guidance and prioritize efforts.

Most of the ALFA-managed effort is concept and procedures oriented, and is not involved with specific materiel development issues. To address hardware requirements, another TAC-TRADOC relationship has been formally established between the TAC DCS for Requirements and the TRADOC DCS for Combat Developments. Again, quarterly meetings are held to review ongoing or planned hardware developments and encourage technological and system interoperability, avoiding unnecessary duplication where possible. Through this medium, the two commands routinely exchange and coordinate materiel development documentation before submitting it to their senior headquarters.

In addition to the high level staff interface, many HQ TRADOC and TAC staff directorates interact on an action officer to action officer basis. This is most prevalent in the field of reconnaissance surveillance and target acquisition. Approximately 20 separate joint procedural and materiel actions are underway or have been completed during the past several years between the two headquarters.

There is a unique spirit of cooperation and interest between HQ TAC and TRADOC. One could ask, to what end does all this effort lead? First and foremost, it leads to better mutual understanding and support for Service-unique efforts. Air Force support of the Army's Airland Battle has its roots in this dialogue.

However, understanding and moral support alone will not do the job. Where differences exist or combat effectiveness can be improved jointly, the two Services must work together. To this end, over the past several years, HQ TAC and TRADOC have initiated a series of studies and programs. One of special merit was the analysis of solutions for the Joint Suppression of Enemy Air Defenses.

As a result, in 1981 the innaugural Joint Concept and Operational Procedure document for Joint Suppression of Enemy Air Defense was published. This document, endorsed by the U.S. Readiness Command, is in use throughout TAC, Readiness Command assigned units, and the TRADOC school system.

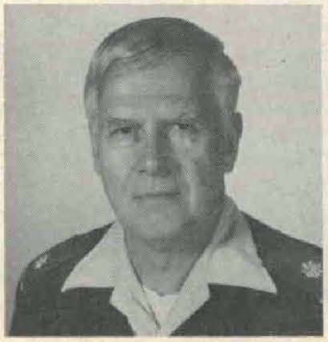
A TAC-TRADOC study resulted in publication of a detailed assessment of the U.S. and Allied capability to defend the airspace in Europe. The result—U.S. Air Force, Europe and U.S. Army, Europe, are now in the process of reviewing air defense concepts for the European Theatre.

The current prime study effort is directed toward joint attack of enemy second echelon forces—one of the requisites for successful accomplishment of Airland Battle Doctrine. In December 1982, TAC and TRADOC published a concept titled, "Joint Attack of the Second Echelon." Detailed joint procedures are being developed and will be provided to the field in draft by summer 1983 for use and evaluation in the annual autumn field exercises.

On the hardware side, a joint operational procedure document for the U.S. Air Force Airborne Communication Jammer has been developed and published. TAC and TRADOC are also working closely in the area of Aerial Mining and in the field of secure voice communication interoperability.

On a broader scale, HQ TRADOC was instrumental through working with HQ TAC in acquiring a special U.S. Air Force five-man liaison team to work closely with the 9th Infantry Division High Technology Test Bed, assuring ready and available Air Force expertise to this important Army high technology-oriented effort.

While the TAC-TRADOC relationship is not a panacea to resolve all differences in Army-Air Force philosophy, roles and missions, it does offer a unique and time tested capability to address selected problem areas. This success is due largely to the cooperation of the commanders involved, the absence of entrenched staff parochialism, and a growing awareness of each Service's contribution to jointly fight and win the next war.



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Total System Management: 'Representing The User'

By CPT John Ailport

Total system management. What is it? Why did it develop? How are we doing? Answering these questions requires a look back in time. With the end of the Vietnam War, the Army began reevaluating its missions and capabilities, both in Europe and other regions of the world, and many difficulties were encountered as the Army tried a crash program to rebuild and reequip its conventional ground forces.

By 1977, the Army encountered increasingly severe problems with the way new systems were being developed and fielded. The average development cycle was long, 7-12 years on the average, and systems were becoming so complex that our soldiers found them difficult to operate.

As might be expected, the maintenance burden associated with these systems grew rapidly as their technological sophistication increased. Identification of training requirements lagged, as did personnel actions, supply and other non-hardware components of the total system. The fundamental problem was that new technology and hardware, not user needs, were driving the R&D train.

Previously, logistics, training, personnel and other elements which make a complete system were generally ignored until the full-scale development phase, or later. Total systems management changed all that. Before discussing total systems management, let's look at what happens when the total system is not ready.

Imagine yourself, a new company commander, eagerly awaiting shipment of all new tanks. The long awaited day arrives and you move to Vilseck to accept your new chariots. But, alas, the motor sergeant comes in with a problem. A new type of hydraulic fluid is required for a recoil mechanism on the new tanks — there is none.

A frenzied search is made through your support unit. Eventually you realize that none is available in country. As you sag disgustedly into your chair, the communications sergeant comes in. He explains that the radios shipped with the new tanks don't have all the proper mounting equipment. There are no additional radio mounts and you've got to turn in your old tanks complete with all the radios, mounts and other basic issue equipment.

While these problems are turning you prematurely gray, the 1st sergeant asks if you know why the SIDPERS printout is wrong. It doesn't have the correct (new) military occupational specialty (MOS) for the mechanics who are supposed to repair the new, highly sophisticated tanks. He says that your unit can't requisition replacement personnel with the correct MOS because they aren't on your SIDPERS printout.

Further, he tells you, your new crop of mechanics, fresh out of school on the new tank, have been deleted from your rolls as excess because they have the "wrong" MOS. Obviously, the Table of Organization and Equipment wasn't modified to authorize your unit the right people. Does this sound familiar?

The Army, as a result, initiated a series of actions to correct these problems. One major improvement was development of the total system concept. Such a system includes the materiel, training, personnel, logistics, doctrine and other essential elements which, along with the hardware, comprise a complete, operationally ready weapon system.

These elements must all be identified, integrated and tested early in development, and refined throughout the materiel acquisition process. Total system management is a process to oversee the entire development and acquisition process to insure a complete system is fielded. Elements of the total system include: individual and unit training; manuals (FMs, TMs, et. al.); personnel and organizational structure; logistics requirements; training devices; test, measurement and diagnostic equipment; along with ancillary item and support equipment. Keeping all these different actions tied together is tough.

The process is frustrating, and often confusing, but the commander in the field has a right to expect a new system to be fielded which is ready to use. A problem in any of these areas places a tremendous burden on the gaining unit when the system is finally fielded.

Total system management is initiated at the beginning of the program. The complete system is considered when DARCOM and TRADOC draft the Letter of Agreement, before the weapon system enters the demonstration and validation phase of its development.

Logistics, training and other support plans are evaluated during Operational Testing I which is the final segment of the demonstration and validation phase. The systems operational requirements, usually stated in the Required Operational Capability, address elements of the total system. During full-scale development, Operational Testing II verifies that the complete system, from hardware to training manuals, meet the Army's requirements and is ready for type classification.

Management of total systems is accomplished by TRADOC in two different ways, depending on the type of new system. A TRADOC system manager is assigned for major and selected non-major systems. For remaining non-major items, the proponent school is assigned total system management responsibilities.

A TRADOC system manager (TSM) is assigned for each major system and for certain designated acquisition programs, and this system manager is located at the TRADOC school which has proponency for his system. There are currently 30 such managers authorized by HQ TRADOC. This number may vary depending on the number of major programs requiring special total system management.

In addition, a TRADOC System Manager may be authorized for a number of like systems which represent a single function. An example is the newly created manager for mines, located at Fort Belvoir.

What specifically does the TRADOC System Manager do? His primary function is to insure that the user is represented during development and fielding of a weapon system. He insures that the combat developer and the training developer from the TRADOC school plan the training, develop the organizational structure and employment concept for the system, develop requirements documents and staff decision review positions.

Another function is to staff the Materiel Fielding Plan with the gaining command and identify remaining problems for resolution. He is an expediter, not a functional guy. His job is to facilitate actions: e.g., to see that a BOIP is properly prepared by the right people, not do it himself.

The TRADOC System Manager is the user's project manager and the DARCOM PM's alter ego. Finally, as the TRADOC CG's personal representative, he is frequently called upon to justify the need for the program at HQDA, OSD and on Capitol Hill.

The TRADOC manager is much akin to the DARCOM PM. While both are chartered to manage a portion of the program, the essential difference lies in their overall responsibility. The PM is responsible for complete development and fielding of the system to include handoff new equipment training.

The TRADOC manager on the other hand, watches over the system to insure that individual and unit training, organizational structure and a myriad of other TRADOC actions, such as basis of issue planning, are completed on time, and that the user's views are presented to the PM. They form a partnership. Together, they insure that the total system is ready when the hardware is ready.

The second method for performing total system management addresses non-major systems. Here the proponent TRADOC School Director of the Combat Development Office performs this management function. Whether large or small, the fielding requirements are the same, and failure to perform them have the same impact on the using unit. Whether managed by a TRADOC System Manager or by the proponent school, the TRADOC commitment to total system management is fulfilled.

The process of developing and fielding a new system is extremely challenging. Complex interrelationships between DARCOM and TRADOC create many opportunities for Murphy's Law to creep in. Not all the programs fielded since the creation of total system management have been developed and issued to the user without problems, but significant overall improvements in the fielding process have been made. Total system management does work but must be continually improved to provide better support for the user in the field.

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Modernizing Military Symbology

By Beverly G. Knapp

Although modern warfare bears little resemblance to that of the Napoleonic era, some of the symbols for depicting battle have not changed in 300 years. Field Manual 21-30 and the related NATO version, D-49 (1980), list symbols for disclosing mostly static functions, such as unit type and location. Symbols for dynamic functions, such as attack capability, status of weaponry, and unit morale, are lacking.

There is wide agreement that conventional symbology is inadequate for modern command, communications, control, and intelligence (C^3I). As a consequence, many agencies, system developers, and research organizations have independently developed new symbols. For example, there are currently in use 27 ways to show a helicopter.

The loss of standards through symbol conflicts and independent development reduces the communication value of battlefield displays. The result is potential misunderstanding, confusion, error and delay.

Part of the human factors research effort of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is directed toward solving the problems in current military symbol use. Key problems are too many symbols for the same or similar concepts, and no symbols for dynamic concepts of modern warfare. Three steps have been taken: creation of TACSYM, an automated symbol catalogue; a survey of user needs for symbols; and development of a mathematical formula to compare symbols for ease of recognition.

TACSYM is an automated catalogue of over 600 symbols indexed by concept, category and source. A typical user command from the computer terminal might be, "Let me see all the radar symbols." The accompanying illustration shows the resulting display of symbols, source, identification and comments.

The TACSYM program includes an explanation section for using the data base and instructions on how to construct and input new symbols. This latter feature, in effect, establishes a user network for military symbology so that a standard symbol set for cross-system use can be eventually achieved.

TACSYM is currently installed in an experimental/demonstration capacity at the wargames facility, Combined Arms Center, Fort Leavenworth, KS. With the imminent transfer of TACSYM to ARI headquarters in Summer 1983, symbol users, symbol developers and doctrine developers will be able to access the new system through existing computer lines.

ARI surveyed 42 officers with field unit experience and familiarity with current doctrine to produce an inventory of modern symbol needs. Over half of the officers indicated that the standard symbology of FM 21-30 is inadequate for such concepts as updating unit status, current unit strength, firepower, mobility, threat, logistics support capabilities, types of enemy formations, and weapon range fans. Many officers are using nonstandard, innovative techniques to modify or create symbols for these concepts.

ARI has begun to develop a mathematical formula to rate a symbol's "recognition value"—how quickly a symbol can be detected when several symbols are seen together or against various display background. Symbol characteristics, such as number of lines, angles, triangular vs. circular structures, are parts of the formula.

The TACSYM catalogue highlights the fact that there are a vast quantity of unique symbols in existence. It allows comparisions among symbols by concepts and categories, and provides a vehicle for new symbol entry and user feedback. A need still exists to develop new symbols, and to expand the prototype technique available to evaluate conflicting symbols, in order to arrive at the "optimal" symbol set.

ARI has developed procedures for processing of user feedback to TACSYM and established entry format techniques for new symbols or symbol sets. The user network that is being established for military symbology will allow dialogue and initiatives on the best symbols for modern needs to begin.

