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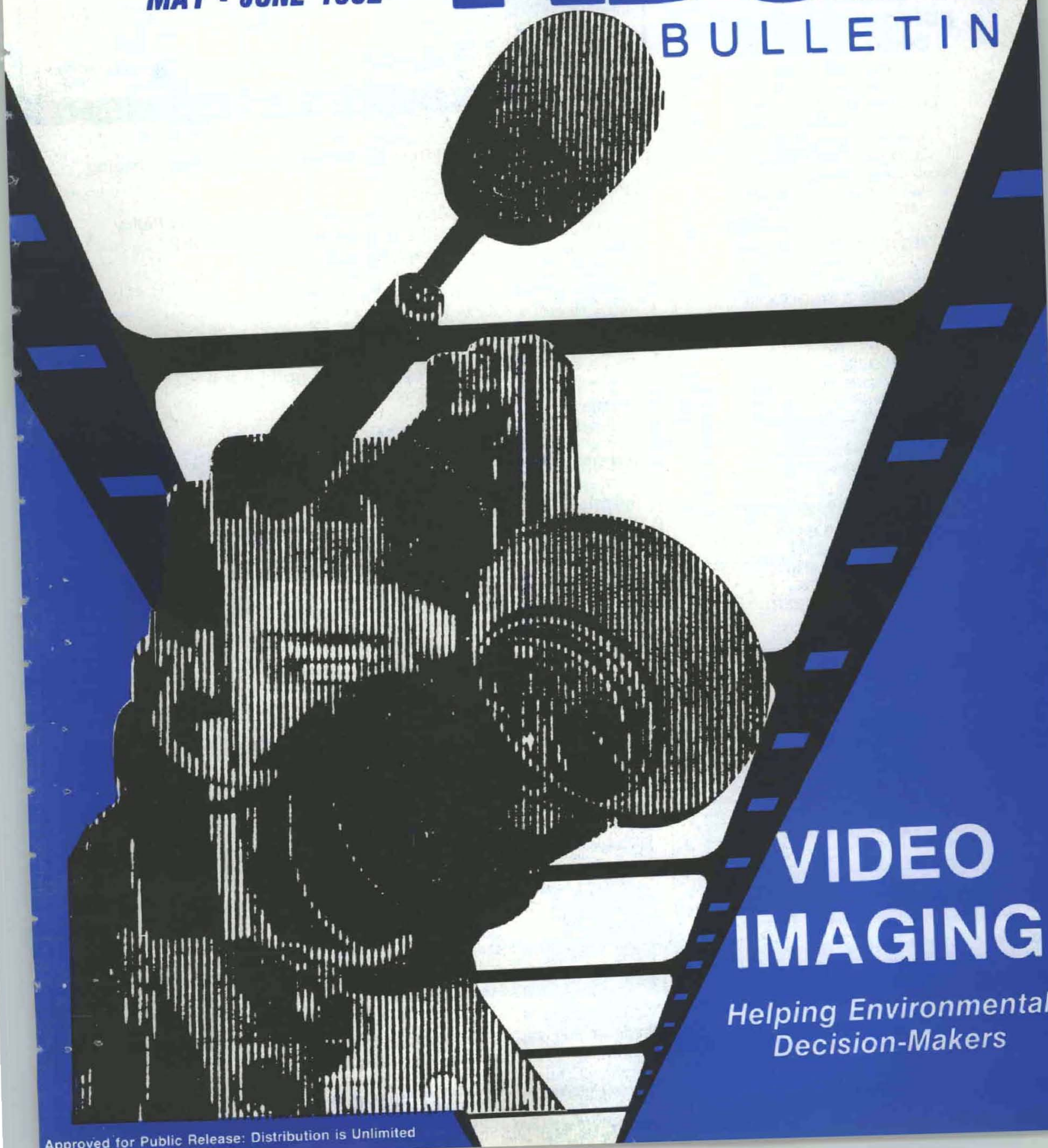

VIDEO IMAGING

Helping Environmental Decision-Makers

MAY-JUNE 1992
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ARMY RD&A BULLETIN

Research Development Acquisition

Professional Bulletin of the RD&A Community

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COVER

Video imaging technology, recently used by the U.S. Army Construction Engineering Research Laboratory, is proving to be a highly useful tool for environmental decision-makers. Cover designed by Ned Owen, HQ, AMC Graphics Branch.

HELPING ENVIRONMENTAL DECISION-MAKERS THROUGH VIDEO IMAGING

By R. Marvin Marlatt
and Thomas A. Hale

Introduction

The Army's environmental managers face a growing challenge in their decision-making process. The complexity of environmental regulations and procedures for complying demand an unyielding effort. Yet, never has compliance been a more serious matter:

- In FY90, the U.S. Environmental Protection Agency (EPA) levied some \$61 million in civil fines and \$5.5 million in criminal penalties for violations;
- Individuals are being held responsible for infringements through indictments; and
- The Army's training mission has in some cases been threatened when the American public's expectations for compliance and accountability were not met.

Effective environmental management requires intelligent, informed decisions. Because the decisions are so complex and so important, Army managers are relying more and more on the support available through emerging technologies. At Camp Shelby, MS, a new technology called "video imaging" helped show decision-makers the potential impacts of several proposed changes in the land use.

In video imaging (or simulation), an existing site is captured in photographs, slides, or video footage. The picture is digitized and then edited electronically using special computer equipment to show how the site can be expected to look after a proposed land use is implemented.

The U.S. Army Construction Engineering Research Laboratory (USACERL) used video simulations throughout the development of an Environmental Impact Statement (EIS) for Camp Shelby. In January, the images were presented during public hearings on the EIS, marking the first known instance of using this medium to communicate proposed land uses on a military installation.

The Camp Shelby EIS

Camp Shelby is the largest National Guard training installation in the United States. The camp occupies approximately 134,000 acres of land in South Central Mississippi. Land ownership is shared by the State of Mississippi, the U.S. Army and the U.S. Forest Service (USFS), an agency of the U.S. Department of Agriculture (USDA). As the primary landowner at Camp Shelby, USDA allows the Mississippi Army National Guard to operate through a Special Use Permit (SUP), with compliance coordinated by USFS. Some form of permit or Memorandum of Understanding (MOU) has been in effect since WWII.

In its current state, Camp Shelby is not equipped to handle the recent changes in Army policy and doctrine. Today's Army emphasizes the AirLand battle doctrine and a heavier reliance on National Guard and Reserve units in national defense. To ensure adequate training for the many armored and mechanized units served by Camp Shelby, the Army is proposing extension changes at the installation. Several new facilities are required and proposed for construction.

This proposed federal action required development of an EIS to examine the environmental impacts of military training on National Forest Lands at Camp Shelby. The EIS is mandated by the National Environmental Protection Act (NEPA) for all major changes proposed to public lands.

USFS will decide whether to reissue the SUP based on findings in the EIS. The SUP will establish the level and types of military training activities permitted on National Forest lands. The Department of the Army (DA) will use the EIS to verify in the Record of Decision (ROD) their selected alternative and commitment of manpower and resources to support operations and training activities at Camp Shelby within the framework of the SUP.

The Decision-Making Framework

Army Regulation 200-2 establishes the procedures for integrating environmental considerations into Army planning and decision-making in accordance with NEPA. The DA staff proponent in Washington, DC, is the principal review and approval authority over all lower level proponents. However, there can be several review and approval levels between the installation where an action is proposed and headquarters.

For the Camp Shelby EIS, participants included: trainers, environmental personnel, and facilities engineers from Camp Shelby; the Mississippi Army National Guard in Jackson, MS; the Mobile District Corps of Engineers in Mobile, AL; the regional forest supervisor and various other professionals from the USFS in Jackson, MS; the National Guard Bureau in Washington, DC; Headquarters, Department of Army in Washington, DC; USACERL, Champaign, IL; and the affected public.

Communication among these participants was crucial to the Camp Shelby EIS decision-making process. Without a clear understanding of proposed actions and associated impacts, these key players could not be expected to fully participate in a meaningful way. It was recognized that video simulation could offer a very powerful tool to facilitate this communication.

A special challenge was to answer questions posed by the public after reviewing the draft EIS: what will the proposed facilities look like? How many trees will be cut down? What is a wetland crossing? Video simulations provide the ideal means to answer such questions.

Video Simulation Technology

A variety of computer graphic techniques are supplanting traditional tools for communicating the extents and impacts of large-scale planning activities. Computer tools speed this process as well as offering advantages in accuracy and flexibility for changing circumstances. Applications of these techniques, outgrowths of the movie and advertising industries, are increasing due to advances in microcomputer technology.

A Video Imaging (VI) Laboratory has been established at USACERL to explore, test, evaluate and enhance simulation technology for comprehensive Army training land management. Video simulations allow land managers to depict the appearance of proposed projects realistically and inexpensively before they are actually built. The video (TV) medium is familiar to land managers, Army trainers, and the public and provides a convenient method for obtaining project input and feedback. Video simulation technology is also a versatile tool for public information and involvement.

Simulation Procedure

Video simulations are created through three steps:

- Image collection—assessing what is needed for the project and then capturing the appropriate baseline and "library" images (explained below) in the field using either a 35mm or video camera;
- Image editing—converting captured images into a digital format and storing them as computer files. Using special software, these digitized images are edited and retouched to produce the desired effect;
- Image output—developing or printing finished simulations as 35mm slides, prints, overheads, videotapes, or other formats in either black and white or color.

Image Collection

For Camp Shelby's simulations, images were collected on 35mm slides during two site visits. Among the proposed project alternatives captured were: tank engagement areas, including vegetated tactical concealment islands; tank trails and maneuver corridors; wetlands crossings; and threatened and endangered species restricted use areas. Baseline photos were also taken of denuded landscapes to be used in simulating rehabilitation projects.

"Library" images were also collected on a site visit. These images are used to build or create a final simulation, but do not serve as the primary base image. For example, a species of grass to be used in rehabilitation was photographed and then later "pasted" onto the baseline image to show the area after revegetation.

Image Editing

The 35mm slides were next scanned using a Howtek Scanmaster 35mm slide scanner. This step digitized the slides

and created special graphics computer files (called TGA, an extension used in naming the files which refers to the Truevision Advanced Graphics Adapter Plus 16/32-bit display card—the heart of the simulation workstation).

Then the TGA files were manipulated or "edited" by imaging software to create the final simulations. For this process, several specialized tools within the imaging software were used. One of the most important tools used for this project was a "Move" function which allows a portion of the screen to be selected and moved to a new location in the image and "pasted" down. For example, a portion of an image containing grass or shrubs could be moved to cover a denuded area to represent rehabilitation or natural regrowth. This tool provides further flexibility by allowing the editor to flip, rotate, scale, and copy the selected piece.

Another very useful tool is the "Tile" function. Tile allows the editor to select a portion of the image and use it as a texture for "painting." For example, the editor could select an area of grass in the image and use this texture to paint "grass" onto a barren patch of ground to represent revegetation.

"Windows" taken from other images can be imported into the current image and pasted down to simulate, e.g. structures, bridges, roads, signs, large trees or any other element not found in the original base image. A "blend" function can be used to fade the edges of the windows into the background.

Several other tools were used to create the Camp Shelby simulations, but those just described were the most important for this project.

Image Output

Several forms of output are possible for finished simulations. For this project, output consisted of color slides, 8 by 11-inch color video prints, and 30 by 30-inch plotted color prints.

One of the strengths of the TGA-based simulation workstation is its ability to input and output videotape. Transfer to video degrades the quality of images slightly, but the benefits of having the simulation on this medium outweigh this drawback. Image sequencing software can produce the electronic equivalent of a slide show which can then be output to videotape.

Video is a convenient, familiar medium during most briefings and presentations. Viewers readily respond to a TV format. Several video simulations were used early in the EIS development at Camp Shelby and proved very useful. However, for the public hearings, it was felt that proposed actions simulated on videotape would move on the screen too quickly, which would not allow participants to absorb them adequately and interject their pertinent comments. For this reason, the still images were used.

Discussion

Video simulation refreshes that tired old maxim, "A picture is worth a thousand words." A typical EIS contains tens of thousands of words. Just reading this document can be a formidable task; actually understanding one, even more challenging. Yet visualizing the proposed action and its associated impacts is critical to the decision-making process. This ability to visualize the outcome is what fosters the communication needed to develop a sound EIS and promote meaningful participation at all levels.

Communication

At all stages in the editing process, the Camp Shelby project planners were given the opportunity to provide feedback to the image editor as the simulations were created. This iterative process was useful to both the planners and decision-makers in ensuring that design intentions were clearly understood.

The project planners showed the simulations to various participants in the decision-making process to gather comments and suggestions. Participants were encouraged to mark on color prints and to discuss videotape. Several suggested changes and comments were incorporated into later versions of the simulations.

Interactive editing of simulations was used with great success during the process. The project planner and environmental manager from Camp Shelby and a representative from Mobile District traveled to USACERL's Video Imaging Lab to provide real-time feedback to the image editor. At one point, the project planner used the equipment to edit an image so as to illustrate an important concept that he was having difficulty expressing verbally.

All participants in the decision-making process found it easy to respond to the simulations and noted that the appearance of the various alternatives in the EIS were well represented. The simulations provided a communication medium that helped participants interact successfully with each other—which is typically a challenge for environmental decision-making.

Participation

The Camp Shelby experience with video simulations as aids to environmental decision-making demonstrates one very important advantage of the technology: the ability to quickly and easily incorporate changes into the design process. This feature encourages participation because suggested changes can be viewed immediately after the image is edited.

Conclusion

As environmental decision-making becomes increasingly complex, new technology must be exploited to ensure effective participation by all persons involved. The simulations prepared for Camp Shelby using video imaging were realistic and assisted in design, public relations, and the critical feedback cycle. Positive response from participants suggests that video simulation can be a useful, productive tool for environmental decision-makers.

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INTERVIEW WITH KEITH CHARLES

Deputy Assistant Secretary for Plans, Programs and Policy Office of the Assistant Secretary of the Army (RDA)

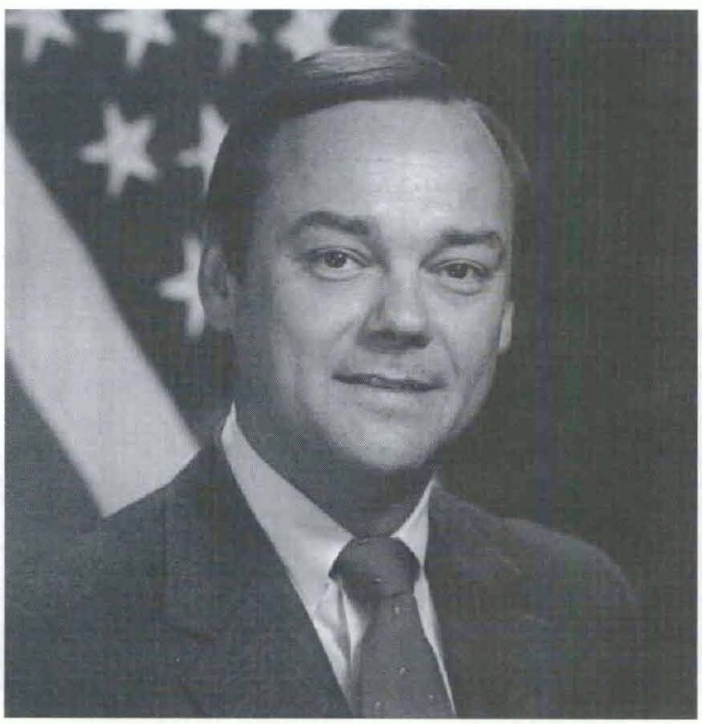
Q. What is the role of the Deputy Assistant Secretary for Plans, Programs and Policy?

A. I guess I would like our organization to be viewed as being in the business of solving problems. We solve problems related to money, policy, or, in the case of the PEO structure, TDA space authorizations—both military and civilian. We work with money if it's near-term, if it's budget, or execution. We also deal with money if it is related to the POM—the five-year projection of the program, and we orchestrate acquisition's role in the planning document, which is a 15-year outlook.

Q. Could you briefly discuss how the Army's budget cycle works?

A. As it is with most of the agencies in the executive branch, during the summer months the field begins to project the following fiscal year's budget requirements. They look at how current contracts are executing; they look at their baseline agreements and then decide what they will require in the following fiscal year. They submit this to headquarters and we review that budget along with our top line authority to see if everything fits. We then submit everything to OSD in the September-October timeframe. OSD and OMB, together, then review our budget. Ultimately, this becomes the president's budget which is submitted to the Congress in January.

The budget then begins the Congressional review cycle with hearings from late February through May. The Congress makes its decisions and funds are authorized and appropriated—sometimes before the end of the fiscal year but sometimes not until later in the calendar year. If approval occurs late, the government operates on a continuing resolution from Oct. 1 until the appropriation is ultimately passed.



Q. What is the continuing resolution and how does it affect planning for future systems?

A. The continuing resolution is a resolution provided by the Congress and signed by the president. It allows the government or a segment of the government to continue under what the legislative branch calls a current services basis until the Congress passes an appropriation for that segment of the government. It has been around for a long time and is basically a stop-gap measure that allows government to continue to operate even though it does not legally have any money. The continuing resolution does not have major impact on any part of the Army except for a new program. A program that is just starting out or a program that is moving from an engineering development phase to a production phase is categorized as a new start. If a program is a new start, the current services meaning under the continuing resolution will not allow that program to begin. The Army must wait until the Congress acts on the appropriation and authorization bills. However, if Congress had endorsed the Army's plan to spend, say $100 million last year and $200 million in the coming year, then the Army could spend up to the $200 million under a continuing resolution. The intent of the continuing resolution is to prevent disruption of government operations.

Historically, the Pentagon has been very narrow in defining continuing resolutions. However, under the current DOD leadership, the definition of continuing resolutions has become much more realistic. Therefore, I believe we are implementing a little better than we were four or five years ago.

Q. How does the five-year budget differ from the current budget?

A. That is an interesting question because I have had the opportunity to work in other parts of the executive branch, at NASA and at OMB. If you ask that question anywhere except the Pentagon the answer would simply be that there is no difference. However, when you refer to the five-year budget—assuming you mean what we call the POM or the document we submit in April or May giving the next five-year program—this process was established as a separate process when Secretary McNamara was in office. His stated reason for establishing this process was to improve planning. In looking at the way it operates in the Army today, I do not believe that McNamara's first objective has ever been met. I do not think we have improved planning whatsoever.

What we really do in the way we build our POM is that we simply re-review decisions that were just made by OSD and OMB three months earlier. So, this is just another iterative process where we review things almost constantly. We make decisions and then we ask the same questions again three months later, hoping to get the same answers.

In contrast, in the other parts of the executive branch of the government, this all happens at one time. In some cases, like at NASA, the budget process goes all the way through the life of the project. In other executive branch organizations, it goes out a minimum of three years and a maximum of five to seven years. Also, in other organizations, whatever is submitted in January remains constant until the Congress reacts to that request later in the calendar year—sometimes nine to 10 months later. In the Pentagon, we do not let the ink get dry on the budget before we begin to re-review the five-year defense plan, which we now refer to as the future years defense plan because it encompasses six years.

I do not think this is a very efficient process. The individual in the Pentagon who is responsible for the POM is Dr. David Chu, Assistant Secretary of Defense for Program Analysis. Even he refers to the POM as Pentagon "gossip." The POM is an internal document only. It is for planning and very seldom is it an "actionable" document. It usually means that we simply have more work to do. If we have a program approved in the budget that is not approved in the POM, we still cannot take action on it because it is on the hill awaiting their vote. The Congress has the power of the purse, so it is almost a redundant process. I do not find it very useful at all.

Q. Would it be very difficult to change this process?

A. I really have mixed opinions about this. The change would only require a change in the Department of Defense and not a change in the executive office, because they do not do a POM. Also, I am not sure if we would have to change all of the DOD, if we only wanted to change the Army. When the budget is done, we could simply concentrate not only on the budget year but also five to six years hence. When that document is approved, we would simply send it to DOD a few months early or hold it for three months and only make "fact-of-life" changes like termination of a contract. We would make only minor adjustments and send it up as the POM instead of going through the entire process all over again. I believe it is certainly within the art of the possible for the Army to change and not have DOD change its procedures at all. If we look at the statutory basis for the position of the Assistant Secretary for Financial Management, I believe it may be more consistent with the intent of the law if we were to do it that way as opposed to the way we now do it. The FM's statutory basis indicates that that position also carries with it the responsibility for the Army program for out-year planning. Every time we do a budget we do out-year planning because we are required by the Congress to submit the five years after the budget. So, it seems very appropriate for us to make only minor changes in the POM cycle.

I think it causes more instability to keep asking the same questions constantly. Some project manager out there has to execute his program and it's a little hard if, every three months, someone asks if his program should even exist. This does not make a lot of sense as far as I am concerned. In any situation—whether it's in government or the private sector—if you keep asking the same question, you are apt not to get the same answer. Even if the answer is only slightly different, the guy who has to execute the program is constantly justifying his existence, his program, and his plan. If a program is only "tweeked" a little—such as changing the contract award date—it might have to be started all over again. This just does not make any sense.

Q. Can you comment on a proposed plan which will allow major subordinate commands to tax PEOs and PMs for matrix management and other services?

A. Army policy is such that no one will ever be allowed to tax programs for anything unless provided in law. There is a program called the Small Business Innovative Research Program that requires us to tax some RDT&E accounts that contract their efforts. These must be taxed one-quarter of a percent and these funds must go to small business innovative research. There is one other unusual situation where current law eliminates what is referred to as the "M" account or the merged account. This is used to pay implied obligations by the government in a program year that is no longer available for obligation.

Back in 1985, if we had a contract with someone for a specific amount of funds, for specific work, and the contractor failed to bill us for something we both agree he should have, that contractor could put in a claim to the government for an inferred obligation in 1985. We previously had an "M" account we could use to get the obligation authority to pay that claim. However, that account was dissolved and we are now in the process of dealing with that while still protecting our PMs from contingent liability.

Other than the two reasons I just cited, no one in the Army is allowed to tax PMs or PEOs for anything. There is a proposal which will go into effect completely in 1994 but which partially began this year. This proposal will move reimbursable matrix support salaries from the major subordinate commands (MSC) to the PM's accounts. The PM will go to the MSC, negotiate for reimbursable matrix support, and pay the salaries required for that support. If the matrix support cannot meet the PM's needs, the PM has the authority to go elsewhere. The PM is responsible for delivering his system within cost, on schedule and within performance parameters. Previously, the PM did not have the authority to execute his responsibilities and had to rely on the MSC, even if performance was not to his satisfaction.

The new proposal provides the PM with one more piece of the authority he needs to accomplish his mission. There is a lot of controversy regarding this. Some critics say this will diminish the technical skills available at the MSCs because PMs will go outside the government for them. This, obviously, would not be good for the Army. We need to strike a balance—a very delicate balance. We are not going to maintain large subordinate commands without jobs. This puts a challenge on the MSC to be the most competitive and to win the "contract" with the PM. If the MSCs do not continue to win the contracts, then they will not have the money to pay their salaries.

Q. The problem of cost growth in development programs seems to be endemic to the acquisition process. What suggestions do you have for controlling costs, particularly in today's environment of diminishing resources?

A. The first thing is that we have to stop letting contractors "buy in," especially when we know they are "buying in." There have been many past cases where we knew the cost of a program

It makes good sense up front for both the government and the contractor to know, based on their combined knowledge, what a program is really going to cost.

would be $375 to $400 million to develop but a contractor substantially under bid the cost at $175 to $200 million on a cost-plus-fee basis. So, we knew that contractor would overrun the contract right from the start. That was almost a standard procedure. Mr. Conver [Assistant Secretary of the Army for RDA] is very much against that kind of approach.

It makes good sense up front for both the government and the contractor to know, based on their combined knowledge, what a program is really going to cost. We all knew about many of these overruns because we put together a realistic government estimate. We even budgeted for the $400 million. However, we did not make the contractor do his internal budget and management of work packages based on the $400 million. So, we knew about a lot of these situations but we just did not manage them very well. We need to force the contractor to manage to what we believe the cost will be. We can then monitor execution and know if the contractor will really have an overrun.

A second thing we need to do, in line with Mr. Conver's policies, is to provide an incentive for the contractor to be right. What I mean is that if a contractor comes in under cost, we should share some of the savings with him. However, if he comes in over cost, then he should have to pay for some of the overrun. That will force all of us to be right or, at least, provide an incentive for all of us. These two efforts, in and of themselves, will be a major part of the solution.

There is a third thing that we do not talk about too much, but I do think it is just about as important as the other two. It is to do an "honest job" of technical risk. This is something the government at large and, certainly the Army, has never done very well. There are some very difficult technologies that we undertake. I am not suggesting we should always assume a pessimistic approach, that we will always fail. But, by the same token, we should not always assume success.

Everyone knows that the first time we test new technology, we probably will not succeed. Yet, many times we see programs put together suggesting that the first time the technology is tested everything is going to work. When we see this optimism in a budget, we know things really will not work that way. It is not just the cost of an additional test we have to incur when a test fails. The second and third tests also slip, and the R&D and engineering team must be kept on the payroll longer. Consequently, all the costs go up. So, we need to strike a balance regarding technical risk, between the optimism we would like to assume and the pessimism everybody else would like to assume.

From having worked at NASA, I found that a very good approach is to look at similar technologies which were considered advanced 15 or 20 years ago, and compare how many times those technologies failed before they were successful. We did that routinely at NASA. We compared previous NASA programs, previous Air Force programs, other military programs, and even programs in industry. We kept a large historical data base and looked back and realized that, as an example, on the average, the first test failed three times. We would then assume we would fail three times before being successful. Surprisingly, history does tend to repeat itself.