Reader comments regarding the emerging TACSYM and other symbology issues are welcome. The symbology POC and coordinator is Beverly G. Knapp, U.S. Army Research Institute, 5001 Eisenhower Ave., Alexandria, VA 22333, ATTN: PERI-SF; AV 284-9134; AC 202-274-9134.

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TRADOC and Army RSI

By MAJ James L. Fry and CPT Denney K. Nivens

Technological advances and weapons modernization by the Warsaw Pact have become a growing challenge to NATO forces in their bid to retain the technological edge against the Pact's superior number of conventional systems. This increased modernization and sophistication of Warsaw Pact systems dictate that NATO forces learn to operate together on the battlefield to ensure their survival in any future NATO-Warsaw Pact confrontation.

Yet, the phenomena of modern technology aggravates the difficulties of fielding interoperable NATO combat systems because of differing national goals, capabilities and resources among member nations. Recognizing the existence of this condition, the U.S. Army's Rationalization, Standardization and Interoperability (RSI) Program is designed to overcome some of these difficulties — overcome them by focusing on efforts to improve the interoperability, and therefore battlefield survivability, of NATO military forces.

Initiated by the 1977 Defense Appropriations Act and Public Law 94-361, the program improves the interface between the U.S. and Allied Armed Forces by conserving resources in the industrial base, concentrating research and development and procurement efforts, and by promoting the need for common doctrine and training. The ultimate goal of the program is to increase the effectiveness of the combined combat power of the Alliance.

The RSI Program makes use of existing allied development projects by involving the U.S. in joint development initiatives, or by purchasing "off the shelf" foreign equipment which fits the needs of the U.S. The RSI Program also focuses on increasing the interoperability of NATO Armed Forces by developing joint concepts, doctrine, and equipment; administrative procedures; intelligence gathering and dissemination methods; and operations and logistics techniques that ensure alliance forces can fight effectively together on the battlefield.

TRADOC plays a key role in the Army's overall RSI effort, and its focal point in this effort is the International Army Programs Directorate. As the proponent for the development of tactical and logistical concepts, doctrine, training, and equipment requirements documents, TRADOC works with various allies through Army level Bilateral Staff Talks, NATO, and the Australian, British, Canadian, and American Programs.

The NATO organization within which the U.S. pursues RSI is large and complicated. Because of the political and economic structure of the alliance, political considerations significantly influence the standardization process. Nonetheless, military input to the process is essential; and in areas such as concepts and doctrine, it is the main ingredient for achieving interoperability.

In NATO there are two major organizations that deal with RSI. These two organizations, the Conference of National Armaments Directors and the Military Committee are immediately subordinate to the NATO Defense Planning Committee. The Council of National Armaments Directors promotes cooperation in research and development, and in procurement of future military equipment. It oversees several subordinate working groups including the main armaments groups.

The Army Armaments Group is of primary concern to TRADOC. The panels in the Army Armaments Group deal with all facets of equipment, from electronics to combat vehicles. There is also a panel on Tactical and Logistical Doctrine. Although HQDA is represented on most of these panels, TRADOC participates in the development of concepts and doctrines which are presented at the panel meetings. On many of these panels, TRADOC provides supporting delegates to the primary representative.

Subordinate to the Military Committee is the Military Agency for Standardization (MAS). This agency seeks to standardize military doctrine and procedures and achieve interoperability and interchangeability of equipment already in the field. The MAS addresses current military issues to enable NATO forces to operate together effectively.

Within the Military Committee, TRADOC participates in various working parties which meet on an annual basis. Through these working parties, the NATO community has developed common doctrine and procedures, allowing the Armies to operate effectively together.

Means of standardizing equipment and major logistical items have also been developed through these working parties to encourage materiel logistical support capabilities.

In these NATO programs, TRADOC actively participates annually in approximately 35 NATO Army Armaments Group and Military Agency for Standardization meetings and contributes to the efforts of another 26. These agencies have developed some 1,300 standardization agreements and 45 Allied Tactical Publications that TRADOC must incorporate in U.S. doctrine and training literature.

The Australian-British-Canadian-American (ABCA) Program is basically organized in the same way as the NATO organizations. It is driven by the Tactics, Equipment and Logistics conference where the vice chiefs of staff of the participating nations meet to review the accomplishments to date and outline the objectives and guidelines of future endeavors.

Within the ABCA Program there are a number of working groups very similar to NATO panels and working parties, known as the Quadripartite Working Groups (QWG). Their functions and purposes are similar to the NATO counterparts.

TRADOC participates actively in the Working Groups with representation and staffing efforts. Many of the representatives of the Groups also represent TRADOC in the comparable NATO working parties, adding continuity to the programs. Also organized in the ABCA programs are Information Exchange Groups designed to exchange correspondence on specific subjects deemed to have potential for standardization but not yet at a stage where achievement is likely. ABCA principals may also organize Special Working Parties to achieve tasks requiring expert examination beyond the QWG capability.

TRADOC, DARCOM and TECOM together identify and test foreign equipment which may meet requirements of the U.S. Army under a program called the International Materiel Evaluation. The focus here is to cut R&D costs by fielding systems already in existence.

Finally, the TRADOC CG is the DA Executive Agent for bilateral Army initiatives with the United Kingdom, West Germany, and France. In that capacity, he conducts Army level Bilateral Army Staff Talks with each of these allies. Here the focus is on concept development, doctrine, training issues, and materiel development.

Through this mechanism, the U.S. Army has measurably improved the interoperability of some of the forces and equipment in the central region of NATO and combined concepts and materiel requirements for future operations and Army organizations. For example, the Army's Airland Battle 2000 concept has been discussed in hopes of aligning future U.S. and allied doctrine at the Corps level and below.

An example of more tangible RSI progress is the development of bilateral concepts such as the U.S.-German Concept

Armor Operations of the 1980's, and the development of trilateral monographs — such as the UK-GE-U.S. paper on "Soviet Use of Smoke and Obscurants".

Examples of RSI materiel progress are interoperability efforts such as the U.S.-UK SIGMA-WAVELL and TACFIRE-BATES projects, the U.S.-GE SIGMA-HEROS (The SIGMA Program is for Force-Level Maneuver Control Systems) and TACFIRE-ADLER projects, and a proposed U.S.-French SIGMA-SACRA project. In addition to these Staff Talks, TRADOC sponsors a doctrine exchange program with Canada in which doctrinal matters of mutual interest are discussed.

In conclusion, the pursuit of RSI is not a separate, independent program but consists of many initiatives throughout the Army. The RSI effort represents a commitment by the Army to accomplish those actions which improve its ability to operate with its allies at the lowest possible cost to all, and TRADOC plays a key role in that commitment.

MAJ JAMES L. FRY is the UK-U.S. Army Staff Talks Program Manager at HQ TRADOC. He received a commission in Armor from the University of Tennessee in 1967, and served two tours in the 3rd Armored Division, including assignments as tank platoon leader, company XO, company commander and BDE S-5.

CPT DENNEY K. NIVENS is the NATO action officer in Combat Developments, HQ TRADOC. He was commissioned in 1973 from Wichita State University and has served numerous assignments in both the 1st Armored Division and the 3rd Armored Division.

Plating Process May Save $100 M Annually

Use of a portable, high speed metal plating process to repair previously scrapped aircraft components could, when implemented throughout the Army, result in savings that exceed $100 million annually, according to a recent announcement from New Cumberland Army Depot, New Cumberland, PA. Mr. Vincent J. Varankar, the depot's value engineering program manager in the Directorate for Resources Management, said that the projected savings at New Cumberland are $5 million for FY 83.

Currently, the plating process is being used by depot personnel on CH-47 helicopter components being repaired in the Aircraft Shops Division, Directorate for Maintenance. However, it can also be used to repair components of all other Army aircraft as well as vehicle parts.

Varankar stated that this process is targeted for implementation in the 16 active and 11 inactive Army divisions. The study was initiated by Mr. Barry Panza, chief of the depot's Support Section of the Fabrication Branch, Directorate for Maintenance.

"A large quantity of worn or damaged CH-47 components that were being sent to New Cumberland for repair," Panza stated, "were being sold for scrap because portions of the metal surface, which were nicked, scratched, pitted or out of tolerance, were considered unrepairable."

"We had a real challenge on our hands," Panza continued. "The plating equipment that we had been using for other types of work was too bulky and didn't have sufficient electrical output to do this type of plating properly. Also, additional equipment would be needed to grind the surface."

"Doing the plating this way would not be cost effective," he said. "It would take about 80 manhours to repair a CH-47 landing gear at a cost of about $30 to $35 per hour. With the new plating process it takes only one manhour to do the work," he added.

"The result was a savings of $60,000," he continued. "Six landing gears and several other components previously destined for the scrap heap were once again in good, usable condition."

Marketed by Selectron Ltd., of Waterbury, CT, the process is a high-current density, electrochemical method that uses hand held plating tools and direct electrical current to deposit metal coatings which form an excellent bond with base metals. "By using this process," Panza said, "the components are once again as good as when they were new — sometimes even better."

ATTENTION Authors

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

• *Length.* Articles should be about 2,500 to 3,000 words. Shorter or longer articles are acceptable, depending on what is required to adequately tell the story.

• *Photos.* Include any photographs or illustrations which complement the article. Black or white or color are acceptable. We cannot promise to use all photos or illustrations and they are normally not returned unless requested.

• *Biographical Sketch.* Include a short biographical sketch and photo of the author/s.

• *Clearance.* Article must be cleared by author's security/OPSEC Office prior to submission.

Articles should be addressed to: HQ DARCOM, ATTN: DRCDE-OOM, 5001 Eisenhower Avenue, Alexandria, VA 22333. Telephone: Autovon 284-8977, Commercial 202-274-8978.

Training Device Development & Management

By Charles E. Harris

It is a known and proven fact that success and survival on the battlefield relate directly to the quality of training a soldier receives before he goes into combat. The better the training, both individual and collective, the more likely the soldier and his unit will engage the enemy successfully.

At one time, training was a relatively uncomplicated matter — the soldier learned on the equipment. However, for a variety of reasons, that is no longer possible, so the Army now must look to alternative methods of training.

Operational hardware on which to train quite often is not available, or it costs so much to operate that the Army just can't afford to use it for training. In other instances, even if the equipment were available, it would still be preferable to use a training device. A flight simulator, for example, can teach a student the proper reaction to an emergency situation that could never be duplicated safely in an actual aircraft. The result has been an increasing reliance on the so-called training device.

There are two types of training devices — system and nonsystem. A system device is developed in support of a specific system and is designed for use only with that system, including its subassemblies and components. It is the responsibility of the system project manager or appropriate materiel developer to develop, fund and procure the device concurrent with the parent system.

The requirement document for the device is included as an appendix to the requirement for the system itself. This overcomes the time lag that has historically existed between the fielding of the system and fielding of the device necessary to operate and maintain the system.

It does no good to have an advanced weapon system in the inventory if it can't be operated or maintained effectively. Another benefit derived from having the two documents together is that it provides more assurance that the training device will receive the same priority as the system it supports.

In contrast, a nonsystem device is one developed to support general military training, or training on more than one item or system. This type of device can be developed, funded, and procured by the materiel developer, normally Project Manager for Training Devices (PM TRADE) or the trainer.

Every training device has a proponent, normally a service school that prepares the initial documents and monitors the device as it progresses through the various phases of its life cycle. The proponent also recommends disposition of the device when it is no longer serving its intended purpose. That could include transfer to reserve components, foreign military sales, or classification as obsolete and disposal.

Even though this article deals with training device development, training devices should not be considered the ultimate answer to all training problems. Quite often, other types of training aids such as audiovisual, literature, etc., would be preferable. The establishment of a training device requirement should come about only after a comprehensive front end analysis has shown beyond all doubt that a device would be a vital factor in meeting training needs. In short, the front end analysis is the keystone to the generation of any requirement document.

The development of a system training device generally follows development of the system itself and should begin once the Justification of a Major System New Start, which is prepared by the combat developer, has been approved. If the training device is going to be available for Operational Test II of the system, the training developer must become involved during the earliest phase of the system development.

There must be close coordination between the trainer and combat developer to be sure that the training device accurately reflects the new system. Additionally, training developers from logistic-oriented schools must be brought on board early to allow for consideration of any maintenance trainers that may be necessary.

As the combat developer prepares the Required Operational Capability (ROC) or Letter of Requirement (LR), the training developer should be preparing his input to the training paragraph and the training device appendix.