Q. What impact will the current DOD/Army build down have on future Army programs?

A. Given the last state-of-the-union message, it should be quite obvious that there will be substantial impact. I guess I have to start out by saying something I often use in speeches: *We gotta not lose perspective*. Let me explain what I mean. The glass really is half full instead of half empty. The reason for the draw down in both military strength as well as our programs—not to mention the civilian draw down—is because we have won the cold war and we just proved our superiority in the desert. These two things make it completely understandable why the American public and the government think we are spending more than necessary to keep an edge on a threat that is no longer there. So, the glass really is half full. Having said that, I must add that we are going to have some very difficult transition years from now until about 1995. The force structure will be substantially decreased, the civilian end strength will be decreased and, obviously, research, development and acquisition programs will be decreased. All of this will have a multiple impact.

Because the Army will be smaller, we will not be buying the quantities we were going to buy previously. Unit costs will increase and programs will need to go through the cost and economic analysis phase to prove themselves worthy of funding. When the unit cost goes up, we need to look at that cost in terms of what the item is doing for us on the battlefield. Some programs that were marginal, will be terminated. Other programs which are based primarily on dealing with the Soviet threat—which is no longer imminent—will be substantially scrutinized and may not continue. In addition, the legislative branch may conclude that the equipment we had in the desert is probably good enough for many years to come. This is because there does not seem to be a threat out there investing heavily in modern equipment. However, there are those who ask about all of the high tech people who are going to leave the Soviet Union and go to the highest bidder. This is a concern of a lot of people and it will be watched very closely during the next few years. Currently though, there is no clearly definable, modern, large force. So, what we are dealing with is building capabilities, not deterring a substantive threat.

There will be a major impact on the reserves, the active forces, civilians, and on RDA programs. One thing I want to say, related to the glass being half full, is that I really believe the Army has set about this very deliberately. Even prior to the conflict in the desert, we had a plan to reduce the size of the Army. I also believe we are being more careful now than anytime in our history in making the Army smaller. I do not believe we did a very good job of reducing the size of the Army right after World War II or Vietnam. We allowed things to just sort of happen. For example, not too long after Vietnam, we were asking people, who we had asked to leave, to come back. Today, I think we have planned much better and we will orchestrate things much better, but it will be a difficult transition.

In 1991, the Army Research Office (ARO) celebrated its 40th anniversary. To commemorate this achievement, ARO is publishing a series of articles in the *Army RD&A Bulletin* that describe its mission and some of its research activities. The first article in the series appeared in the March-April 1991 issue. It provided a broad overview of the ARO program. The research programs supported by the Physics, Chemistry and the Mathematics Divisions have been described in subsequent articles. This article reviews the research program managed by the Materials Science Division.

The Army Research Office . . .

SHAPING THE FUTURE THROUGH MATERIALS SCIENCE

By Dr. John T. Prater and Dr. Gerald J. Iafrate

History

Throughout history, materials have played a critical role in the advance of civilizations. In fact, the successful evolution of mankind can be traced to his mastery of materials. The Stone, Bronze, and Iron Ages each denote major periods of technological advancement for mankind. Despite these roots back to antiquity, it has only been in the last 40 years that an intellectual underpinning for material science has begun to take shape. Since 1950, the field has evolved rapidly, first gaining recognition as an autonomous discipline, and more recently, becoming recognized as a field that is critically tied to the health and international competitiveness of U.S. industry.

The discipline of materials science examines the complex interrelationships that link the composition, microstructure and processing history of a material to its final properties. Through composition and processing control, material scientists attempt to tailor individual properties and introduce property combinations to satisfy various end-use requirements.

The growing prominence of materials science corresponds to a recent change in approach. The age old tactics of serendipity and trial-by-error are not yielding to a new methodology. Using ultraprecise new technologies, researchers are on the verge of being able to construct materials atom by atom and manipulate their most basic properties.

The rewards achieved to date have been enormous. There have been phenomenal gains in material performance in the past 20 years: strength-to-weight ratios of structural materials have increased nearly five fold, the number of electronic devices packed on an integrated-circuit chip have increased two orders of magnitude, and optical transparencies in optical fibers have improved four orders of magnitude. These developments have led to the birth of entirely new technologies including personal computing and optical communications.

For the Army, materials science oversees the critical task of converting raw material into combat materiel. The scheduled downsizing of the Army requires that this process be streamlined in the future. The timely and cost effective implementation of a new material or processing technology is a complex undertaking.

Getting it right on the first pass demands an integrated approach to product design and manufacture. This requires a thorough understanding of the material behavior, processing effects, flexible and automated manufacturing approaches, potential inspection techniques, and end-use requirements. When successful, the payoff can be great. An integrated manufacturing approach maximizes product reliability and performance, while reducing costs.

The Army has and will continue to be greatly impacted by advances in materials science. Performance increases and weight reductions across virtually all Army systems are continually being realized. The result is a stronger and more mobile fighting force.

Past Accomplishments

High-strength steels have always been the structural material of choice for the Army. Years of ARO-funded research have directly contributed to our fundamental understanding of carbon steel metallurgy. Studies by G. Krauss in the late 1970s led to the design of high carbon martensitic steels with vastly superior fatigue properties. These steels are now found in Army transmission and bearing systems. For this research Krauss was awarded the prestigious Adolf Martens medal.

Early efforts to use high-strength steels was plagued by stress corrosion cracking. At relatively low stresses these alloys could fail catastrophically. ARO-sponsored research by H. Uhlig produced a full understanding of the mechanism by which certain alloy additions reduced the sensitivity of the steels to this type of catastrophic failure. This had an immediate impact in extending the life of early generations of Army helicopter blades.

More recently, Professor O. Sherby (Stanford) has identified new thermomechanical processing approaches for ultrahigh carbon steels which produce outstanding combinations of strength and ductility. Excellent fracture toughness and ballistic resistance are achieved when this steel is combined with a mild steel to form a laminated structure. This research may find direct application in future generations of armor.

ARO-sponsored research has also led to the discovery of new classes of material. In some cases, these studies have launched entirely new technologies. A prime example is the early research conducted by W. E. Wallace (Carnegie Mellon Institute) on the thermodynamic and magnetic properties of the rare-earth intermetallics. This work led to the development of the samarium-cobalt compounds, which are among the most powerful magnets known today. These form the basis for a variety of Army systems including transmitters, radars, jammers and compact motors.

Another example is the research performed by Dr. R. Kikuchi at UCLA. This work established the stable phase regimes for the alloy mercury cadmium telluride and established the optimum conditions for uniform growth of the alloy system. Today, this alloy represents the cornerstone for all the Army's advanced night vision capability.

Current Materials Program

The Materials Science Division continues to explore the complex interrelationships that link composition, microstructure and processing history with a material's mechanical and physical behavior. The goal of the division's programs is to identify new materials and processing techniques that will provide enhanced Army materiel performance and reliability at lower costs.

For structural applications, the research emphasis is shifting from steels to alternatives that offer the potential for producing huge system weight reductions. Of particular interest are the polymer-matrix composites whose properties can be highly tailored to satisfy end-use requirements.

Major obstacles that prevent the wide-spread incorporation of composite materials into Army systems are their high production costs and concerns over their long-term reliability. A major aspect of the ARO materials program is the identification of streamlined manufacturing approaches and non-destructive inspection techniques that are applicable to composites.

Since 1986, the Materials Science Division has funded under the University Research Initiative a Center of Manufacturing Science at the University of Delaware. The center addresses some of the fundamental issues underlying the automated manufacture, maintainability and reliability of thick-section polymer-matrix fiber-reinforced composites. Notably, the cure cycle used by FMC in the manufacture of the prototype composite hull of the Bradley Fighting Vehicle was developed at the Delaware center. This technology transfer provided the Army with a significant cost savings.

Current practice in fabricating composites relies heavily on costly, labor intensive hand layups. Several ARO-funded programs are exploring novel single-step melt extrusion approaches which would remove the need for these costly procedures. D. Baird at Virginia Polytechnic Institute is studying the blending of engineering thermoplastics and thermotropic liquid crystalline polymers. He has found that carefully tailored blends can be melt extruded to produce a reinforced composite with outstanding mechanical properties. In fact, its strength greatly exceeds that of the same constituents processed by more conventional routes. The difference has been attributed to the formation of a superior fiber-to-matrix bond.

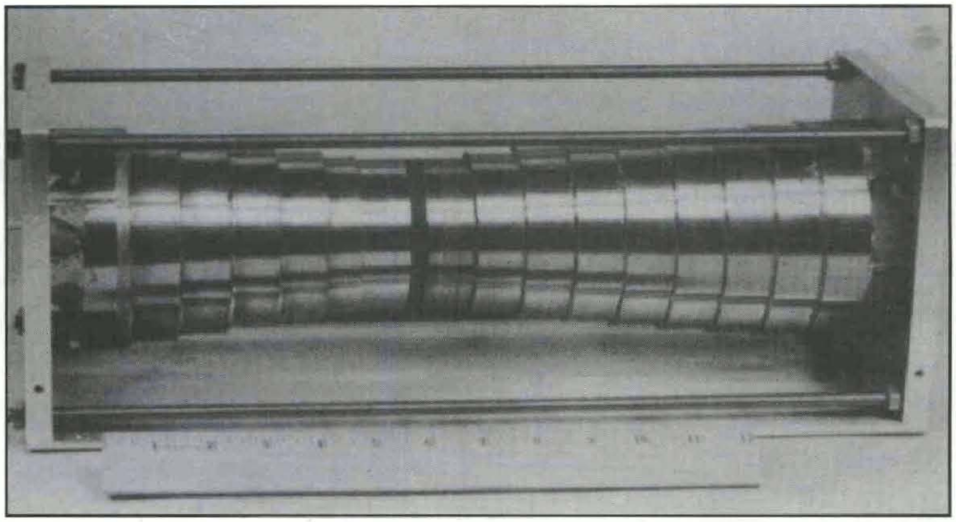
Manufacturing costs can also be significantly reduced if near net shape fabrication techniques can be employed. This is particularly true of ceramics, whose intrinsic brittleness and hardness add greatly to the final machining costs. By reducing the grain size of a ceramic to the order of 10's of atomic diameters, these materials can display a ductility that exceeds that of normal metals. This discovery of superplastic behavior affords the possibility for near net shape casting of ceramics for blades and vanes in gas turbine engines, gun tube liners and armor.

O. Sherby (Stanford), with ARO support, has recently constructed a universal model that describes the superplastic behavior of any material. The model is based on a few fundamental material parameters and should facilitate the superplastic processing of any ceramic or metal.

Many Army mission-critical components are exposed to high velocity impacts, blast loadings or other high-energy shock-generating events. These are events where stress levels far exceed the strength of the materials. Again, under the University Research Initiative, ARO has established a center at the University of California - San Diego which is investigating the behavior of materials under these extreme conditions.

In related research, R. German at Penn State University is investigating the effects of the solid solution strengthening and grain refinement in tungsten heavy alloys. This work is setting the foundation for net-shape forming of kinetic energy penetrators.

The Materials Division is also active in promoting research to better understand the importance of material composition. For example, recent research by M. Hara at Rutgers University is finding that major improvements in the fatigue behavior of polymeric materials can be achieved by adjusting the chemistry. Ionic additions above a threshold



Broadband microwave tube (Circuitless Electron Beam Amplifier) that uses an ETDL rare-earth permanent magnet design.

concentration can form ionic aggregates or ionic clusters which reinforce the matrix phase. He has shown that polystyrene containing sulfonic acid above five percent will transform the deformation mechanism from a brittle failure (crazing) to a ductile failure mode. An improvement in fatigue life of several hundred percent is obtained in the process.

Attention to composition effects are producing major improvements in aluminum alloys. ARO-funded research by S. Poon at the University of Virginia has recently identified glassy aluminum compositions with very good temperature stability, and strengths that exceed the strongest 7,000 series alloys by 30 percent. These have immediate application to many Army systems including helicopters, bridging and light-weight armored vehicles. Similarly, by carefully controlling the grain morphology of aluminum alloys through microalloying, D. Olson at the Colorado School of Mines has identified methods for greatly enhancing the weldability of aluminum. This could greatly simplify the fabrication and repair of aluminum components in the future.

Even the most perfect materials are filled with defects. These defects determine a material's real-life behavior. This is true of strength, optical behavior and electronic properties. This realization underscores the need to fully understand the behavior of defects and, where possible, turn their presence to man's advantage.

In electronic materials research, the concept of defect engineering is already being realized. J. Lagowski at the University of Southern Florida is deriving a comprehensive understanding of the effects of crystal stoichiometry and cooling rate on the EL2 defect concentration in Gallium Arsenide (GaAs). The EL2 defect is responsible for producing semi-insulating GaAs. With this newly derived knowledge, one can envision new processing steps which would judiciously introduce insulating material between active (conducting) device regions. Such a structure could greatly reduce leakage currents between closely packed integrated circuit devices and significantly enhance the radiation hardness of the circuits.

The future of sub-micron electronic and optoelectronic devices requires the construction of extremely stable geometries. Interdiffusion or mixing across different material and device regions must be avoided. With ARO support, M. Nicolet at Cal. Tech. is pioneering the idea of utilizing thin, relatively inert layers (diffusion barriers) to provide interfaces with enhanced thermal and electrical stability. This research has already produced major advances in metal contact technology for submicron devices. In addition, it may well prove critical in the construction of devices using the new classes of high-temperature superconductors, whose conducting properties are very sensitive to small shifts in composition.

Finally, ARO recognizes the importance of developing new characterization techniques. These can play an important role in extending our understanding of materials. For example, with ARO support Rutherford backscattering spectroscopy and positron annihilation techniques have been applied to the study of polymers. E. Kramer at Cornell University and J. McGervey at Case Western University have conducted these experiments. These studies have produced major advances in our understanding of the aging and free volume effects which determine the transport behavior of organics in these systems. These results are providing essential information in developing barrier materials for chemical and biological agents.

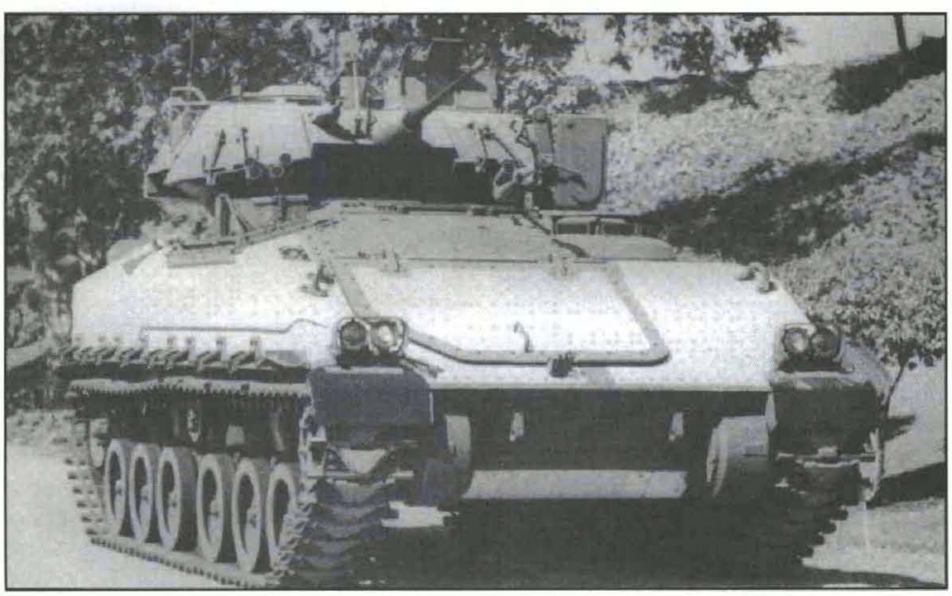
Materials for the Future

Research recently launched by the Materials Science Division provides a tantalizing clue to the exciting breakthroughs that the future may hold. With recent development of such techniques as the scanning tunnelling microscope and molecular beam epitaxy, researchers can now observe and precisely position individual atoms on a crystal surface. Structures can now be engineering which have no counterpart in nature.

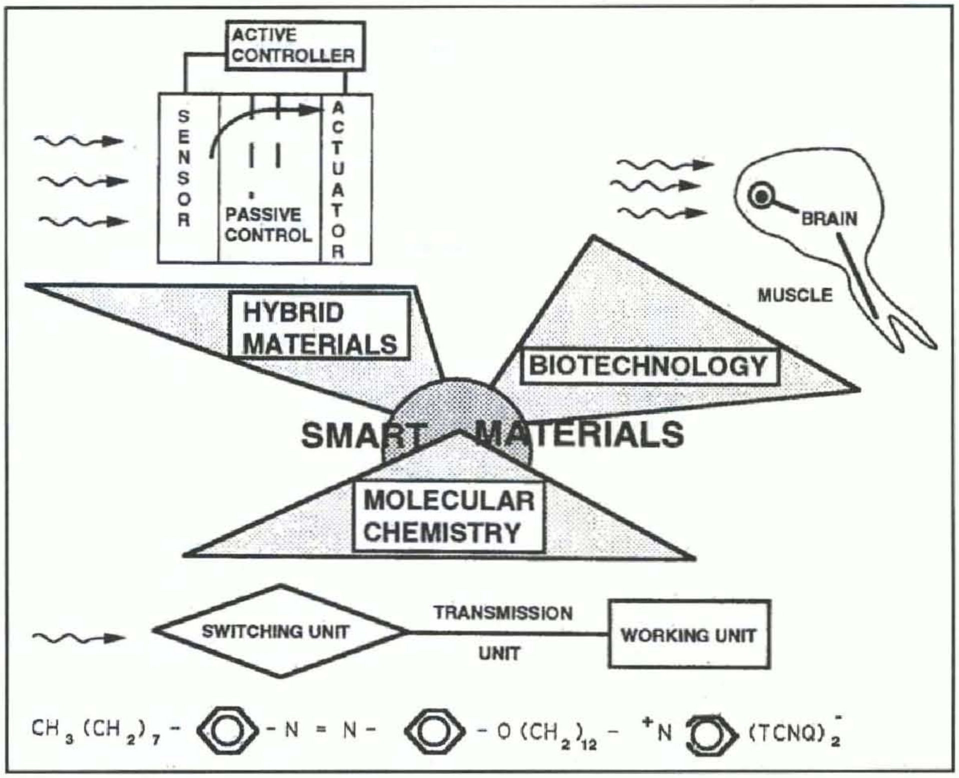
The fruits of these developments are already being felt. Solid-state quantum structures, with dimensions on the order of a few atomic diameters, have been fabricated. These new structures have revealed that the limits once thought to have been imposed by nature can be relaxed. For example, researchers have found that the electronic band structure of the very smallest atomic assemblies can vary with their physical dimensions. Contrary to earlier teachings, band structures are not uniquely determined by alloy composition. This revelation is reshaping the microelectronics industry.

Materials are continually being asked to meet increasingly higher standards of performance. This has led to the introduction of material systems with increasing complex microstructures. For example, structural composites have been formed by placing high-strength fibers into pliable matrices. This produces a material with a unique combination of strength and ductility.

Such hybrid approaches to material



Bradley Infantry Fighting Vehicle with a prototype composite hull.



The smart materials thrust is an interdisciplinary endeavor to synthesize materials which can sense and autonomously respond to their environment.

design offer the potential of greatly expanding the menu of property combinations that can be designed into a material system. Such approaches will become a matter of routine in the future. An example of the potential of this technology for the Army is the construction of a stealth tank. It is conceivable that new levels of battlefield performance could be achieved by constructing the armor and structural components from high-strength materials that also possess specific dielectric or conducive properties.

A tank's radar absorbing features could thereby be greatly increased. To this you might envision adding some active dampening and applying a surface coating that has camouflaging properties in the infrared and visible portions of the light spectrum. The result would be a vehicle that survives on the future battlefield by remaining undetected.

Better yet, envision the use of a chameleon surface on that same tank. One that can change its optical properties to blend in with its surroundings, much like that of certain fish whose neural responses can produce color changes to match their environment. This is an example of a proposed new class of "smart materials" which can sense and autonomously respond to their environment.

ARO recently launched a broad exploratory research program in this area. This technology should have broad applications in such diverse areas as vibration dampening, structural stiffening, catastrophic damage mitigation and repair, aerodynamic surface contouring, self-tuning detectors and communications, breathable chemical/biological suits, and intelligent drug delivery systems for chemical/biological protection.

The desire to attain higher levels of performance and perhaps to even build intelligence into materials is causing ARO to turn to nature for inspiration. Evolution has produced several examples of natural structures that demonstrate amazing combinations of strength and toughness, eg. the shell of the abalone. Likewise, living systems provide the only real examples of intelligent systems. Such systems are characterized by extreme structural and organizational complexity that vastly exceed anything that is currently synthesized by man. These are hierarchical structures comprised of many highly connected and interacting levels. ARO is investigating the feasibility of reproducing or mimicking these structures through a combination of biotechnology, synthetic polymer chemistry and nanofabrication. This concept represents a revolutionary new approach to materials synthesis.

Future Army materiel needs will require the exploitation of advanced materials and the development of a flexible manufacturing base which can produce components and structures with greater reliability and at lower cost than is currently possible. The Materials Science Division at ARO takes pride in sponsoring basic research which is contributing to this goal.

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CUSTOMER FOCUS: THE KEYS TO THE KINGDOM

By LTC Kenneth H. Rose

The current interest at all levels of the Army in total quality management has brought special attention to processes. Organizations are awash with process definitions, process flow charts, process action teams and process owners. But, this emphasis is premature, if not misplaced. Process without purpose is folly, and purpose is defined only by those who use the process outputs. The real keys to the kingdom of quality lie in a clear and unwavering customer focus characterized by three simple admonitions: know your customer, know your product, know yourself.

The importance of customer focus is recognized in the 1992 scoring criteria for the Malcolm Baldrige National Quality Award. Of 1,000 total points, 300 are allocated to the Customer Focus and Satisfaction category. The nearest competitors are Quality and Operational Results (180), Human Resource Development and Management (150), and Management of Process Quality (140). The Leadership, Information and Analysis, and Strategic Quality Planning categories claim less than 100 points each.

Know Your Customer

The first key in the focus set is Know Your Customer—and that is much more than a mere matter of identification. It means knowing what your customers do, what they might like to do, and what they might be expected to do. This is not to say that identification is unimportant; it is, in fact, the fundamental first step.

Customers exist in two classes: those internal and those external to the organization of the producer. Internal customers are more related to processes than end products. While they are equally important, they are a digression and will not be discussed in further detail here. The obvious external customer is the one who ultimately uses or consumes the product. But, it is not that simple.

Consider, as an example, soft drink manufacturers. Their ultimate customers would seem to be the people who consume their product. But, what about the shoppers who make the selection to buy the product or leave it on the shelf? Are they not customers, too? Pet food manufacturers understand this point very well, and prepare their advertising campaigns accordingly. What about distributors? If their systems are designed to handle 24-can cases in 4x6 configurations, are they likely to show much interest in a great product that is innovatively packaged in 18-can circular arrays? The product has a number of external customers and all must be considered.

Army materiel developers face a similar situation. It is easy to view The soldier as the customer of weapon or support systems. Easy, but not very wise.

The real keys to the kingdom of quality lie in a clear and unwavering customer focus characterized by three simple admonitions: know your customer, know your product, know yourself.

Those who approve, acquire, sustain and maintain the systems are customers, too. For some considerations, they may be more important than the first line operator.

So, the first step in Know Your Customer is knowing who they are. The purpose is not just to make a list, but to gain insight into the complex network that compromises customers in order to better partition the production workload, focusing on what is important based on who it is for.

The next step is to develop a comprehensive understanding of what customers do and the environment—physical, structural, procedural, and so on—in which they operate. There is some belief that customers define quality. This is a rather seductive trap. It seems quite reasonable and fits well with the customer-is-king philosophy. In reality, the customer role is more Darwinian than developmental.

Customers do not drive producers to higher quality. Instead, they choose what they perceive to be the best from what is available. In other words, they selectively take what they are given. To borrow an example from W. Edwards Deming, no customer ever wrote a specification or otherwise placed a demand on producers for a digital watch. The opportunity—even obligation—for improvement, innovation and new product development lies with the producers. The base on which they must build is knowledge of eventual product use and the conditions and contexts of that use.

Such knowledge, if extensive enough, opens the door to going beyond meeting specifications and going beyond meeting expectations, as well. A new marketing concept known as the Kano Model (named for the Japanese quality expert who developed it) considers customer expectations versus things a customer does not expect, but would be delighted to find in a product. This model breaks the traditional mold of customer satisfaction and puts in its place opportunities for customer delight.

Know Your Product

The second key is Know Your Product. This, too, goes beyond superficial identification. It is not sufficient to possess descriptive knowledge of one or several products. Rather, a deep knowledge of production capabilities is necessary because the real product is not an item, but the ability to produce the right item at the right time it is needed. It is a matter of knowing what is, what could be and what should be. It includes knowledge of systems and the technology required to produce those systems.

A good example comes from the recent war in the Persian Gulf. Intelligence estimates indicated that Iraqi forces had emplaced a vast amount of mines in broad belts around their positions. Advancing coalition forces would have to deal with these mines rapidly in order to survive defensive fires and maintain the tempo of the attack. A call for help went to the Belvoir Research, Development and Engineering Center, the Army's bastion of expertise on countermine materiel systems.

A quick answer would have been to point the field commanders toward the set of rollers and plows that were available in the inventory, and wish them luck. However, knowledge of the product and how it would perform under the conditions faced by the troops in combat ruled out that option immediately. Mine warfare technology had advanced considerably since those items were developed and fielded. Current mines were equipped with sensors—and in many cases multiple sensors—that would greatly reduce the effectiveness of these items.