The training paragraph should address the need for skill performance aids; user and maintainer description; time allowed to train; new equipment training requirements for Operational Testing II, instructor and key personnel training, and units to receive equipment when distributed; training materiels; and a listing of validated training devices required or a statement that the proponent, in coordination with the supporting schools and materiel developer, has determined that no devices are required.

Characteristics of all devices listed in the training paragraph are included in the ROC or LR as an appendix. The appendix is provided to the school combat developer, who, in turn, forwards it to HQ TRADOC. The Army Training Support Center (ATSC) approves the appendix prior to submission to HQDA.

For each training device developed, a Basis of Issue Plan and Qualitative Quantitative Personnel Requirements Information must be developed. The issue plan becomes part of the system Basis of Issue Plan package and will be added to the TOE/TDA with the rest of the system.

As stated earlier, nonsystem training devices are not tied to a particular system. They are developed to overcome a problem that has been identified in a working training program.

If the required device is available commercially, the proponent submits a Commercial Training Device Requirement (CTDR) to the Army Training Support Center (ATSC). To qualify for acquisition via such a requirement, the device must be available without expenditure or RDTE funds and must be exempt from type classification.

Exemption from type classification is determined as a result of coordination with PM TRADE. This device requirement document was inaugurated a little over two years ago to reduce the time required to process requirements documents and procure a needed training device. It can be used in lieu of a Training Device Requirement (TDR) or a Training Device Letter of Requirement (TDLR) for procurement, reprocurement, and modification of nondevelopmental devices.

Commercial Training Device Requirements are divided into two categories — command peculiar and Armywide. The two categories are further subdivided into those $3,000 or more and those less than $3,000. Armywide type requirements are approved by TRADOC unless there is a DARCOM (PM TRADE) nonconcurrence, or the total purchase cost exceeds $1 million per year or $5 million in five years. Command peculiar requirements are approved by the major command following coordination with the Army Training Support Center and PM TRADE. If there is a nonconcurrence by either or if the cost exceeds the above funding limitation, the requirement is forwarded to HQDA for staffing and resolution.

Armywide Commerical Training Device Requirements are budgeted by PM TRADE utilizing the proper procurement authority in accordance with the Support Center's established priorities. Command peculiar requirements (over $3,000) are budgeted by the major command through Base Level Commercial Equipment funding channels, while those devices with a unit cost of less that $3,000 are budgeted using OMA funds.

Armywide commercial devices are procured by PM TRADE and distributed to the field in accordance with the prioritized distribution plan. Normally, command peculiar commercial requirements are procured by the major command, however, procurement assistance may be requested from PM TRADE or from the Support Center which will be decided on a case-by-case basis.

Nonstandard spare parts to support devices procured with any Armywide commercial requirement are provided by PM TRADE, however, support for command peculiar devices is the responsibility of the major command and maintenance for both types is a major command responsibility unless previous arrangements have been made with PM TRADE. To procure devices that do not qualify under the Commercial Training Device Requirement Category the TRADOC proponent prepares a Training Device Needs Statement (TDNS) and submits it to the Army Training Support Center. The Center then uses the information in the plan to develop a Long Range Work Sheet. The Needs Statement may be submitted anytime during a calendar year, but if it is submitted after 15 March, funding for the device generally will be a year later than it would have been had it been submitted before 15 March.

The Long Range Work Sheet is coordinated with PM TRADE to determine the appropriate funding profile for development and procurement. This also allows PM TRADE and the Training Support Center to determine the most appropriate development strategy. Following this, the Long Range Work Sheet is submitted through HQ TRADOC to HQDA.

After the Needs Statement has been evaluated by the Center and PM TRADE, the proponent will be directed to prepare one of three different type documents — a Training Device Letter of Agreement (TDLOA), a Training Device Requirement, or a Training Device Letter Requirement. If a letter of agreement type is prepared, the proponent must prepare either a Training Device Requirement or the Letter Requirement type document. The Letter of Agreement type only authorizes advanced development to determine if a training device is feasible, and, if it is, its complexity and cost. The other two are used to authorize development and procurement.

If the device cost exceeds $2M RDTE, $3M Procurement in one year, or $15M in five years, then the appropriate document is a Training Device Requirement. If it is less than the above figures, a Letter Requirement is used. The main difference between the two documents is that the first must be approved at HQDA level, while the the latter is jointly approved by TRADOC and DARCOM.

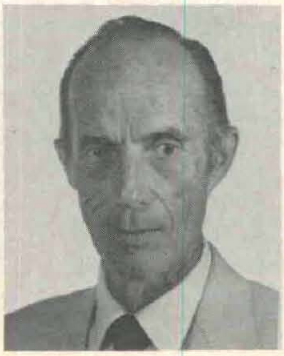
To explore available training alternatives based on applicable costs and potential training effectiveness, there is a process called the Training Development Study (TDS). It is submitted prior to each decision point in the acquisition cycle of a device developed under a Device Requirement or a Letter Requirement. And, as with a system device, each nonsystem device must also have a Basis of Issue Plan and Qualitative and Quantitative Personnel Requirements Information to predict the number of devices required and any equipment or personnel changes that may be necessary to accommodate the new device, while the Personnel Requirements Information provides information used to make MOS or SSI decisions and estimates the cost of the new device in terms of manpower.

Logistical support for training devices varies according to the complexity of the device, numbers of devices, location, and a number of other factors. Therefore, the logistic support plan is developed on a case-by-case basis — this is normally done by DARCOM in coordination with the Support Center and the U.S. Army Logistics Evaluation Agency. However, the proponent is responsible for providing a logistical support concept in the requirements document and this should not be unilaterally changed once concurrence is reached.

Repair parts support for system and nonsystem devices depends on whether the device is type classified or nontype classified. If type classified, the repair parts are the responsibility of the commodity command that fielded the device. They are normally provided either by the contractor, if one has been specified, or by requisition under Military Standard Requisition and Issue Procedures — commonly known as MILSTRIP.

Maintenance of devices that are line items or an MTOE will be accomplished in the same manner as the maintenance on the equipment they support and the devices will have the same priorities and maintenance records. For devices not listed on an MTOE, organizational maintenance is the responsibility of the Training and Audiovisual Support Center while DS/GS maintenance is provided by the installation maintenance activity. For those devices where contractor support has been specified, the on-site contracting officer representative acts as liaison between the Government and the contractor establishing priorities and performance standards.

Generally speaking, assignment of maintenance missions at all levels is accomplished under policies and procedures contained in AR 750-1 and AR 750-7. Any exceptions must be approved on a case-by-base basis by HQDA (DALO-SM) through the requirements document approval process.



CHARLES E. HARRIS is chief of the Operations Division, Devices and Systems Training Directorate, Army Training Support Center, Fort Eustis, VA. Following service in the Navy during World War II, he received his liberal arts education from the University of Pacific and Oklahoma State.

TRADOC SYST

***ACRONYMS:**

BFVS — Bradley Fighting Vehicle System
HUMMV/LAV-25 — High Mobility Multipurpose Wheeled Vehicle and Light Armored Vehicle-25
DIVAD — Division Air Defense Gun (Sgt York)
TASCE — Tactical Automatic Switched Communications Equipment AN/TTC-39
SINCGARS — Single Channel Ground and Airborne Radio Subsystems
TACSATCOM — Tactical Satellite Communications
ATACS — Army Tactical Communication Systems
ATSS — Automatic Test Support Systems

***BFVS**

COL Walter R. Jones

***HUMMV/LAV-25**

COL Floyd McAfee

***DIVAD**

COL Charles C. Clarke, Jr.

PATRIOT

COL Kurt L. Keene

ROLAND

COL Ronald L. Peden

***ATSS**

COL Emil J. Klingenfus

***ADDS/MSE**

COL Charles L. Gordon

GROUND TAC EW/INTEL SYS

COL James E. McMahon

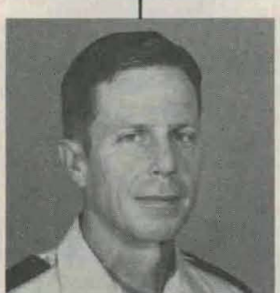
***SEMA**

COL Leonard G. Nowak

***ASAS**

COL Floyd L. Runyon

SCOUT HELICOPTERS



COL Robert S. Fairweather

UTILITY HELICOPTERS

COL C.F. McGillicuddy

HELLFIRE *MLMS

COL Lee C. Smith, Jr.

COPPERHEAD

COL Laurence R. Peate

***FIREFINDER (Acting)**

PHOTO NOT AVAILABLE

MAJ Douglas Brown

EM MANAGERS

ADDS/MSE — Army Data Distribution System/Mobile Subscriber Equipment
SEMA — Special Electronic Mission Aircraft
ASAS — All Source Analysis System
SIGMA — Force Level and Maneuver Control
MEP/ECE — Mobile Electric Power/Environmental Control Equipment
HELLFIRE/MLMS — Heliborne Fire and Forget Missile/Multipurpose Lightweight Missile System
FIREFINDER — AN-TPQ36/AN-TPQ37 Counterbattery Radar
MLRS — Multiple Launch Rocket System
FATDS — Field Artillery Tactical Data System
RPV — Remotely Piloted Vehicle

STINGER

COL James E. Leach

***TASCE**

COL Berkley Whipple

***SINCGARS**

COL David W. Partin

***TACSATCOM (Acting)**

COL David W. Partin

***ATACS (Acting)**

COL Emil J. Klingenfus

TANK SYSTEMS DEVELOPMENT

COL Samuel L. Myers, Jr.

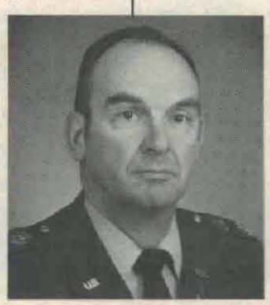
***SIGMA**

COL Williams S. Kromer

***MEP/ECE**

COL Richard H. Benfer

MINE WARFARE



COL H.G. MacGregor, Jr.

ATTACK HELICOPTER

COL Lee C. Smith, Jr.

***MLRS**

COL George L. Moses

PERSHING II

COL Robert W. Salley

***FATDS**

COL Louis C. Fancher

CANNON

PHOTO NOT AVAILABLE

COL Malcolm L. Marks, Jr.

***RPV**

PHOTO NOT AVAILABLE

COL Joseph M. Patterson

ISS: What Is It?

By MAJ Bob Currey

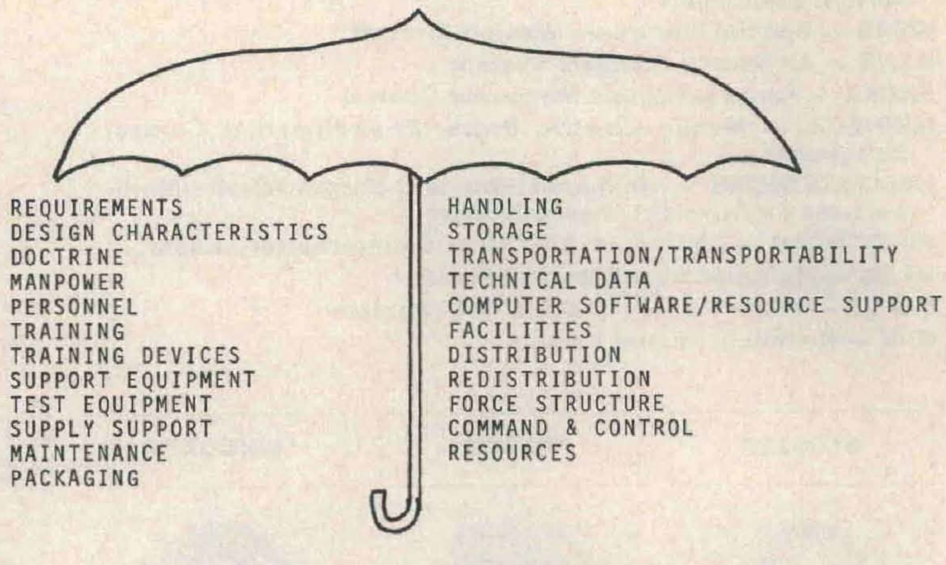


Fig. 1. Integrated Systems Support

When the three letters "ISS" first appeared in print, the immediate reaction of materiel and combat developers was to check for a typographical error. When none was found, the question arose: "What is Integrated Systems Support (ISS)?"

The first answer was, "ISS is an expansion of Integrated Logistics Support. I heard about it in a briefing. An umbrella was shown on a vugraph and under it were 23 elements of ISS."