Instead, center engineers applied capability knowledge to develop new options—things that could be. This involved knowledge of soils and terrain, fluid mechanics (sand was viewed as a liquid that would flow through a rake rather than a solid mass to be pushed aside by a plow), mechanical engineering, strength of materials and more than a little Yankee ingenuity.

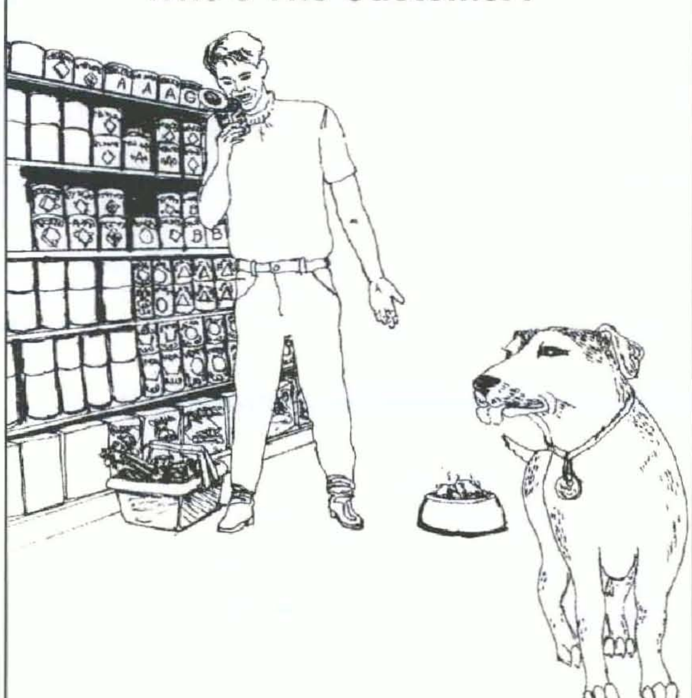
Next, test results, knowledge about existing vehicles, and some quick coordination with theater commanders were all combined to reach a decision on what should be. The result was a unique, full-width mine clearing rake that removed mines from the path of advancing vehicles and was able to sustain several unintentional detonations before being replaced. The rakes were produced in quantity, shipped to theater and provided to Army, Marine and Egyptian forces that used them in ground operations to free Kuwait.

Know Yourself

The last-minute loop back to customers mentioned above introduces the final key: Know Yourself. Know-

The first step in Know Your Customer is knowing who they are.

Who's The Customer?



ledge about customers and products has little value if no one puts it all together. The combination is not a serendipitous event: someone makes it happen. While there are some new tools available to support this effort (see related article on Quality Function Deployment, page 14 of this issue), none are self-actuating. All require people to apply them.

As with other admonitions, Know Yourself is more than a one-step process. First, acquisition managers must develop an accurate awareness of what they know. Is their knowledge of customers and products complete enough, or at least as complete as the situation will allow? This is no time for assumptions or personal pride and posturing about expertise. The knowledge required is not a naturally occurring attribute of rank or position. It comes only from current, direct involvement with the customers and products concerned.

Managers must also take a hard, introspective look at themselves. Everyone has strengths as well as some abilities that could probably be a little stronger. Not everyone can be a "people person," cold-eyed analyst, technical wizard, E-Ring salesman and paperwork potentate all at the same time. But, for successful materiel development, each is required. It is not a sign of weakness or cause for embarrassment to build a team whose members' skills complement each other. In fact, it probably ought to be the rule, if it already isn't. Such an approach not only serves near-term capabilities, but also provides consistency and stability over the long haul of the development cycle by reducing sensitivity to the loss of a single star player.

The last and perhaps the most important thing managers must know is their own predilection for procrastination. Some time ago, a senior Army official was presenting a briefing on the then-new Army Acquisition Corps to students in the Materiel Acquisition Management Course. He displayed a vugraph with two words: "dedication," and "integrity." He bluntly told the students that if they did not possess these two qualities in abundance, they should do him and themselves a favor by finding some other line of work, now.

The briefing official might have done well by adding something about the ability to take decisive action. In a complex defense environment, there are always ample reasons to delay: budgets, requirements changes, schedule conflicts to name a few. In a commercial market, the customers can simply look elsewhere for what they need. But, defense is a monopoly where soldiers in the field use only what is provided to them and where the cost of waiting is not in lost customers, but can be in lost lives.

In a world
where national security
depends on the capability
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customer delight
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it should be
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Customer Focus

There is one last hurdle regarding customer focus: language. There is something about the term that just does not ring true with the traditions of military service. It is really hard to whistle "Garry Owen" and think about "customers" at the same time. But, that is exactly what must be done. In matters of materiel development, it is entirely proper to view the battlefield as the market place and soldiers as customers.

A solid customer focus will orient the view of materiel development toward market research and away from advertising. The commercial sector—at least some elements of it—has come to realize that "make what people want to buy" is a better approach than "sell people what you make." The military equivalent to this is to produce materiel items that provide a capability rather than a response to a defined threat. Instead of forming a basis for specifications, defined threats should be viewed as constraints in developing new materiel capabilities. Thus, customer focus becomes the first step to innovation.

There is also a developer benefit in this approach. Concentrating on capabilities—the flexibility to produce what is needed—rather than fixed products produces stability for the organization and long-term value of the organization as part of a larger whole. A healthy side effect is personnel stability, based on capabilities rather than individual programs.

After all of this, is customer focus really important, or is it just another neat idea? In a world where national security depends on the capability to respond rapidly to a wide variety of contingencies, customer delight should not be the newest buzzword, it should be the order of the day. The goal is not to eliminate the worst through trial and error, but to generate the best through knowledge, imagination and design.

The question of importance may be answered by a review of recent history. In 1950, a U.S. Army task force was deployed on short notice to the Republic of Korea in response to an attack from the North. Among their arms they carried obsolete bazookas that were useless against the armor of the advancing tanks that rolled relentlessly into their positions. This should not have happened, but did. Only customer focus, consistently applied at all levels in all domains, will guarantee No More Task Force Smiths.

LTC KENNETH H. ROSE is attached to the Office of the Deputy Commanding General for Research, Development and Acquisition, HQ, Army Materiel Command. He is a single-track R&D officer and a member of the Army Acquisition Corps.

The Advanced Field Artillery System. . .

APPLYING QUALITY FUNCTION DEPLOYMENT

A Team Approach to Design with QFD

By Susan Frank and John Green

Introduction

The Army is currently involved in the development of a new generation Advanced Field Artillery System (AFAS). AFAS is the anticipated successor to the M109A6 Paladin, and will provide superior fire support well into the 21st century. When the AFAS Advanced Technology Transition Demonstrator (ATTD) contract was signed in May of 1991, the Project Management Office (PMO) - AFAS, and the FMC Corporation found themselves in the enviable position of being responsible for developing a demonstrator to prove out technologies critical to AFAS. "Team AFAS" (PMO-AFAS, TRADOC System Manager, government laboratories, FMC, and others) also recognized that they had an awesome responsibility. As COL David A. Napoliello, project manager, AFAS, observed, "The AFAS system will ultimately be operated by our children—an AFAS cannoneer is in kindergarten right now." For their sake the AFAS must be a truly 'world class' howitzer that stands apart from all peers.

A number of AFAS system requirements have been well publicized, including: extended range, high firing rates, four-round time-on-target delivery (simultaneous impact), reduced crew size, autonomous operation capability, and enhanced mobility.

But Team AFAS had a dilemma. We could potentially satisfy all of the stated requirements and still have an ineffective system if we didn't fully understand the needs of the soldiers in the field. Numerous quality "gurus" and world class companies like Ford and Toyota had been extolling the virtues of Quality Function Deployment (QFD) to develop new product specifications for several years. QFD is a structured approach which translates the "voice of the customer" into high level system requirements and product specifications. QFD assures customer satisfaction throughout each stage of the product development process, starting with concept development. Performance and quality targets established during QFD exercises are used throughout design, development and production. Additional benefits of QFD include shortened acquisition cycles, early identification/resolution of problems, consideration of all customer expectations and enhanced program performance. The leaders of Team AFAS made an early decision to use QFD as a part of the AFAS concurrent engineering approach.

The purpose of this article is to share Team AFAS's QFD experience—how

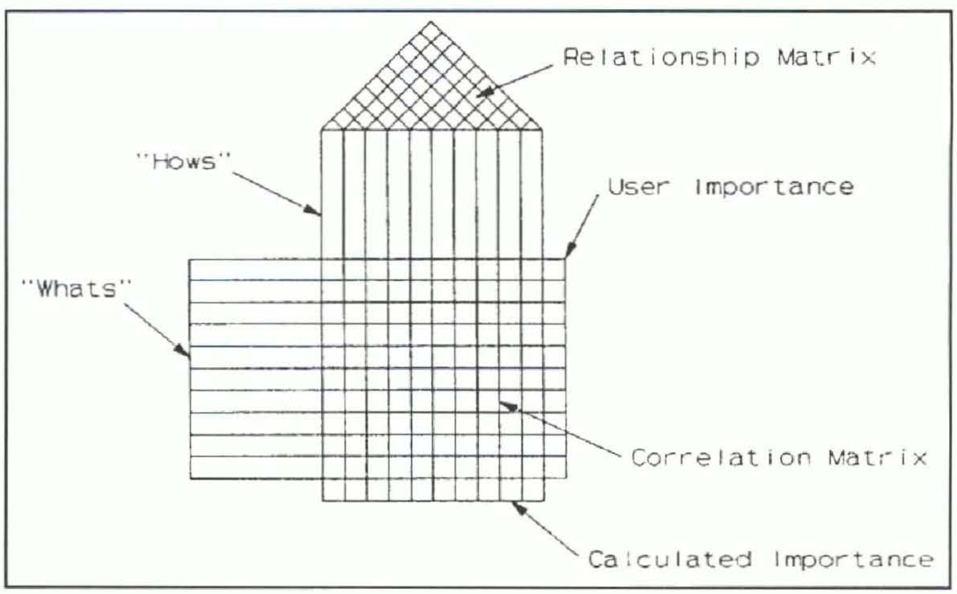

Figure 1.
House of Quality Matrix.

we applied QFD, what worked and what didn't, the lessons learned in applying QFD to the AFAS ATTD, and some suggestions to others considering using QFD.

Goals

The goals for the AFAS QFD exercise were:

• **Identification of Unstated Requirements.** We suspected that some of the AFAS expectations were neither stated nor implied in the various specifications. In order to make AFAS successful, we had to uncover what these were. By asking Team AFAS to consider all the ways that AFAS could satisfy a high level requirement (e.g. lethality), many system expectations would be brought to light. QFD then documents, weights, tracks and flows

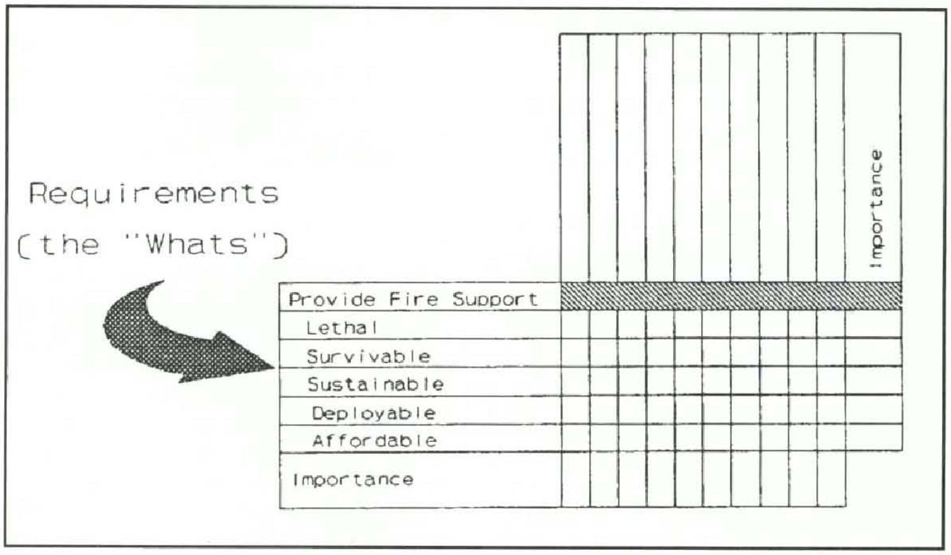

Figure 2.
Determine the "Whats."

Lessons Learned About the QFD Process

1. Do sanity checks after each step of the process.

Do these checks after the "what's" have been listed, a second time after the "how's" have been listed, again after the relationships between "what's" and "how's" have been defined, and a final time after the relationships between "how's" have been defined. These mid-course sanity checks will save time, avoid group frustration, and ensure that problems in the structure of the matrix are corrected early in the process, when it is easiest to do.

2. Keep group size small.

While representation from all involved parties (customers, contractors, subcontractors, engineers, manufacturing, purchasing, etc.) is critical, the ideal size for a QFD group is eight to 10 people. Each additional person beyond this range seems to exponentially increase the time it takes to reach consensus.

3. Keep a glossary.

Terms have different meanings to different people, and it is crucial to have common definitions in QFD, not only between individuals in the group, but between matrices. Definitions seem to "evolve" as the requirements cascade down several levels of matrices in the QFD exercise, which threatens the integrity of consensus decisions made earlier. A glossary creates a helpful audit trail for reviewing the ways in which terms were used earlier in the QFD exercise. This can be crucial for those who did not directly participate in the exercise.

4. Start early in the program and allow plenty of time.

The AFAS QFD analysis began appropriately early in the program, as it should, but we underestimated the length of time the workshops would take and the amount of advance planning/preparation that was needed.

5. Use a simple case example in the overview training.

A case example of QFD to design something everyone can understand, say a soft-drink can, greatly facilitates learning QFD. Also, an everyday example focuses the group on the QFD approach during training rather than on the real product being designed. Many participants are so knowledgeable about the product that they tend to digress unless a more generic example is used for training. Also, the training for Team AFAS was too short. More extensive training with some "hands-on" exercises would have better prepared us for the two week session.

6. Beware of experts.

Some of the most valuable people in a QFD exercise are those who have the least technical knowledge about the product. Experts, while essential to the process, must be managed in the QFD group. They have the strongest preconceived ideas, many of which will be born out by the QFD process, and they can easily dominate the group. Set up ground rules which encourage respect for all opinions.

7. Beware of rank.

Unless the highest ranking people in the QFD group make a point of encouraging equal participation, lower-ranking group members may not participate fully. Team AFAS declared its QFD sessions "non-attribution, non-retribution" to encourage everyone to open up.

8. Keep a record of rationales.

Discussions which lead to group consensus about the inter- relationships between "what's" and "how's" should be summarized in writing and filed with the matrices. The responsibility for recording the rationales for matrix inter-relationships may be assumed by a QFD group member or by an outside resource. There are pro's and con's either way. A QFD group member will interpret and summarize the discussion well, given their knowledge of the subject matter, terminology, etc. But this responsibility will preclude him/her from fully participating in the QFD exercise. Recorded rationales are useful when communicating the results of QFD exercises to others who were not present. They also provide a valuable reference when creating lower-level QFD matrices, and design engineers can use them to better understand the requirements/features.

down these expectations. QFD analysis relies heavily on interaction with customers, who are defined as anyone affected by the design of the product. We expected that this interaction alone would reveal needs which might have otherwise been missed.

• **Improved Development Process/More Effective Design**. Team AFAS recognized that developing a true understanding of the users' needs presented a challenge. User participation in the QFD exercise would enhance this perspective. It would also distinguish *what* the users required, from the specifics of *how* the requirement is accomplished. For example, users may not care whether AFAS has automatic ammunition handling, only that it delivers substantial fire power, which can be accomplished in multiple ways. This is a subtle but important distinction that system designers must understand in order to address the users' true needs.

• **Communication Enhancement.** Because of the high degree of customer participation in the QFD exercise, we also expected to enhance communication between all parties. The QFD workshops included more than 50 representatives from PMO AFAS, U.S. Armament RDE Center, Fort Sill, Benet Laboratories, Defense Plant Representative Organization, TRW, Magnavox, Dynamic Research Corporation, and other government and industrial organizations. A continuing dialogue with numerous government offices representing various system customers was required.

Week 1

We felt uncertain on the first morning of the QFD exercise. This was due in large part because few on the team understood what QFD was or why we ought to spend the next two weeks doing it. Some team members were not looking forward to spending that much time doing what they believed the requirements documents had already done. "If the ROC doesn't spell out the requirements, then why the heck did we do it in the first place?" asked one of the participants. "This is going to be a real waste of time," muttered another.

"This exercise will not only ensure that we build the best possible AFAS," said COL Napoliello, "It will also continue to build the best possible 'Team AFAS'."

"These sessions are meant to help us all take a new look at AFAS," added Dave Wallestad, FMC's deputy AFAS program manager, "Let's keep our minds open. Also, everyone here can feel free to speak his or her mind. Please don't hold your ideas back. No one will be blamed for contributing. You're here because you have something to add to this exercise."

The effort began with a two hour overview of QFD. The QFD approach seemed simple enough to the group...too simple to many. On the left were the requirements of the system—the "what's." (See Figure 1.) Each of the "what's" was given a user importance rating—a "why." Along the top were the design features—the "how's." In the middle intersection, the degree to which the "how" facilitated the "what" was recorded. In the "roof" of the house, the degree to which a feature helped or hindered another feature was recorded. When all of these entries were complete, each "how" received a score based on how strongly it contributed to the total requirements—the "calculated importance value."

The group became impatient during training. After all, they thought, "what" the AFAS needed to do and the basics of "how" the design would accomplish those needs were already well known. Or were they? Well, even if they weren't that's how systems engineers are supposed to earn their money—by figuring all that stuff out!

After the QFD overview, Team AFAS brainstormed a list of all of the AFAS

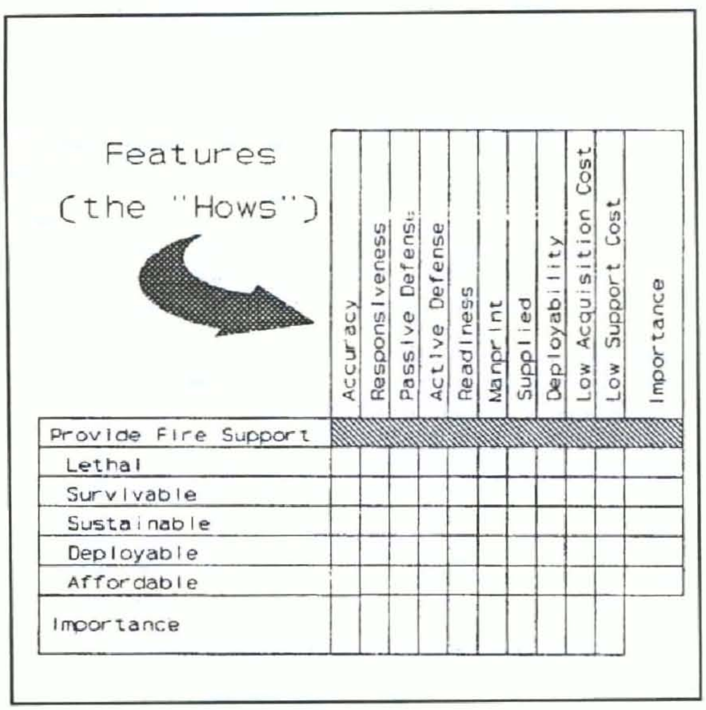

Figure 3.
Determine the "Hows."

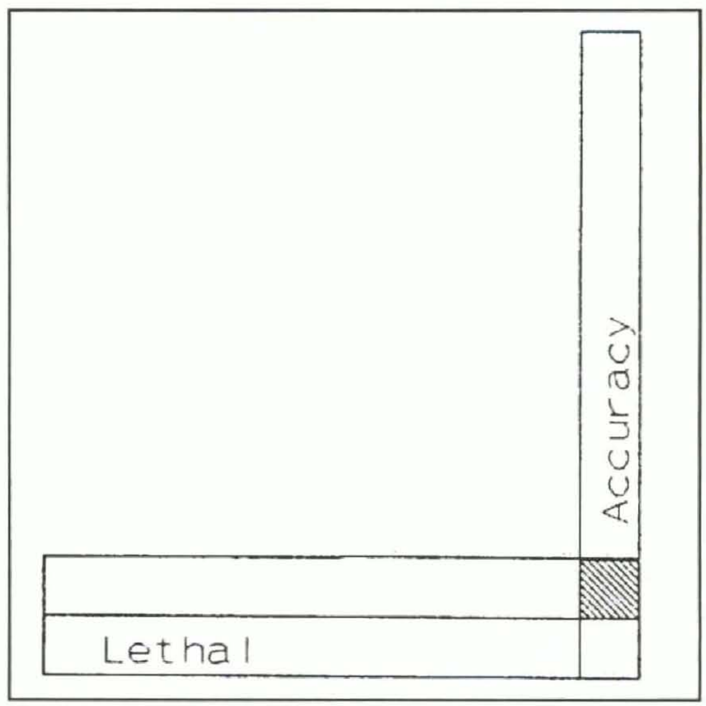

Figure 4.
Identify Correlations.

HOUSE of QUALITY
Date 05 Dec 91
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WHATs vs HOWs

Strong Relationship: ● 9
Medium Relationship: ○ 3
Weak Relationship: △ 1

WHATs		1 Location (howitzer)	2 Precision	3 Accuracy	4 Fire control	5 Reaction time	6 Fire direction	7 Ammo compatibility	8 Range	9 C3I	10 Mobile	11 Graceful degradation	12 Ammo storage	13 Rate of fire	14 Signature reduction	15 Ballistic protection	16 Damage control	17 Countermeasure	18 Self defense	19 Reliable	20 Available
System accuracy	1	●	●	●	○		●			△											
Responsiveness	2			○	●	●	○	△	●	○	○	○	○	●							
Passive defense	3								○	△					●	●	●				
Active defense	4			△	○	○	△		△	△	○			○				●	●		
Readiness	5											△	△							○	●
Manprint	6																			△	
Supplied	7							△		△	△		○								
Strategic deployability	8																				
Tactical deployability	9									△	●										
Control acquisition cost	10																				
Reduce support cost	11																				
Importance (calculated)	1	37.53	37.53	56.28	68.76	56.25	56.28	8.000	60.00	31.17	42.75	18.33	27.33	56.25	33.75	33.75	33.75	33.75	33.75	13.99	29.97

WHATs	21 Maintainable	22 Durable	23 Manpower	24 Personnel compatibility	25 Training	26 Human factors	27 Safety	28 Health hazard	29 Arm	30 Fuel	31 Provision	32 Transportable	33 Operating environments	34 Storable	35 Operating range	36 Commonality	37 Producible	38 DTUPC	39 DTUSC	40 P3I	Importance (carry over) 1	
System accuracy																					4.170	1
Responsiveness									○												5.000	2
Passive defense																					3.750	3
Active defense																					3.750	4
Readiness	●	△			△	○								△		○					3.330	5
Manprint	○		○	○	●	●	○	○													4.000	6
Supplied									●	●	○				△	△					3.000	7
Strategic deployability												●	●	○							1.500	8
Tactical deployability										△		△			●						1.500	9
Control acquisition cost	△															△	●	●		○	1.000	10
Reduce support cost	○	○	●		○									△		○			●	○	3.000	11
Importance (calculated)	51.97	12.33	39.00	12.00	48.33	45.99	12.00	12.00	42.00	28.50	9.000	15.00	13.50	10.83	16.50	22.99	9.000	9.000	27.00	12.00	1	

Figure 5.
AFAS Requirements Matrix.

customers. The group grumbled, feeling that it was obvious who the AFAS customers were. Once the definition of customer was expanded to include "anyone affected by the design of the product," the group realized that there were many customers it had not previously considered...from the EPA to the taxpayers.

One person even added potential targets to the list! "well, they certainly are *impacted* by the design," joked MAJ Thomas J. Moriarty, executive officer to the program executive officer, Armored Systems Modernization.

"If you think about it," said COL Napoliello, "the burgermeister in the town AFAS rolls through is our customer, too."

Once the list was complete, the group placed the customers it had identified into eight categories—regulators, decision-makers, users, supporters, combat developers, material developers, beneficiaries and influencers.

"But I think of the *soldier* as the customer," objected one of the team members. "Ninety percent of the AFAS customers on this list will never even get near the vehicle!"

"We should consider *all* of these needs for the remainder of the QFD exercise," explained the facilitator. "Otherwise, some of the needs may go unidentified and jeopardize the success of the program downstream, when it's too late to fix."

The next step was identification of the high level system requirements—the "what's." The facilitator indicated that while many of the needs were already stated in the requirements document, some of the unstated needs might be either implied or cultural. One of the engineers on the team rolled his eyes. *"Cultural?"* he asked. "What does *that* mean? Should we design AFAS to pipe classical music into the cabin?" The group laughed along with him.

COL Ralph Reece, TRADOC Systems Manager - Cannon, noted that there was at least one need that hadn't been discussed. "The 'culture' in the field is that the soldiers fire their equipment only after it's been double-checked for safety. If the AFAS design doesn't account for this need," he said, "The soldiers will not think of it as a quality system—in fact, they won't be confident firing it." The value of uncovering unstated expectations suddenly took on a new and urgent meaning to the group.

By brainstorming and then refining their ideas through discussion, Team AFAS then identified the high-level system requirements—the "what's" (See Figure 2), and the high-level system features—the "how's" (See Figure 3).