This was followed by a response similar to, "Oh yeah, I remember that. But I thought they listed 25 elements." Since then, ISS watchers have seen ISS illustrated on vugraphs with anywhere from 17 to 27 elements under the umbrella.

Lack of understanding ISS has given way to misconception. So, this article tells what ISS is, its deficiencies, and how it should be used to manage force modernization.

ISS is defined as "the system by which all relevant factors are integrated into the materiel acquisition and organizational development process, before, during and after fielding, to ensure that modernization is totally supportable and executable."

Initially, the concept of ISS, as an umbrella (Figure 1) for monitoring all elements of a given system, with responsibilities in the Office, Deputy Chief of Staff for Operations and Plans (ODCSOPS) DA, was ratified by the 1981 Army Commanders' Conference. Later, on 30 September 1982, ISS was formally promulgated by a DA letter, stating that the Force Modernization Master Plan is the medium by which the ISS concept is being initiated, specifically through the process of supportability assessments.

These assessments were called for by an earlier ODCSOPS letter of May 1982, which directed organizational force integration staff officers to conduct organizational supportability assessments. The letter provided a checklist of assessment elements, somewhat similar to the list in the umbrella chart of Figure 1.

Within HQ TRADOC, implementation of ISS is found in the reorientation letter of instruction from Deputy Chief of Staff for Combat Developments. TRADOC Integration Staff Officers — TISOs, were told to conduct assessments of 25 Heavy Division 86 and 10 Armored Cavalry Regiment organizations. The assessment methodology involved the application of still another checklist to the major items or systems that make up the organization being evaluated. The resultant assessment would be a matrix of the checklist elements along one axis and the list of major equipment items on the other axis (Figure 2). The chief purpose of the assessment is to identify issues that need resolution for successful execution of a given organization transition.

Proponent

The Army staff proponent for ISS is the Army Force Modernization Coordination Office. Currently, they envision ISS as a management tool for DA use only. However, they also feel that ISS will become broader in scope than has been previously described by either the DA letter or the Force Modernization Master Plan. Currently, they feel that ISS has two major components: a logistical portion — ILS; and other aspects, such as organizational design.

The roles that TRADOC, DARCOM and other major Army commands will play in the development of the ISS concept have not been defined.

What's wrong with ISS?

Well, for starters, the name is wrong. Integrated *Systems* Support. Although the formal definition includes organizational development, the title is misleading. The perceived focus is materiel system. Take this statement from the 1981 Army Commanders' Conference: "The concept of ISS as an umbrella for monitoring all elements of a given *system* . . ." This perceived focus on materiel systems is the biggest thing wrong with ISS.

It is manifested in our application of a checklist approach to the modernization process. Yet, *the modernization process is not sufficiently understood for a checklist to be appropriate.* More on this later.

Within TRADOC, the Office of the Deputy Chief of Staff for Combat Developments has been reoriented, with materiel systems directorates being realigned with TRADOC functional mission areas. The principal focus has been shifted from materiel systems themselves to organizations into which these systems must be integrated.

To accomplish this, TRADOC Integration Staff Officers were designated for organizations at the battalion and separate company level where they also take an overall organization perspective and identify disconnects in organizational modernization. This is where we really want to be — thinking about *organizations,* and how to modernize them.

To do this we have to think about the organizational modernization or transition PROCESS. This PROCESS has some complex and interactive component processes. (I am using small letters for the component *processes* of the larger organizational modernizational *PROCESS.*)

Generically stated, these processes are the concepts and doctrine process; the personnel accession, training, and distribution process; the facilities development process; the equipping process (includes materiel development); and the resources process (includes time). Simply stated, these processes are: ideas, people, places, things and dollars.

Each of these processes contains within it one or more of the formal Army management systems such as: Army Program for Individual Training; Total Army Equipment Distribution Plan; Recruit Quota System; Life Cycle Systems Management Model; Planning, Programing, and Budgeting System; Personnel Structure and Composition System; Logistics Structure and Composition System; and The Army Authorization Document System.

Not many people really understand all of these systems. That may be what is wrong with force modernization — it is too complex and intricate to be totally understandable. We can all understand and describe the piece of the elephant we are holding, but we aren't confident that all the other pieces really add up to an elephant.

This is where ISS should come in. *We*

A MATRIX MANAGEMENT TOOL TO IDENTIFY PROBLEM AREAS OF AN ORGANIZATIONAL TRANSITION

ORGANIZATION TANK BN ______ TISO ______ DATE ______

ISS ELEMENT \ ITEM	ORG. OVERALL	M1 Tank	M3 CFV	M88 VTR	HEMTT	HMMWV	SINCGARS												
R, S, O, F,																		
DESIGN CHAR.																		
DOCTRINE																		
MANPOWER																		
PERSONNEL																		
TRAINING																		
TNG DEVICES																		
SPT EQUIP																		
TEST EQUIP																		
SUPPLY SPT																		
MAINTENANCE																		
PACKAGING																		
HANDLING																		
STORAGE																		
TRANS																		
TECH DATA																		
COMPUTER SPT																		
FACILITIES																		
DISTRIBUTION																		
RE-DISTRIBUTION																		
FORCE STRUCTURE																		
CMD & CONTROL																		
RESOURCES																		

NOTE: EACH ASSESSMENT BLOCK IS RATED GREEN, AMBER, OR RED.

Fig. 2. Organization Assessment

should consider ISS as an umbrella concept that integrates the management processes that modernize a unit. This is what needs to be integrated — the management processes. We know them to be complex, intricate, and interactive. What happens in the equipment development process has a profound interaction in other processes, and vice versa.

Only after we start thinking of integrating all these processes, can we progress to developing a function that analyzes the PROCESS. This anlaysis should identify inadequate outputs, missed or late milestones, and other deficiencies at the point of interaction from one of the processes to another. This is where a good many of our problems lie — at the point where one management system passes information to another.

It would be desirable if our analytic process could predict the impact of any incomplete or missed interactions. Even more desirable would be the ability to project what special corrective actions can make up for the situation.

In any case, our analysis should automatically set off an alarm when one of these process interactions is incomplete. The alarm should call for a careful study of the total PROCESS impact and for a decision concerning any adjustments made.

As an example, whenever a Basis of Issue Plan or a Qualitative and Quantitative Personnel Requirements Information requirement happens late in the development cycle, we should immediately make an assessment of the impact on the personnel accession and training system, on the programming and budget system, on the force structure system, etc.

A 60-day program slip in one process may result in a missed resource window in another process, which in turn enlarges the total PROCESS slip from 60 to 365 days, or more. The analytic function that we seek must be designed to tell us all this at the time of the first slip or even before it. In this example, our work-around solution may be to continue using the unrevised issue plan or personnel requirement and incorporate the revised data at a later date, such as we now preplan product improvements.

Interim Solution Possible

An interim solution may not be very far away. Even though we do not have a detailed model of the entire PROCESS, we feel that it should work. We also have a management tool that can serve as an interim analysis of the force modernization PROCESS. This tool is the Force Modernization Milestone Reporting System, the subject of AR 700-10.

The regulation says that the reporting system "will be used to aid integration and coordination for effective development, timely deployment, and sustained operational capability *materiel systems* and associated support equipment." It is defined as "A standardized management information system that integrates and portrays key milestone events." These events are selected by the commands and agencies involved in the development and deployment of new, improved, or redistributed Army materiel.

The proponent for this milestone reporting system is the DA Deputy Chief of Staff for Logistics (DCSLOG). The system itself is derived from the Integrated Logistics Support Milestone Reporting System, hence its heavy orientation on materiel development and fielding.

This milestone system is a laudable effort. Its list of milestones is perhaps the most comprehensive to date. However, — it too falls short of the mark — again because the focus is on materiel systems and does not include organizations. Thus, in its current form, it is actually only a *partial* Force Modernization Milestone Reporting System.

Modernization Is More Than New Equipment

We know that modernization can be more than integrating new equipment into the force. We can modernize without adding new equipment: by reorganizing; by changing doctrine, tactics, or techniques; or by constructing new support facilities. All of this is also modernization, and the Force Modernization Milestone Reporting System should be expanded to include it.

The system could be better. To do this, we should reorient it to include the modernization of organizations, in line with ISS. When this is done, it may prove to shift proponency from DCSLOG to DCSOPS.

Additionally, all major Army commands and DA staff agencies, should be required to provide their specific organizational transition milestone requirements into the system. Further, we should ensure that milestone data are collected, *maintained*, and, most importantly, *shared*. With interactive computer terminals, it is possible for all the Force Modernization Coordination Offices of the major commands and DA to share this data on a real-time basis.

When these things have been accomplished, we will be in a position to use the Force Modernization Milestone Reporting System to assess the executability of our modernization plans — and work toward the integrated management of modernization — which is the goal of ISS.

In summary then, we should consider ISS as an umbrella concept that integrates the management processes that modernize a unit. This is more than new equipment development and fielding. We need a model for the total modernization PROCESS — a model that integrates the management processes for ideas, people, places, things and dollars. This model should have analytic processes that can be used to assess the impacts of delays and malfunctions in any component process.

In the interim, the Force Modernization Milestone Reporting System could be a useful management tool if we expand its scope to include all aspects of organizational modernization; DA, and all major commands input the milestone requirements that they need to monitor for successful management of modernization; and the data are collected, maintained, and shared.

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The Combat Development Process in the Canadian Army

by Major D. A. Gronbeck-Jones

There is an adage which ascribes an army's worth in battle to the accumulated personal experience of its members, and to their indoctrination into a system they have learned to master over a period of many years. It is not surprising, then, that armies tend to be bastions of resistance to change. All soldiers, at one time or another, have been accused of preparing to fight the last war. Considering one's army as ready to carry out its present assigned tasks is thought by many to be the ultimate in preparedness, even though these missions are not directed against an identifiable enemy, and may not even relate to war.

Changes do take place, though often very slowly, and this pace is particularly evident in the capital equipment acquisition process. The chain of events from design to delivery can easily span ten years. Also, we tend to design our doctrine around the equipment when, clearly, the doctrine should have been formulated first. To embark on a sensible strategy of thinking at least ten years in advance of equipment availability requires us to know where we are going. We have to determine what will be required to engage in combat at some future point and work toward it in an orderly manner. That statement describes what is involved in the term Combat Development.

Combat development in the pre-unification Canadian Army was the responsibility of the Army Tactics and Organization Board. That organization, and its function, disappeared during the mid-sixties integration reorganizations, and it was not until 1974 that the Combat Development Committee (CDC), was created to deal with future planning. The CDC is composed primarily of all general officers in Land Forces appointments and has representation from all formations, headquarters, teaching establishments, NDHQ staffs, etc. It is chaired by the Commander, Mobile Command, while all NDHQ staff responsibility rests with Chief Land Doctrine and Operations (CLDO) who is also Vice-Chairman of the CDC.

Our conceptual thinking has revealed that the next war, even if fought tomorrow, *will* be different from those of the past. Our ABCA and NATO allies have also realized this, and have been applying their own combat development process to the 1986-1995 and beyond 2000 time frames, respectively. The goal is to produce a viable deterrent to the Soviet Bloc.

The Concept and Strategic Analysis

The key to the combat development process is the concept — who we must fight, where, according to what doctrine and with what equipment. Simply stated, the concept is what we must do to achieve success in battle. It is derived from strategic analysis and takes into account political direction and guidance, and of course a technological forecast and estimate of equipment availability in the period under study. The concept may, for example, result in a requirement for a piece of weaponry which at this time is only on the drawing board. It would not do so, however, unless the technological forecast had indicated that such a weapon would be feasible at the required time. The concept might, then, give technology the needed push to produce state-of-the-art equipment, or develop a brand new system. Past experience has shown, over and over again, that we are usually too conservative about the rate of technological change. Thus, we will probably continue to be cautious.

A concept should be unrestrained by costs, present or past organizations of roles, and present doctrine; these factors may all change suddenly when war is declared. The army must be prepared for a logical set of circumstances that would exist in a country in a state of war, not one on a peacetime footing.

The basic concept leads to *operational concepts* — what combat operations and what capabilities are required by the various levels of command. This phase of the combat development process consists of analysis of capabilities, possible employment, manpower requirements, and command level of employment. 1986-1995 will see a more fluid and violent battlefield with capabilities on both sides to hit harder and deeper. It follows, then, that characteristics of all types of operations may change. These changes will have to be stated before any further development takes place. Obvious examples of new developments which can change operational concepts include such items as attack helicopters, scatterable (remotely-delivered) mines, long-range multiple rocket launchers, laser/TV or infra-red guided artillery projectiles, and real-time intelligence gathering systems that see the enemy long before he is committed to battle.