Each of the "what's" was weighted in terms of its importance to the AFAS customers. Then, the group began to define the relationships between the "what's" and the "how's." The group stalled at many of the intersections of the matrix, unable to reach consensus without long and heated discussions. While everyone realized by this time that discussing relevant issues to reach consensus was valuable, things were getting out of hand. At the rate they were going, the system would never be designed! The AFAS project manager suggested a structured approach to the analysis of each intersection of the matrix, which made the process considerably easier. The "Napoliello method" involves asking a series of questions of the QFD team at each intersection of the matrix. With all other parts of the matrix hidden from view (See Figure 4) to avoid digressions, ask the following questions in this order:

1. Does this "how" help us to achieve this "what?" Only yes or no answers are acceptable. Clarification for yes or no opinions may be necessary, but should be kept brief. If no, go on to the next "how." If yes:

2. Strongly? (gage the group response)

Moderately? (gage the group response)

Weakly? (gage the group response)

Only strongly, moderately or weakly answers are acceptable. Some discussion is inevitable to reach consensus, but it can be easily facilitated to a conclusion, especially when the issues are relatively insignificant (i.e. part of the group feels that the relationship is so weak that it doesn't belong on the chart while another part of the group feels that it should be noted as a weak relationship.)

3. Is the "how" quantifiable? (Give an example target value.) Once the "what's" and the "how's" had all been correlated, the group tallied up the scores for each of the "how's" based on how strongly each of them supported the "what's." At first glance, there were some surprises in the results. By this time, Team AFAS had spent two long days hard at work on the QFD matrix. After they overcame their initial confusion about the results, they realized that this "sanity check" of the matrix yielded several types of surprises. One type included discoveries about the system requirements. For example, some members expected that "firing rate" would be the single most important need, yet it scored somewhat lower than "range."

This ran counter to the group's expectations, but was a valid representation of the true system requirements.

Correctable errors in logic also surprised the group. For example, some of the "what's" on this first attempt at a matrix were really "how's." And some of the "how's" were at a much lower level of detail than other "how's." These mismatches had skewed the score of some of the "how's." At this point, the group learned the first of several lessons about the application of QFD (See Lesson #1 in the accompanying article).

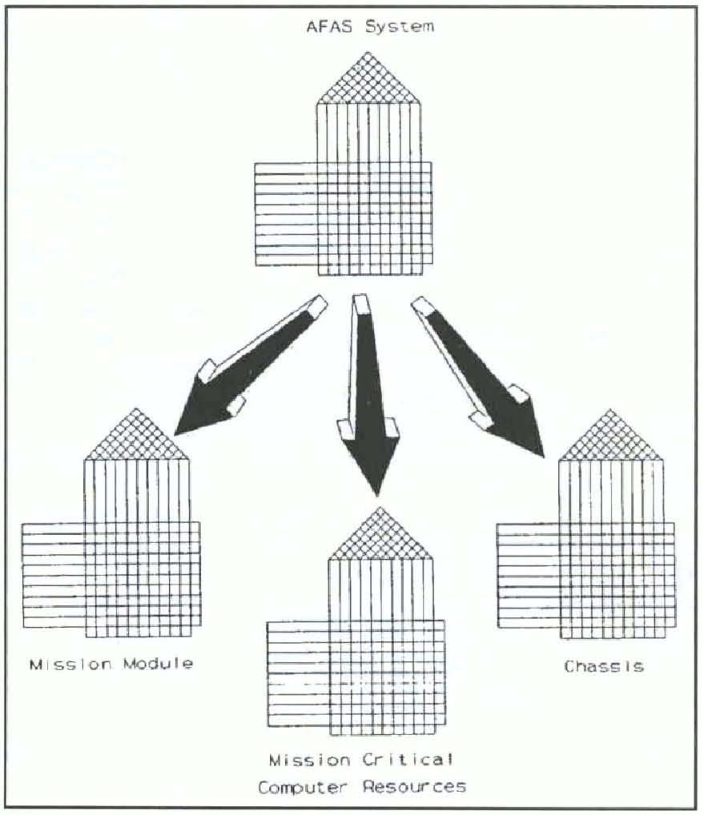
Prior to the second week, Team AFAS decided that it should complete another requirements matrix at a lower level of detail (See Figure 5).

Week 2

The objective of the second week was to take the high-level matrix of system requirements and features as a foundation on which to build lower-level matrices of requirements ("what's") and features ("how's") for the major subsystems. The initial group was complemented during the second week by experts in the three subsystem areas. The group then split into three sub-groups, each dedicated to a subsystem— Mission Module, Mission Critical Computer Resources and Chassis (See Figure 6).

Subsystem groups had a difficult time getting started. First, while some of the subsystem group members were present during the first week's discussions, many were not. There was little "buy-in" to the work of the first week by the new members. Second, there were several areas which were of concern to more than one subsystem group. This resulted in confusion and disagreement about which group should define what design features. These issues were eventually resolved through discussion.

Figure 6. Flow Down System Requirements.



The third obstacle blocking the subsystem groups' progress was the size of the groups. This led to another "lesson learned" (See Lesson Learned #2 in the accompanying article).

As the subsystem groups created their matrices, some members who had been present during the first week noticed that those definitions used by the subsystem group participants did not match those used during the first week. This led to another "lesson learned" (See Lesson Learned #3 in the accompanying article).

Program Application

The QFD approach required Team AFAS not only to identify system and subsystem requirements, but also to *quantify* them. This led to a discovery that *some of the target values for the requirements/features were not known.* As a part of the "sanity check" process described earlier, each design feature was reviewed for its ability to be quantified. This was a "screen" of sorts which helped differentiate requirements from features. When the group was asked whether or not reliability could be quantified, the answer was easy—*yes, with Mean Time Between Failures (MTBF).* But what the MTBF target value ought to *be* was not as easy to answer. Throughout the QFD exercise, when missing information like this was uncovered, it pointed out needs for additional research that might have not been discovered until much later in the development process. These oversights are more expensive to correct and potentially more harmful the later they are identified.

The need to do some trade-off analyses is well understood by system developers. But which trade studies ought to be done? The "roof" of the QFD house of quality matrix pointed out the positive and negative effects that AFAS design features had on each other. When satisfying one requirement made it harder to satisfy another, there was a legitimate need for a trade study.

Traditional requirements analysis tools, such as functional flow block diagrams, effectively identify operational requirements, but do not help in prioritizing their importance, nor do they identify new operational requirements. In these cases, the design engineer makes a subjective judgement about concept selection. One of the most useful aspects of QFD is weighting of system requirements. AFAS weightings are being used to objectively evaluate concepts and select appropriate baselines.

Conclusion

The QFD matrices created during the two weeks of intense team effort will continue to evolve as the program progresses. These matrices will serve as the basis for a series of matrices at successively lower levels of detail. For example, QFD matrices will be developed for appropriate subsystem assemblies and components. Also, QFD will be used to insure that timely and appropriate planning takes place for manufacturing process control and quality control.

While the approach taken by Team AFAS in its first QFD attempts left room for improvement, the experience was an overwhelmingly positive one for the program. Viewing the results from a technical perspective, we uncovered many system expectations which were not previously known, and which may have never been discovered or discovered too late to be effective. We also created matrices which built the foundation for sound concept selection, a better design, and a much more effective design/development process.

At least as important as the technical results of the QFD exercise were its team building benefits. It was clear that a number of communication barriers between organizations had been eliminated as a result of this exercise. In fact, the relationships built during those two weeks would have taken many months or even years to form otherwise. The matrices generated by Team AFAS will provide a common communication tool for the duration of the program. They will also clarify accountability, ease midcourse corrections or changes in direction, make interactions between all parties more effective and help ensure continuity in the face of personnel changes. Overall, the QFD project was well worth the effort. It not only laid the foundation for the success of the AFAS howitzer, it unified Team AFAS.

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QUALITY IN ENGINEERING

By Allen B. Dumont

EDITOR'S NOTE: The following article is reprinted from the November 1950 issue of Proceedings of the Institute of Radio Engineers, (now an Institute of Electrical and Electronics Engineers, Inc. publication). The intent of publishing the piece is to show that the subject of "quality" was an important consideration even 40 years ago.

As a manufacturer of cathode-ray tubes, oscillographs, and television equipment, I have from the very beginning insisted that quality should be the first consideration in all of the products bearing our company name. I have always believed that thorough inspection and testing were necessary to insure that material and workmanship were kept at high levels.

I would like to stress one fact which is commonly overlooked in connection with quality control. I find that many people, who are aware of the necessity for quality control, feel that because they have a staff of inspectors who are familiar with the latest sampling techniques, tables, and formulas, can talk knowingly of X-bars and A.Q.L., and utilize control charts and methods, they have done about all they can, so far as quality control goes.

I say to you that quality control can and must go far beyond that. In my plants, we have numerous placards posted which read "Quality cannot be inspected in, it must be built in." This is an excellent slogan, but it does not really get down to basic fact. I feel that quality *must be designed in!*

Every single component and piece of material used in the assembly may be thoroughly tested, every connection and solder joint may be perfect, every individual set may, on its completion, meet all of the operating specifications. However, if the basic design was not made with the idea of quality constantly in the mind of the engineer, the final result will be just another radio or television set.

Quality control must commence on the drawing board, not on the assembly line, and it is up to each engineer to recognize the need for quality. Don't leave it up to the assembly line inspectors. They can't produce a quality product no matter how hard they try, if the basic design is weak. Specifications should be made as complete as possible, and components should be included therein only after thorough investigation and test to determine their suitability for the work in hand. A television receiver, for example, can only be as good as its poorest component, and even the best components will fail if they are used in applications for which they were not intended.

I realize all too well that, in these days of competition in the industry, production costs are of vital importance and that, in many cases, top management has agreed to compromise in design or construction in order to shave a few cents here and there. However, too much of this type of economy will result in field failures or poor operation which will be reflected first, in excessive replacement costs under guarantee, and second, in the attitude of the buying public. In these early days of the giant new television industry, we should all as engineers and manufacturers strive constantly to bring the design of television equipment up to the highest standards possible.

In closing, I would like to quote a brief but eloquent thought on quality, the author of which is unknown to me, but which should be kept before us always:

> *"Quality is never an accident. It is always the result of high intentions, sincere effort, intelligent direction, and skillful execution."*

THE ARMY'S TANK ENGINE ADVENTURE OF WORLD WAR II

By C. Douglas Houston and COL Lawrence W. Day Jr.

Today, there are few in our military vehicle community who remember the days preceding World War II. Since those times are so well documented, many historical events are easily retrieved, such as those of our engine scene as fate carried us toward the war. It's interesting.

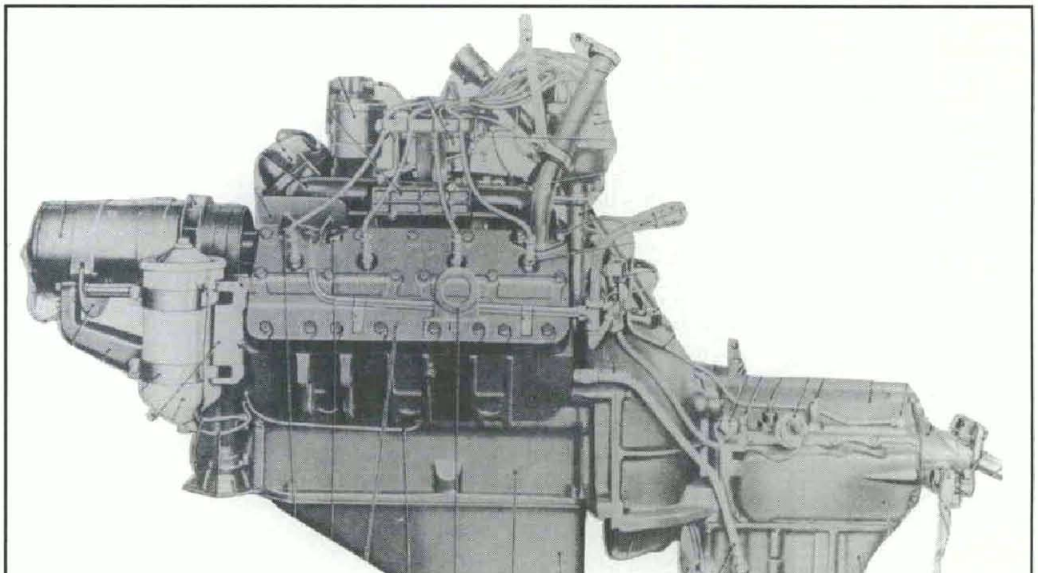
Engines and transmissions for vehicle applications are available in such great variety today that it is hard to believe that there was a period when only a small variety of automotive propulsion systems were suitable for driving an armored vehicle. In the mid-1930s, our peacetime combat vehicle inventory was small, and development of new items was understandably slow. Whatever engineering and development that was done took place at Rock Island Arsenal, IL. The remnants of World War I provided the basis for any advancements that were made during those years.

Then, as now, the brute of combat vehicles was the tank, a big enclosure of armor, moving on tracks, and carrying a heavy gun, with the crew to operate this weapon system. In terms of motive power, the demands of a tank are the most severe. With World War II on the horizon, we were plagued with an unfortunate awareness: there was no such thing as a tank engine!