Conceptual Organizations

The next logical step is the creation of conceptual organizations designed to meet the established capabilities and which can operate within the designated operational concepts. During this phase, the CDC applied organizational principles and characteristics to structure formations which bear the traditional names of brigade, division, etc. The level at which a formation contained all army tactical functions required to operate effectively has been determined to be the corps. Accordingly, conceptual organizations for a Canadian corps, known as "Corps '86", have been developed.

Validation is necessary

At this point, it is appropriate to mention that a validation process occurs throughout all phases of combat development. Validation is perhaps most important at this point, following conceptual organization development, and before money is committed on a large scale for any new equipment. It may take the form of numerical analysis, staff checks, war gaming, command post exercises or field training exercises. In some cases the only validation possible is the collective military judgement of senior officers. Errors will probably be found and will cause corrections to be made to operational concepts and conceptual organizations. In this manner the combat development process is responsive to contemporary requirements.

The next phase is the development of detailed organizations — war establishments, tables of organizations and equipment, and peacetime restrictions. Command and Staff Colleges will then be able to use these new organizations as study aids. Coincidentally with the development of detailed organizations, equipment procurement can begin. It takes about ten years for major items to be brought into service, but not all equipments to be used in the 1986-95 period have to be purchased. Many familiar in-service items have life cycles that will extend their use well into and perhaps beyond the desired time period. Some needed items may not be acquired because there simply is not enough money.

concept, and as mentioned earlier, it is perhaps at this stage where resistance to change will be hardest to overcome.

The final stage in the combat development process, is the production of training standards and plans for the introduction of new items of equipment into units. It can begin as soon as the equipment is specified, but logically it must be completed before the equipment is brought into service. Maintainers, trainers, and users are all involved at this point and must exhibit a co-operative attitude.

Figure 1 shows how the major phases of the combat development process inter-react in a ten year period. The first five years can be classed as 'development' followed by another five years of "implementation'. This ten year period is followed by ten years of 'operational life' of the concept, during which time the first half of the cycle is repeated.

CD SEQUENCE — THE FIRST HALF OF THE CYCLE

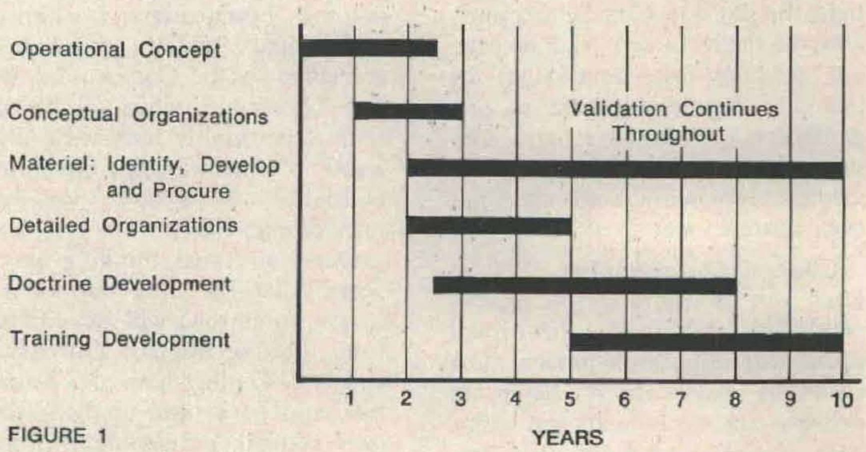

FIGURE 1

The Development of Doctrine and Training

Once equipments have been identified, it is possible to examine and change battle drills standard operating procedures, and tactics. This function is performed by the Army Doctrine and Tactics Board, which consists of commanders and staff officers from NDHQ, Mobile Command, Command and Staff Colleges, and specialist organizations. Doctrine must keep pace with the

Major review of the concept is anticipated to occur in ten-year increments. To account for unanticipated changes, an update cycle is suggested, to be superimposed at the five-year point of the first half of each cycle. Figure 2 shows this continually overlapping relationship and depicts how the developmental aspects of the process actually continue without pause, as do implementational aspects. Major review and changes take place every ten years, while updates or minor changes take place at the mid point of each major cycle.

There has been, and will continue to be, compression of activity to meet the 1986 start date of the next operational life phase. It may in fact be several more decades before the process can be applied exactly as foreseen; however, a definitive programme must be established, at the very least to provide a goal.

THE CD PROCESS

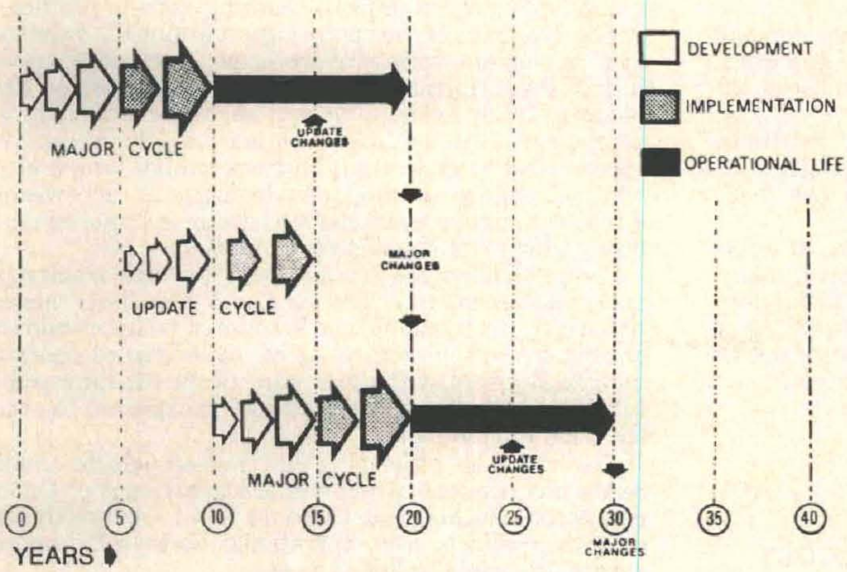

FIGURE 2

The Combat Development Process in 1982

The Canadian Army is now at the year 3-4 point of the 1986-95 cycle. A System Study was produced and then approved by Defence Management Committee; in the developmental stage it identified the corps as the level at which the Canadian Army will be structured. Operational concepts and conceptual organizations will be incorporated in doctrine manuals and taught at Command and staff colleges and training schools.

We have an organizational plan, or establishment, which sets out the army's mobilization requirement in time of war. We may now reorganize the peacetime regular and reserve army forces into units which have a place in the corps order of battle. We will thus develop expertise in many functions which exist only at levels higher than brigade group.

Combat Development is the military application of good system management principles. The process interlocks neatly into the existing procurement system and provides sound justification for oganizational change. It is simply good sense to have a package to which both soldier and politician can relate, one that has been logically developed from first principles into a mission-oriented structure. Combat Development is more than all of this — it is a positive state of mind that is already being reflected in the planning actions of army personnel at all levels of Command. The 1974 decision to establish the Combat Development Committee has proven to be wise and far-sighted.

Canada is working together with our major allies on the process, and so most equipment development being carried out fits into our concept. Our own procurement staffs are taking account of the concept for any equipment being procured in the 1986-95 time frame. As NATO and ABCA are now examining the period after 1995, in a very short period of time Canada will be producing a concept for that time frame.

What of the Future?

The combat development process must be related to our peacetime situation. The concept development is unrestrained by financial matters, but we all know that our wallets do not contain an unlimited supply of funds for capital equipment expenditures. We must also continue our training and build on the lessons learned during Exercise Rendezvous '81. Training at levels higher than division must be a goal.

At least twice when Canada went to war it did not do so with the organizations it had when war was declared. In those instances we were not as well prepared as we could have been, but now we can say that at the minimum we do have a mobilization plan. We can also say that our personnel will be familiar with contemporary operational concepts when and if they have to be used. We can also hope that the Army equipment expenditures will fit closely into the concept.

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The Army Track Program for Combat Vehicles

By Leonard Sloncz and Dr. James L. Chevalier

The U.S. Army Tank-Automotive Command (TACOM), Warner, MI, has embarked on a new program that uses an integrated systems approach to resolve track and suspension deficiencies and optimize operation of both current and future combat vehicles.

The concept of the tracked vehicle was first applied extensively to military vehicles, principally tanks, during WWI. The concept is simple: lay down a roadway, travel over it, and pick it up again. Considering the track as an endless roadway which the tracked vehicle carries with it, the track suspension is functionally identical, and similar in terms of design, to that for wheeled vehicles.

Use of tracks to distribute concentrated wheel loads over a broad range of surfaces led to the development of a mobile, armored weapons platform, capable of operating over rough terrain and of crossing obstacles and trenches.

Although the basic concepts of operation remain the same, track and suspension systems for military vehicles have evolved to a state of considerable sophistication and complexity. This has occured in response to stringent performance requirements; e.g., the need to drive a 60-65-ton tank safely over rough terrain at 45 miles-per-hour and still maintain pinpoint target accuracy.

Today's battlefield scenario demands that our combat vehicles have the capability to move, shoot, and communicate simultaneously, over all terrain and under all manner of threat conditions.

To meet these requirements, the track must: distribute the vehicle weight over as large an area as possible to minimize sinkage; provide a smooth path for the roadwheels; and provide limited propulsion in water.

Structural features and design configurations of track take various forms. All tracks, however, have many features in common, such as a ground surface to support traction in loose soil and propulsive thrust in water; a wheel path over which the roadwheels run; a means to keep the roadwheels centered on the track; drive input; and a hinge or other means of flexible connection between individual track sections to negotiate terrain profiles.

ANNUAL TRACK REPAIR & REPLACEMENT COST PROJECTIONS (CONSTANT FY81 $)

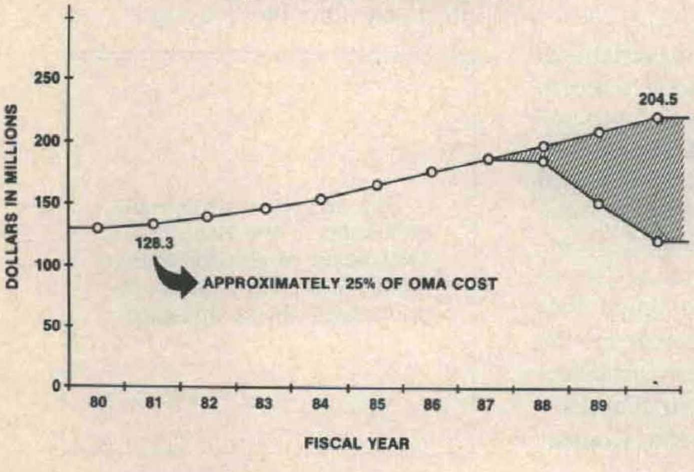

Figure 1

TRACKED VEHICLE MOBILITY TRENDS

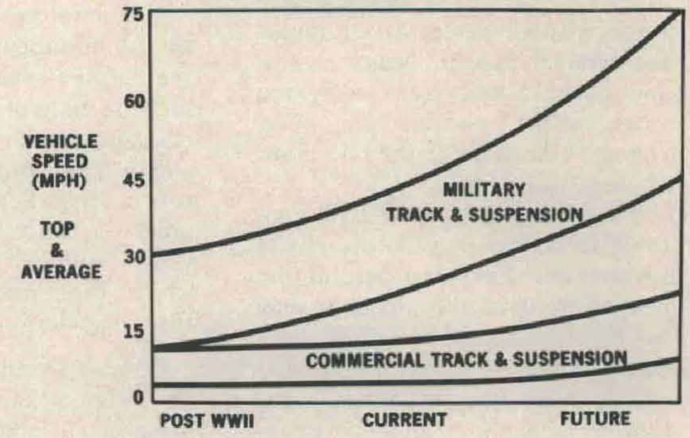

Figure 2

The dynamics of the operating environment of the track system causes a variety of problems; specifically, traversing difficult terrain which results in increased track loading, track misguiding and throwing and failure of components. In addition, higher vehicle weight and speeds tend to generate high track rubber temperatures which contribute to component loading and early wear. As a result, a higher maintenance burden is imposed on the user and logistic support costs grow.

Figure 1 shows the average annual vehicle track repair and replacement cost. During fiscal year 1981, this cost was nearly $130 million, and accounted for approximately one-quarter of the entire Army maintenance operating budget. By 1990, with the fielding of the M1 tank and the M2/M3 fighting vehicles, this cost is expected to exceed the $200 million mark.

The high cost of keeping our tracked vehicles combat ready has resulted in Army and Department of Defense concern. Something must be done now to reduce this cost or future vehicle fleet operational costs will impose a severe financial burden on users.

As illustrated in Figure 2, military track and suspension mobility requirements far exceed those required in commercial use. Thus, the Army cannot expect the commercial marketplace to provide answers to its specialized problems. Current suspension state-of-the-art technology cannot satisfactorily meet military requirements in terms of performance, durability and cost.

Therefore, today's challenge is to develop the technology to meet the requirements for future combat vehicle systems.

One method selected to meet the increasing speed requirements is to reduce track weight. Conventional track weight has characteristically been between 9 to 11 percent of the gross vehicle weight. Most recently, however, the M1 tank has departed dramatically from this trend. For this vehicle the track constitutes only 7 percent of gross vehicle weight.

Meeting track durability and performance requirements, under the restrictive conditions of less weight with greater horsepower, poses a significant challenge to the track designer. Track trends are expected to concentrate on increasing vehicle speed over all terrain, maintaining gun platform stability, increasing componenet life, and providing increased vehicle mobility.

While performance requirements have grown, so have the demands for increased component life and reduced maintenance burden in the field. The obvious solution to these problems is to reduce the stress levels during track operation. To meet these stringent requirements, TACOM has developed an Army program designed not only to address all of the requirements listed above for our current systems, but also to lay the technological data base which will provide the technology criteria for ground combat vehicle systems.

The Army program consists of four basic elements:

• Analytical efforts directed at improving design and analysis capability through the use of extensive model development and incorporation of foreign track technology.

• Material efforts encompassing both elastomeric and structural materials.

• Experimental efforts encompassing the development and testing of new track concepts leading to the reduction of the maintenance burden through improved fastening techniques.

• The development of weight class track systems to reduce the number of different tracks required to support the combat fleet.

The four elements of this program are divided into both near-and long-term efforts. The near-term effort is aimed at optimizing our current track designs, while the long-term effort will be designed toward the development of the technological base necessary to meet future vehicle requirements.

The near-term program is specifically designed to obtain the needed downturn. This program is specifically aimed at applying high technology to current track systems. For the heavy class of vehicles, improved elastomeric and structural design and materials are being sought to increase track rubber and pin life.

Alternate methods of fastening components are being investigated to reduce field maintenance requirements. A new double-pin, replaceable-pad track design is being developed for the lightweight class vehicles which has the potential for doubling track life.

Currently, each vehicle fleet has its own track, designed specifically to meet its own peculiar requirements. The objective of the weight-class track is to develop common track systems for three specific weight classes of vehicles; light, medium and heavy. Thus, the number of major combat tracks will be reduced from seven to three. Logistic costs will be substantially reduced, and battlefield repair capability will be significantly enhanced.

As mentioned earlier, the long-term program is to develop the technology to meet future vehicle requirements. The programs, described below, comprise the framework for the development of a technological base capable of satisfying future vehicle needs. These efforts include, not only the development of new technology, but innovative application of existing capabilities as well.

The analytical base development program is primarly designed to exploit computer technology and to attain a capability for dynamic track component and system design and analysis. In addition to commonality within our own vehicle fleet, development of a NATO-common track envelope is being pursued on the basis of the weight class tracks. Foreign technology is also being investigated for exchange of knowledge and possible application to present and future track systems.

In the material area, the two basic thrusts of the long-term program are track rubber and structural material development. Simply stated, the track rubber program is aimed at extending track life and consequently, reducing cost through the development of new and alternate materials for track pads, bushings and other track components.

In order to obtain reduced track system weight without compromising structural integrity and reliability, high strength ferrous and nonferrous alloys as well as metal matrix composite materials are being investigated as possible solutions to this pressing requirement.

In the experimental area, we are looking at innovative ideas in track system design and the application of new technology to provide future track systems that meet ever increasing requirements at an affordable cost.

Thus, the Army program as outlined above is a broad program that attempts to cover the entire spectrum of track requirements for current and future ground combat vehicles in each of the three weight classes. At the same time it addresses the major concerns in each vehicle class: cost, weight, reliability, maintainability and performance.

As stated, the goal of the near-term program is to significantly reduce the acquisition cost of track for our combat vehicles.

The goal of the long-term program is to develop the technological base to address the future track requirements of our ground combat vehicle systems, and to assure that the cost downturn initiated in the near-term program will continue into the future.

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Human Factors Considerations for C^3I

By MAJ Jack Laveson

It is almost axiomatic that human factors inputs to system development have been too little, too late in the cycle. Although the soldier-system interface is often the critical link to operability, developers and designers continue to concentrate on the hardware.

Emphasis on hardware occurs partly because the pay-offs of human factors work — maintainability, trainability, usability and user satisfaction — are invisible until the hardware is in the field. The time between effort and visibility can be the longest of the system development cycle.

Human factors integration poses the question of how to design so that soldier abilities are part of the system. The issues are critical for automated Command, Control, Communications and Intelligence (C^3I) because computer interface characteristics affect human information processing, and in turn, human tactical decision making.

Current problems include the fact that human factors information does not always reach the right personnel in the right form at the right time. When the system is so advanced that it has no existing counterpart, as in automated C^3I, demands on soldier ability must be projected and basic data developed from scratch. Motivation to use the data must also be considered. Even the strongest management commitment can be dismissed once the rush to complete a piece of hardware begins.

Who integrates the human factor, what information needs to be integrated, and when that information goes into the system are important issues.

The Who Issue

It is not usually a human factors specialist who makes design decisions. Engineers, managers and developers make the decisions, and human factors data must satisfy these people. A main problem for behavioral researchers is ensuring that human factors data have the necessary level of detail and a format that meets the needs of each perspective.

Research on human factors utilization has investigated how user needs differ as a function of their role in the development process. As expressed by Dr. Raymond Sidorsky, one of the researchers on the ARI battlefield automated systems project, "The kinds of things you do to use human factors differ widely between the Mission Area Analysis and the operational test. They're the extreme ends of a continuum."

Planners and project managers need baseline performance data for current systems, training time data, and the relationship between personnel test scores and system task performance. Design engineering specialists need soldier performance time data at the task element level, as well as data on temperature, light, and noise effects.

The What Issue

To illustrate the types of information needed, consider the data base required for automated C^3I. Data exist to determine keyboard and display placements in conventional systems, but no data exist to define specific keys and key groupings or display format details for computer based systems.

Reach times for various control locations are available, but only limited data exist for selecting computer response processing times. Concepts for user-system task allocation exist, but current concepts do not adequately address the limitations of human reasoning ability, human reliability, and human error probability.

Other relevant factors are human short-term and long-term memory, auditory and visual sensing capability, and human information processing speed. All these qualities interact with computer system characteristics.

When any system has a wide range of expected users, including everyone from novice through experienced, the whole range of human performance characteristics needs to be addressed. This complicates the data base, but it is a key human factors concern.

The When Issue

A report by the Human Engineering Laboratory summed up the "when" dilemma of the human factors specialist this way: ". . . one might hear the following statement during the draft Letter of Agreement (LOA): 'Your proposed HFE specification is too detailed for an LOA; save it for the contract.' Then later during the preparation of the contract, the HFE specialist might well be told 'Your proposed HFE specification had no foundation in the LOA; the user didn't ask for it.'"

Early input of human factors data is important because the completion of each successive stage of system development limits the impact of new information. Three cycle components need to be addressed: Mission Area Analysis, Justification for Major System New Start, and the Life Cycle System Management Model.

The Mission Area Analysis (MAA) is the initial and broadest part of "front end analysis." Specifically, the MAA discovers changed conditions of warfare presented by changing technology, corrects deficiencies by using new technology, and identifies technology that offers advantages over current systems. The objective is to determine opportunities or discover deficiencies presented by technical breakthroughs. For example, the breakthrough that allows automated C^3I is the rapid advance in computer technology and potential applications.

At present, human factors inputs are not identified in the MAA. Human factors can play a role, however, by identifying alternative corrections for deficiencies in soldier capability or in user-system interaction.

The Justification for Major System New Start (JMSNS) follows the MAA by describing the mission, its support, and the justification for initiation of system acquisition. The first detailed human factors input should be prepared in support of the JMSNS. The concern is to provide an analysis of the soldier's role in similar systems and probable role in the new system. In the case of automated C^3I, there was no similar system using computer technology, so these items had to be addressed with specific research.

Acceptance of the JMSNS by the Secretary of Defense leads to development and acquisition through the life cycle system management model (LCSMM). LCSMM has two principal agents: the combat developer and the materiel developer. The user representative, the combat developer, determines the needs of the soldiers. The combat developer is usually an appropriate Combat Developments Directorate of a Training and Doctrine Command School.

The first step in the LCSMM, the Material Concept Investigation, does use human factors information. Determination of feasibility of the proposed role of the soldier, adequacy of the soldier-material interface, and preliminary allocation of functions to soldier and machine are all supposed to be included. This is difficult if there are insufficient data.

Combat developer and materiel developer work jointly to prepare the Letter of Agreement (LOA). The LOA is supported by a plan for logistics support, personnel and training, and test and evaluation in which human factors have an input.

The LOA is a major milestone. Concepts for hardware developers are defined in concrete terms for the first time. If, by this point, the human factors inputs are not provided, the axiom of too little, too late may apply.

Beyond the LOA, a system development schedule must be met. Anything that delays the schedule, such as an additional human factors study, will frustrate the engineers' desire to "bend metal," that is, to get the hardware built on time.

Current Human Factor Research for Automated C^3I

Current applied research within the Battlefield Information Systems Technical Area of the Army Research Institute for the Behavioral and Social Sciences has been concentrated on the more than 70 separate systems for automated battlefield information now under development. The effort has three major thrusts:

•Identifying specific display format and computer interface features that promote easy use of the systems.

•Developing a format for human factors information that promotes more extensive use. There have been many attempts at human factors guidebooks, but basic data format questions have not yet been answered.

•Eventual "behavioral interoperability" between C^3I systems. At present, equipment and especially procedures are devised without coordination among proponents. Software such as data base structure, data entry methods, display formats, command/query language, and help/prompts are different, yet similar, for each system. Lack of standardization results in the soldier psychological effect called negative transfer — training on one system actually causes error in the operation of another.

In summary, a major effort must be made to incorporate human factors into system development if new systems are to function as planned. According to a 1980 Army discussion paper, "The level of effort must be appropriate to the requirements of the systems, applied early in the development cycle (conceptual phase) and specifically budgeted . . . Human factors analysis and engineering is not done early enough nor is applied consistently among development programs."

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MERADCOM Lets Contracts for Air Conditioners, Water Purifiers

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA., is currently procuring air conditioners for use with Pershing II ground support equipment.

The air conditioners are the Army Standard 18,000 BTUH, vertical, compact model that has been updated through a product improvement program to reduce noise levels. They will be employed in different components of the Pershing System.

Preproduction model testing has been completed by the manufacturer, Keco Industries, Inc., of Cincinnati, OH, and the first 45 production units have been delivered. They are now undergoing tests with the Pershing II System at Martin Marietta. Testing to date reportedly has been successful.

The contract is being handled by MERADCOM to prove out changes made in the tech data package (TDP) necessitated by the noise reduction work prior to the procurement. A configuration audit has now been completed and the updated TDP is being readied for forwarding to the Troop Support and Aviation Materiel Readiness Command (TSARCOM). Future procurements will be made by TSARCOM.

MERADCOM has also announced the award of more than $717,000 to Cosmodyne, Inc., a division of AVEL Corp. for the production of two 150,000-gallon per day reverse osmosis water purification units and associated spare parts.

The award is an add-on to an existing contract for $4.5 million which was awarded in September 1981. That contract called for the production of 14 units with an option to purchase six more. Delivery under the latest award, which brings that toal number to be built to 22, is scheduled for July 1983.

The commercial units are being procured for the Rapid Deployment Force as and interim measure during development of large militarized systems. In operation, the reverse osmosis water purification unit forces water through a membrane under pressure to remove salt and contaminants.

CERL Portwasher May Ease Dumpster Cleaning

Portwasher, developed by the U.S. Army Construction Engineering Research Laboratory (CERL) at Champaign, IL, to clean dumpsters in place by using high pressure hot water and retrieving the dirty wash water, is eligible for the Army Quick Return-on-Investment Program (QRIP), the USAF's Fast Captical Amorization Program (FASCAP) and the Navy's Fast Pay Back (FPB) Program.

To qualify for these programs, the return on investment must be realized within two years. Field testing at Fort Leonard Wood, MO, for 18 months indicates such a dramatic return on investment that the payback for Portwasher is 14 months.

Portawasher has also proved to be an effective vehicle for cleaning oil and hazardous materila spills from hard stands and solid ground and is being manufactured by Industrial & Municipal Engineering of Galva, IL, as Portawasher, and by Power Cleaning Systems of New Cumberland, PA, as the Scrubadubster. Portawashers recently have been purchased by Forts Devens and Lewis.

Foam Domes as Expedient Structures

By Alvin Smith

Igloo-like structures made of foam, such as those demonstrated during MOBEX-83, may someday be used to provide temporary housing during mobilization. In fact, three 28-foot diameter foam domes, designed by the U.S. Army Construction Engineering Research Laboratory (CERL) Champaign, IL, have been constructed at Fort McPherson, GA, and one was built at Fort Belvoir, VA. The four domes were constructed based on the success of three similar domes built by CERL at Fort Leonard Wood, MO, in December 1981.

Foam dome structures offer some impressive advantages for mobilization housing. They may be used between the time available tents are occupied and conventional frame (M-Type) barracks are constructed, and they are low cost. The shell cost (for materials) is about $3.50 per square foot of floor space. A General Purpose, Large Tent, by comparison, costs almost $3 per square foot. Additionally, the dome is more durable than a tent and affords much better heating and cooling control because the foam is a highly efficient insulation material.

Each 28-foot dome can house about 12 soldiers (at 54-square-feet per man), or serve as a classroom or dining hall. Two of the three domes built for the demonstration at Fort Leonard Wood have been floored with concrete and are being used as training site classrooms, while those at Forts McPherson and Belvoir are being used as classrooms, offices and for storage.

The domes were constructed of polyurethane foam spray applied on an inflated plastic membrane form. CERL provided formwork and spray equipment for the construction demonstrations, and at each installation trained several soldiers inexperienced in the techniques of this method of structure fabrication.

CERL developed the design and construction process as a part of a study of inflation-forming techniques for building structures in response to requirements from the Army Functional Components Systems Office during the early 1970's. The requirements primarily addressed base development in the Theater of Operations. Spray application of polyurethane foam on an inflated membrane was one of several processes studied by CERL and others.

The CERL spray technique resulted in domes up to 28 feet in diameter — the largest size built to demonstrate the process. During the research period, this size dome was built in about eight hours by a crew of three at CERL. (Currently, they are being built in six hours.)

Construction is simple. A preshaped plastic membrane form is kept inflated during the entire erection operation. Upon this membrane, layers of polyurethane foam are sprayed until the required dome shell thickness is obtained (about four to six inches depending on dome diameter).

Formwork consists of a ring beam that defines the perimeter of the base of the dome. The ring beam used by CERL for the 28-foot diameter dome is made of 10 curved sections which, when joined end-to-end, make the desired circle. A steel band (shipping strapping) is secured around the sections to prevent movement and the sections are anchored to the ground by metal stakes.

The inflatable membrane is made up of two parts. One is a flat sheet that is placed like a drumhead over the ring beam and steel-banded in place. The second (dome-shaped) membrane must be fabricated to the desired shape since the material used is only slightly stretchable. This membrane is arranged on the ring beam and banded in place. Both of the membranes are made of a special reinforced polyethylene film.

The middle layer of the 3-layer film consists of narrow strips of high-density polyethylene that are woven. Low-density polyethylene film is heat bonded to both faces of the woven film. The resulting laminate is strong, airtight and rip resistant. It is very lightweight and can be cut and sewed using standard equipment.

A reasonably airtight double half-lock seam is preferred for air-inflatable membranes. Antistick properties make removal of the membrane from the foam easy. A mold release (oily substance) can be applied if necessary to facilitate release from the foam if the form is used numerous times.

Air is introduced between the "drumhead" and the dome membrane by a high-volume, low-pressure fan unit. Pressure in the form is maintained at a level (about ½ psi) that will make the membrane taut. It is necessary to continue to pump air into the form all during the foam application phase in order to compensate for minor leakage. Excess air is allowed to escape from the form by a controllable exhaust tube. Door and window frames can be attached to the framework and foamed in place.

Polyurethane foam is a 2-component liquid system. The reactants combine chemically into a rigid network polymer. The reaction is exothermic, producing sufficient heat to volatilize (boil) a foaming agent contained in one of the liquids. Gas thus formed is trapped in the reacting mixture causing it to expand into foam.

Foamable chemicals are formulated to regulate the rate of the reaction, the final density, and the cell structure of the foam. Foam formulation also normally contains a flame-retardant material to reduce the rate of flame spread and/or rate of material involvement in case of ignition. Like most organic materials, the foamed polyurethane can burn in an established fire.

Spray-applied foam is formulated to give a nominal reaction and foaming time of 10 to 15 seconds, after which it is dry to the touch. A range of foam densities is available. For example, a foam with a final density of 2 to 2½ pounds per cubic foot is typically used in dome construction.

Foam formulations suitable for dome construction are commercially available in large quantities. The foam is normally used for insulation of buildings, roofing systems and flotation, and millions of pounds are used annually.

Spray equipment, used to apply the foam, pumps the liquids from standard 55-gallon steel shipping drums through a metering system which proportions the liquids in the proper ratio and increases the pressure to several hundred pounds per square inch.

The liquids are passed through a heater to raise the temperature to about 130°F. Heated liquids then enter a pair of heated hoses of up to about 150 feet in length. A spray gun allows the materials to exit from the hoses simultaneously and pass through a mixing chamber and out as a fan or cone-shaped spray. The spray gun is very similar in size, weight and operation to a paint spray gun.

The foam mixture is deposited on the form as a liquid which immediately expands by about 30 times the liquid volume. Optimally, the foam is deposited in layers about ¾-inch thick. A short time is allowed after each foam application for excess heat to dissipate. A second layer is then applied, and this layer adheres tightly to the previous layer, becoming essentially monolithic with it.

Immediately upon completion of the spray application, the formwork can be removed. The structure should be painted soon after construction. A coat of good, exterior quality latex paint can deter darkening of the foam by ultraviolet light and gradual degradation by weathering.

The interior may be coated with a flame retardant paint or other fire resistant coating to reduce the likelihood of ignition or to retard the rate of flame spread along the surface of the foam in case of a fire.

Shell thickness required in a foam dome is related to the dome diameter. A minimum thickness of about four inches of foam is needed for small domes (about 20 feet or less), with the 28-foot diameter domes being about 4½ inches thick.

Fifty-foot domes can be built of unreinforced foam but require a wall thickness of at least six inches. Much larger diameters can be built (up to 350 feet) but must be reinforced by a wire-mesh reinforced concrete layer applied either on the inside or outside of the dome.

Completed domes must be anchored to resist both overturning and uplift forces from wind. Anchoring can consist of an earth berm a foot or two high all around the base. Structures that have the proper wall thickness and are anchored are resistant to typical wind, snow, and combined wind and snow loads.

Domes can be erected quickly — a little slower than erecting tents but much faster than stick-type construction. Required skills are similar to spray painting and can be taught rapidly.

Certainly, foam domes have promise for meeting immediate housing needs for large numbers of people while more conventional housing is built. A great deal of interest in utilizing foam structures as temporary facilities during mobilization or for tactical operations has been shown since the demonstrations at Forts Leonard Wood, McPherson and Belvoir. For example, during MOBEX-83, CERL conducted a preliminary feasibility study for TRADOC of constructing a 5,000-man training base using foam domes.

CERL has concluded that an engineer battalion can complete a 5,000-man cantonment area within two weeks, based on a 24-hour operation and favorable weather conditions (greater than 40°F and wind velocities less than 15 mph). A total of 364 domes of three diameters (28, 36, and 50 foot) would be required, of which 270 36-foot structures would be barracks and the remainder for support activities.

Research in FY83 will evaluate the feasibility of constructing domes up to 50 feet in diameter. Other studies relating to material shelf life, fire safety, and additional use of foam shelters also will be conducted.

ALVIN SMITH is team leader, Polymer Applications Team, Engineering and Materials Division, U.S. Army Construction Engineering Research Laboratory. He is a principal investigator primarily concerned with the application of plastics and polymer based composite materials in the solution of military engineering and building construction problems.

Firing Tables

By J. Kochenderfer and M. Ewing

Soldiers of all ranks share a common need for aiming data. From the foot soldier toting an M16 rifle to the battery commander of long range artillery missiles, this necessity is satisfied in many forms, ranging from the simple sight on an Army rifle to the complex FADAC computer program for Lance.

Since 1938, the principal task of the Firing Tables Branch of the Ballistic Research Laboratory (BRL) at Aberdeen Proving Ground, MD, has been to comprise and publish fire control data to meet the Army's diversified requirements.

Ballistic data reach the field in a number of tangible forms, such as site tables, graphical firing tables (GFT), cams for mechanical fire control devices, direct fire sights and reticles, inputs to hand held calculators, or ballistic inputs to FADAC, BCS, and Tacfire field computers. However, the basic U.S. Army firing table, familiarly known to artillery fire direction personnel as the "brown book," remains the Army's most identifiable aiming tool.

Actually, a firing table is a reference document for a weapon system in that it provides a definitive record of performance. Such tables, dating back to the early 1900's, are on file at BRL, and in some instances, they are the only remaining references to systems which are museum pieces.

Ideally, a firing table enables artillery personnel to solve fire problems and achieve a first round effect on the target. In reality, it is just one of several elements necessary for acurate fire.

Proper location of the target; correct survey; knowledge of existing meterological data; record of tube wear; measurement of current propellant temperature and valid registration data are all essential to the artillery direction center which has the job of placing fire on the target. So, continued efforts are in progress to improve reliability in all these areas through the application of more sophisticated mathematical models and computational techniques.

The most important feature of any firing table is the listing of the range-elevation relationship for a given weapon firing a given projectile at a given velocity under arbitrarily chosen "standard" conditions.

In addition, information for making corrections to firing data due to nonstandard conditions of weather and materiel is essential, as well as the effect caused by the earth's rotation and the differences between the altitude of the weapon and target.

Precision probable error, estimates, terminal conditions, and trajectory charts which show the profile of the shell's path at various elevations are also required.

In order to gather empirical data on the performance of any new weapon system, a statistically designed firing program is prepared, designating the number of rounds and quadrant elevations required for an adequate determination of the range-elevation relationship and the precision of the specific weapon system.

At the time of firing, the desired pertinent observed data, as well as the existing meteorological ("met") conditions, are recorded and forwarded to the BRL for reduction and analysis.

The first step of firing table preparation is the processing of raw data by finding means and probable errors of range, deflection, velocity, and weight for each of the groups of round fired and putting the observed "met" conditions into usable form.

With these values and the aerodynamic coefficients determined by free flight or wind tunnel testing during the shell's research stage, the work of trajectory simulation, that is, the matching of the flight and the impact location by a mathematical model, can begin.

Three general levels of the equations of motion, which have their origin in Newton's laws, are used for different applications in the aiming data process. The most rigorous and time consuming of these are the equations for rigid body motion which are applied primarily when the complexity of the trajectory requires it, such as that of a rocket or missile.

To satisfy this set of equations, complete aerodynamic and physical characteristics are required. The simplest mathematical model is that of point mass, needing only drag as an aerodynamic input.

However, the model currently employed for most trajectory simulations by BRL uses modified point mass equations which allow the computation of a trajectory encompassing a force system and an estimate of the angle of yaw of repose. Its versatility allows its utilization for almost all weapons in the Army inventory with the exception of rockets, missiles, and some shell where the description of the detailed yawing motion is required.

The object of matching the observed data with a trajectory simulator is to produce a set of ballistics which describe the shell and may be used to convert measured data to firing table values.

Having initial conditions of observed velocity, elevation, azimuth, weight, axial moment of inertia and, as a function of altitude, "met" at the time of firing, trajectories are simulated on the computer in an iterative process until the observed terminal conditions of range and deflection are duplicated. To accomplish this, adjustments on drag and lift through ballistic and lift coefficients are made. The former influences range; the latter affects deflection.

When matching results have been realized, these two quantities are analyzed and fitted versus quadrant elevation through a least squares technique. A third value, the difference between computed time and actual flight time, is also determined in the reduction phase and becomes part of the weapon's ballistics.

Once the aerodynamics and ballistics of a weapon system have been defined, the computation of table values is initiated. A number of computer programs incorporating the trajectory simulator employed in the reduction phase have been designed for this purpose.

First, with standard muzzle velocity and varying quadrant elevations, the range-elevation relationship is generated. Then, by perturbing various parameters, corrections for nonstandard conditions are found.

To cut production time, trajectories are run for only a relatively small number of angles and interpolation routines are applied to find intermediate values. All tables are spot checked by other computer programs or manual calculations before printing.

The final phase of firing table production, that of preparing the manuscript for printing by the Government Printing Office, is a lengthy operation not withstanding the fact that it is carried out in large measure by automatic data processing equipment.

Among the tasks involved are putting the data into tubular form, writing introductory material, setting up illustrative fire problems, drafting, proofreading, and editing.

Recent utilization of the capabilities of electronic typesetting and photocomposition equipment have relieved some of the effort expended in manuscript preparation and will lead to improved masters for printing.

Though the entire firing table process from reduction of range fired data to printed copy may take over a year, scheduling is such that when a new combination of artillery weapon and/or ammunition goes into the field, the Firing Tables Branch has an appropriate set of aiming data ready to accompany it.

MR. JOSEPH W. KOCHENDERFER, a supervisory mathematician, is chief of the Direct Fire Weapons/Missile Section of the Firing Tables Branch in the Launch and Flight Division of the Ballistic Research Laboratory, a major research activity of the Army Armament R&D Command at Aberdeen Proving Ground, MD.

MISS MURIEL EWING, a mathematician in the Ballistic Research Lab's Firing Tables Branch, recently retired from federal service after spending nearly 40 years working in the preparation of aiming data for ground firing tables and bombing tables.

Personnel Actions . . .

Zuck Commands Letterman Research Institute

COL Thomas F. Zuck

COL Thomas F. Zuck, following a 5-year tour as chief of the Department of Pathology, Walter Reed Army Medical Center and consultant in Pathology to the Army Surgeon General, has assumed new duties as commander of Letterman Army Institute of Research.

COL Zuck holds an undergraduate degree from Carleton College, an LLB from Yale Law School, and his M.D. from Hahnemann Medical College. Additionally, he served his internship at Tripler Army Hospital, and residency in pathology at Fitzsimons Army Medical Center.

During 1974-77 COL Zuck served as chief, Department of Surgery, Letterman Army Institute of Research. This followed assignments at Fitzsimons Army Medical Center as medical director of the Blood Bank and staff pathologist, Department of Pathology, and assistant chief of the Department of Pathology.

He has served also as inspection and accreditation inspector, American Association of Blood Banks; assistant clinical professor of Pathology, University of Colorado Medical School; clinical professor of Pathology, Uniformed Services University of Health Sciences; and president of the American Association of Blood Banks.

A 1978 recipient of an Army R & D Achievement Award, COL Zuck is listed in Who's Who in America, Who's Who in the West, and American Men and Women of Science. He also holds a Meritorious Service Medal with Oak Leaf Cluster.

Career Programs . . .

Feeney Chosen for CSL Executive Training

Dr. Joseph Feeney, a research chemist with the Army Chemical Systems Laboratory, has been chosen as the 46th civilian to participate in the CSL's technical executive training program.

Dr. Joseph Feeney

Assigned to CSL's Research Division, Feeney is receiving training in the Office of CSL's Commanding General and in the Office of the Deputy Chief of Staff for Research, Development and Acquisition, Washington, DC. The 6-month training program, in existence at CSL since 1971, is designed to give participants practical experience in the essentials of staff work relating to managerial decisions.

Feeney was awarded a BS degree from the University of Scranton, PA, a master's degree from the University of Vermont, and doctorate from the University of Pittsburgh, all in chemistry.

A commander in the Naval Reserve, Feeney also belongs to the American Chemical Society, Sigma Xi, the American Association for Aerosol Research, the Naval Reserve Association, and the Naval Institute.

Awards . . .

Extraordinary Achievements Cited . . .

17 DA Employees Get Presidential Rank Awards

Seventeen Department of the Army employees were among more than 190 Federal Government career executives who received 1982 Distinguished and Meritorious Presidential Rank Awards for the Senior Executive Service. Ceremonies honoring the recipients were held late last year and earlier this year.

The Distinguished Presidential Rank Award is the highest honor given to senior government executives. It is presented annually, for extraordinary achievements, to no more than one percent of Senior Executive Service members and it carries a lump sum payment of $20,000. An individual may earn the award only once in any 5-year period. Department of the Army 1982 recipients of the Distinguished Presidential Rank Awards are:

Mr. Jack E. Hobbs, deputy for Management and Programs, Office of the Assistant Secretary of the Army (Research, Development and Acquisition), was honored for his vital role in restructuring the basic fund allocation and fund tracking system which controls use of funds.

Mr. Joseph P. Cribbins, special assistant/chief Aviation Logistics Office, ODCSLOG, Department of the Army, was credited with numerous innovative initiatives to improve readiness and effectiveness in support of Army aviation. His efforts reportedly resulted in government savings of more than $250 million during the past 10 years.

Dr. Fathollah K. Mostofi, chairman of the Center for Advanced Pathology, Armed Forces Institute of Pathology, was cited for his outstanding work relative to genitourinary diseases. He is nationally and internationally recognized for his studies of the effects of radiation and insecticides on human organs.

Mr. Kisuk D. Cheung, chief, Engineering Division, Pacific Ocean Division, Army Corps of Engineers, received the distinguished award for his leadership which resulted in successful military and water resource programs in Hawaii and for foreign governments in the Pacific and Far East areas.

The Meritorious Presidential Rank Award, which carries a cash payment of $10,000, is also presented for extraordinary achievements. Each year, a maximum of five percent of Senior Executive Service members can receive this award. However, this award — like the Distinguished Presidential Rank Award — can be presented to an individual only once in any 5-year period. The 1982 recipients are:

Dr. Richard L. Haley, assistant deputy for Science and Technology, HQ U.S. Army Materiel Development and Readiness Command, was recognized for his managerial acumen, technical expertise and personal dedication which made him the single most important individual associated with daily management of the Army's RDT & E resources. Dr. Haley, is a nationally recognized authority in the technical and scientific communities.

Dr. Robert J. Eichelberger, director of the U.S. Army Ballistic Research Laboratory, was honored for outstanding technical contributions to the areas of shaped charges, detonation physics, hypervelocity impact and penetration mechanics. He was credited also for exceptional and resourceful planning and management of the Army's ballistic program.

Mr. Edwin Greiner, assistant deputy for Materiel Readiness, HQ U.S. Army Materiel Development and Readiness Command, received the award for his "'professional competence, personal integrity and steadfast devotion to duty which contributed to the accomplishment of the mission of providing logistic support to the Army in the field."

Mr. Joseph G. Blick, former associate technical director (Advanced Process Technology), U.S. Army Materiel Development and Readiness Command, received (posthumously) the meritorious executive award for his exemplary management ability in resolving complex issues and directing major programs.

Dr. Robert E. Weigle, technical director of the U.S. Army Research Office, was selected for his award based on his achievements as former technical director of the U.S. Army Armament R & D Command. He was praised for his excellent management of the Army's "largest R & D organization." His citation read in part, "Through his efforts, the U.S. and its allies have been provided the most sophisticated and advanced armament weapon systems in the world."

Other Department of the Army recipients of the Meritorious Rank Award are *Mr. Lewis H. Blakey*, chief, Planning Division, Corps of Engineers; *Mr. George E. Dausman*, Acting Deputy Assistant Secretary of the Army (Acquisition); *Mr. Clayton N. Gompf*, deputy for Military Personnel, Policy and Programs; *Mr. Federick B. McNeeley*, chief, Construction Division, Corps of Engineers; *Mr. Stanley N. Nissel*, Deputy General Counsel (Logistics); *Mr. Darrell L. Peck*, Deputy General Counsel (Military and Civilian Affairs); *Dr. Joseph Zeidner* (retired), former technical director, U.S. Army Research Institute for the Behavioral and Social Sciences, and chief Army psychologist; and *Mr. Lorenz E. Zimmerman*, chairman, Department of Opthalmic Pathology and associate chairman, Center for Advanced Pathology, Walter Reed Army Medical Center.

HDL Names Lucey 1982 Inventor of the Year

Mr. George K. Lucey has been named Inventor of the Year for 1982 by Harry Diamond Laboratories (HDL). He is the 14th HDL employee to receive this award which is given for patents which either demonstrated outstanding originality or creativity or made a significant contribution to the technical state of the art or the HDL mission.

Chief of HDL's High Production Branch, Industrial Engineering Laboratory, Lucey holds seven patents all relating to the production of electronic fuzes used on artillery projectiles. The invention that won him the award was a stress-free crimp joint for plastic to metal interfaces. It allows plastic nose cones to be assembled on metal fuzes so the plastic does not crack during long-term storage.

According to Lucey's citation, "These inventions and (his) others have contributed significantly to advance the state of the art, enhance the performance, and reduce the manufacturing cost of proximity fuzing which is of major importance to the Army and national defense."

During his 24-year career with HDL, Lucey has patented seven devices, with an eighth patent pending. All of these improved methods of producing fuzes have, according to Lucey's division director, Mr. Ira Marcus, "resulted in the production of millions of improved lower-cost artillery fuzes."

Among Lucey's other inventions are a crush switch, a new way of sensing the impact of a projectile on a target; a springless impact switch that reduces the cost of impact sensing switches in artillery fuzes; a flight simulator for missiles through which plastic nose cones can be tested in a laboratory for simulating high speed flight; and a protective metal shield for plastic fuze radomes that protects the electronics when a high velocity projectile is fired in the rain.

Ryan Receives BRL's Zornig Award

Mr. R. Paul Ryan, chief of Technical Reports, Scientific and Technical Information Branch, Technical Support Directorate, U.S. Army Ballistic Research Laboratory, has been selected as the recipient of BRL's Zornig Award.

Established in 1959, the Zornig Award is presented annually to a BRL employee for technical, administrative or mechanical achievements. It is named in honor of Army COL H. H. Zornig who is largely credited with organizing BRL in 1938. He also served as BRL director until 1941.

Ryan was chosen for the award for improving the quality, consistency, and distribution methods of BRL reports through a reorganization of duties in his branch. Ryan also maintains a central register for all BRL Laboratory notebooks.

President of the Defense RDT&E On-Line System User Group, Ryan holds a bachelor's degree in mathematics from Villanova University, and a master's degree in information science from Drexel University.

Reader's Guide . . .

HEL Book Offers Advice to Computer Personnel

Human Engineering Guidelines for Management Information Systems, a new book designed to offer advice on the human factors of present computer systems and how to integrate those factors into new systems, is now available on a free upon-request basis.

Authored by researchers at the U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, the book includes 10 chapters, glossary and index. It is based on field research which looked at common system problems and reports the results of an extensive literature search of human-computer relationships in such areas as psychology, computer science and engineering.

Initially intended for use within the U.S. Army Materiel Development and Readiness Command, its applications are common throughout the management information systems field. Features of the book include a model of the system design process, principles for improving communciation between the user and the computer, guidance on effective training programs, and a look at office environment factors which impact on efficiency, productivity and worker morale.

Copies are available from: Dr. Daniel E. Hendricks, U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD 21010 or call Autovon 283-2625 or (301) 278-4550/2625.

Conferences & Symposia

MRC Will Host Scientific Computation Meeting

The Mathematics Research Center at the University of Wisconsin-Madison will host a conference, 17-19 May, emphasizing the interdisciplinary nature of large scale scientific computation involving the interaction of ideas and efforts in architecture, science, mathematics, algorithmic development, software packages, graphics, etc.

The purpose of the conference is to present a "window" on many of these activities and bring together scientists interested in these diverse activities. The main program will consist of 13 to 15 lectures.

Further information may be obtained from Mrs. Gladys Moran, conference secretary, Mathematics Research Center, University of Wisconsin, 610 Walnut Street, Madison, WI 53705.

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