In the years between the wars, tanks were powered by a variety of aircraft and truck engines. When very light power was required, automobile engines were used. However, in all of those transitional years, we never had an engine that was specifically designed for driving a tank.

Suddenly, the design, development and production of tanks and combat vehicles accelerated in the late 30s. Because of the automotive character of these items, production of tanks was moved close to Detroit, in the newly built Detroit Arsenal. Chrysler Corporation was the manufacturing contractor. Cadillac Motor Car Division of General Motors established a production facility in a hangar, near Cleveland Hopkins Airport. Our Army would soon need large numbers of tanks, and manufacturing of them would be on a scale never before known.

New designs for bigger, heavier, and faster armored vehicles set a requirement for power units that had become more than the automotive industry could meet. With certain limitations, the best candidates were radial aircraft engines. Here was a powerful package that was compact enough to be installed in a tank's hull. Engines of this variety were found in heavy tanks, such as the M6, as well as in light tanks, such as early versions of the M4. These aircraft engines were air-cooled and needed no radiator, but did need good air flow through the engine compartment. A fan on the engine supplied sufficient cooling air for most situations. But in those crucial moments where the vehicle needed to pull through heavy mud, or lug heavily at slow speeds, the engine could not turn up enough revolutions per minute (RPM) for cooling. The



The Cadillac passenger engine equipped for armored vehicle propulsion, with Hydra-Matic transmission.

resulting overheating caused the cylinders to warp, and the engine would seize.

Aircraft engines operate best at constant speeds for hours at a time. In the role of ground vehicle propulsion, carburetion for the varying speeds was tricky and often was out of adjustment. Operators frequently found that fuel had leaked into the bottom cylinders, causing a hydrostatic lock. The cure was to remove the spark plugs and crank the engine to clear the lockup. This happened all too often during the wintry days of campaigns, such as the Battle of the Bulge, where hardships were already in abundance.

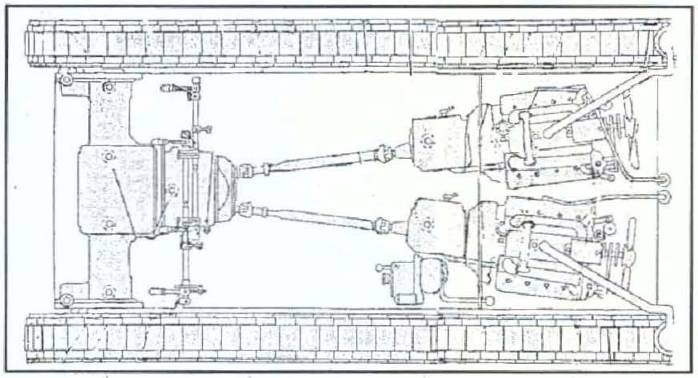
Many of the radial-powered tanks and self-propelled howitzers were in service throughout the entire war. Other defeating factors for aircraft engines in tanks were high price and limited availability for the demands of tank production. To worsen the situation, the accelerated requirements of aircraft production seriously limited the availability of engines for armored vehicles. A new source of engines for tanks had to be found.

At first glance, the selection of engines for ground vehicles seemed to be extensive. Diesel truck engines had found their way into such early vehicles as the M3 tank. Diesel military power, as we know it today, was far in the future, and the logistics of diesel propulsion would demand multiple fuel supplies for ground vehicles at that time. One version of the M3 (medium) tank used two diesel engines to develop 375 horsepower.

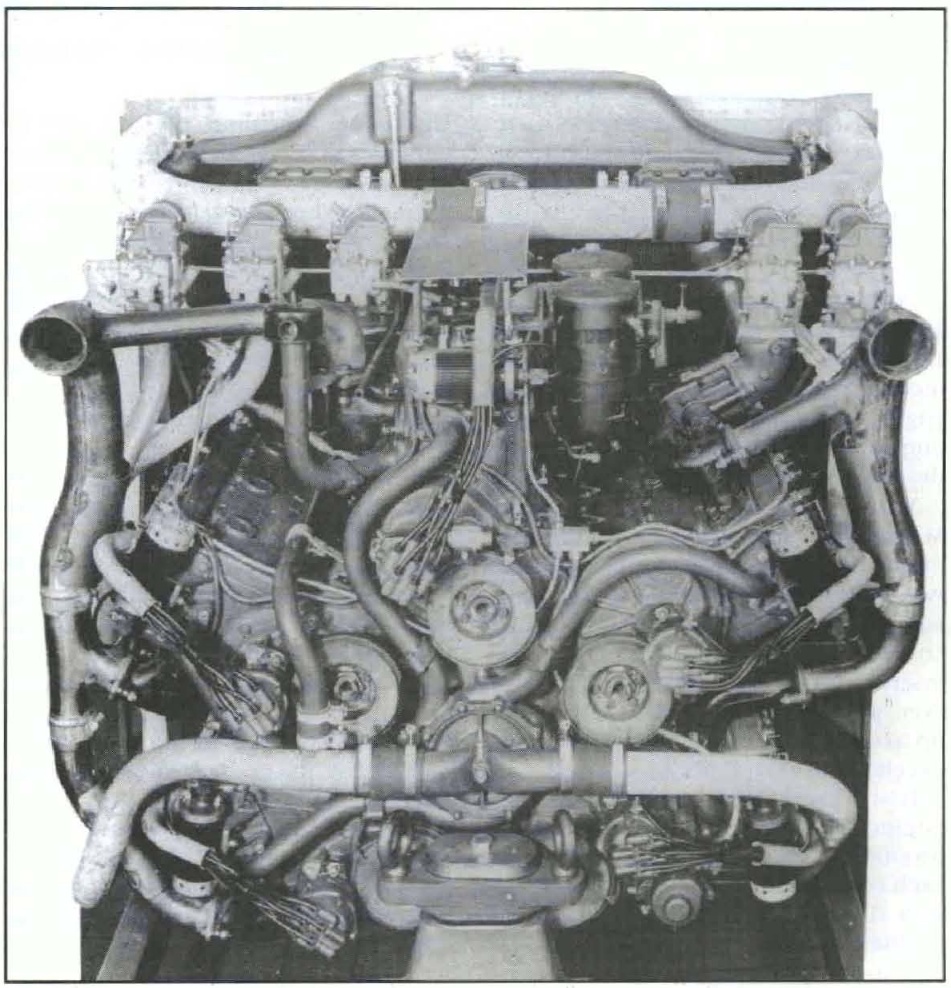
In the waning months of the 1930s, the possibilities for passenger car engines to power armored vehicles had to be examined. Sources for engines were seemingly plentiful, but there were very few with capabilities of more than 100 horsepower. This eliminated the largest percentage of those in production at that time. During the 30s, engine technology was at a low level of development, chiefly because of the depressed economy.

There were 6- and 8-cylinder overhead-valve engines, and only one (Buick) exceeded 100 horsepower. The majority of passenger car engines were L-head designs. The real possibilities lay in V-block engines, because of their relative compactness and their potential for higher horsepower capability.

Packard's 473 cubic inch V12 would



The drive arrangement in the dual-Cadillac powered tanks.



Chrysler's 30-cylinder multibank engine. One starting motor cranked it into operation.

have had interesting possibilities, but it had never been tooled for high-quantity production and was phased out in 1939. Besides, Packard had already been heavily committed to production of Rolls-Royce Merlin aircraft engines and their V12 marine engine that powered the Navy's Patrol Torpedo (PT) boats.

The rugged little Ford L head V8 was short on horsepower. Cadillac's 431 cubic inch V16 engine developed 180 horsepower, but did not lend itself to high production, and lacked the ruggedness that armor would demand. It was phased out in 1940. The search would narrow down to Cadillac's 346 cubic inch V8, rated at 150 horsepower at 3,400 RPM. This engine, unlike many other passenger car engines of its day, had insert bearings and full-pressure lubrication.

The technological shortcomings of most of the automotive engines of that day were poured connecting rod (and main, in some instances) bearings and splash system oiling. Some suffered casting difficulties, which contributed to their frailty.

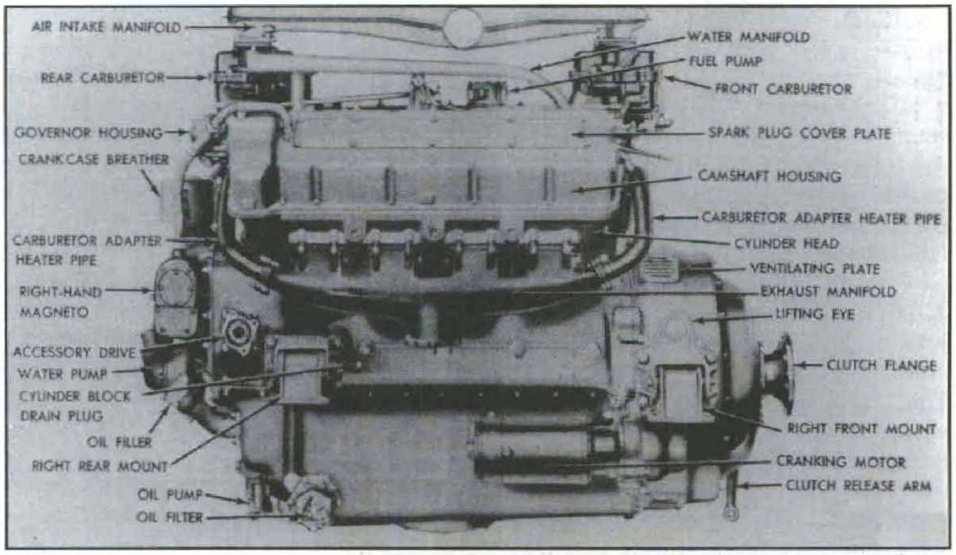
Probably the most interesting, and also the rarest, example of passenger-car engine application was the arrangement of five Chrysler six-cylinder engines in a cluster, driving a common output shaft, and used in one version of the M4.

While experimental versions of the M3 tank had used three Lycoming six-cylinder engines to drive it, Chrysler was the champion of the cylinder (and engine) contest! Note that all Chrysler engines of that day were equipped with insert bearings and full-pressure lubrication systems, and were among the most up-to-date engines available, enjoying an excellent reputation for ruggedness.

History records that the multiple engine tanks that reached significant production were the M5 and the M24. Each of these vehicles was powered by two 150 horsepower Cadillac V8 engines. Each of these engines was also equipped with a Hydra Matic four-speed transmission, coupled to a transfer unit, followed by a final drive to the sprockets.

When the M5 and M24 appeared, they were the first tanks to use automatic transmissions. The Hydra-Matic had first appeared on Oldsmobile in 1940. Cadillac made this option available after March 1, 1941.

In passenger cars, the early Hydra-Matics needed no external cooling.



Our first real tank engine, the Ford GAA series V8.

However, because of the severe demands of tracked vehicle propulsion, with no road air washing past to cool them, an oil cooler was installed in the sump of each transmission. Engine coolant was circulated through the cooling coil. The use of this propulsion package freed the tank driver from having to operate shifting and clutching controls. No need to emphasize, this simplification of operation was a welcome aid to the driver.

Running concurrently with the task of arranging power systems for armor, Ford Motor Company had our very first tank engine in development. About late 1941, Ford began to produce their model GAA tank engine. This magnificent V8 engine was capable of developing 500 horsepower. Its displacement was 1,100 cubic inches. It featured twin overhead camshafts, gear driven from the front of the crankshaft, and was liquid-cooled.

The accompanying illustrations fall short of showing this magnificent creation in its full glory. It seems fitting that Ford Motor Company could produce an engine of this sort, having had the experience of nearly a decade in high production of V8 engines to draw from.

The GAA, with its various versions such as GAC, GAF, GAN, etc., powered light and heavy tanks, alike. Old TACOM veterans, of days past, attested to the worthiness and the performance of this remarkable engine.

Many in our military vehicle community recall that tank engine technology advanced following World War II. The next tank power unit was the gasoline-powered Continental air-cooled V12, in time for the Korean war, equipped with automatic transmission-final drive unit. This engine evolved into the diesel AVDS-1790 engine, used in the M60 and other related vehicles.

The tank engines of today are yet apart from those of 20 years ago, with horsepower availability undreamed of in the days before World War II. Imagine a search today for an automotive engine to power a combat vehicle. Times have changed!

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MULTILEVEL SECURITY. . . STAYING INSIDE THE ENEMY'S DECISION CYCLE

By COL W. H. Freestone

Author's Note: This is the first in a series of articles that will present information about multilevel security technology.

Background

In the mid-80s, the United States, in conjunction with the Organization of Eastern Caribbean Countries, conducted operations in Grenada to protect U.S. citizens and to assist in stabilizing the situation there. It has been alleged that during the operation, a U.S. soldier on the scene used a personal credit calling card (from a public, non-military phone) to call Fort Bragg, NC. This was necessary, according to reports, to establish a communications relay to U.S. ships providing direct fire support for the invading U.S. forces.

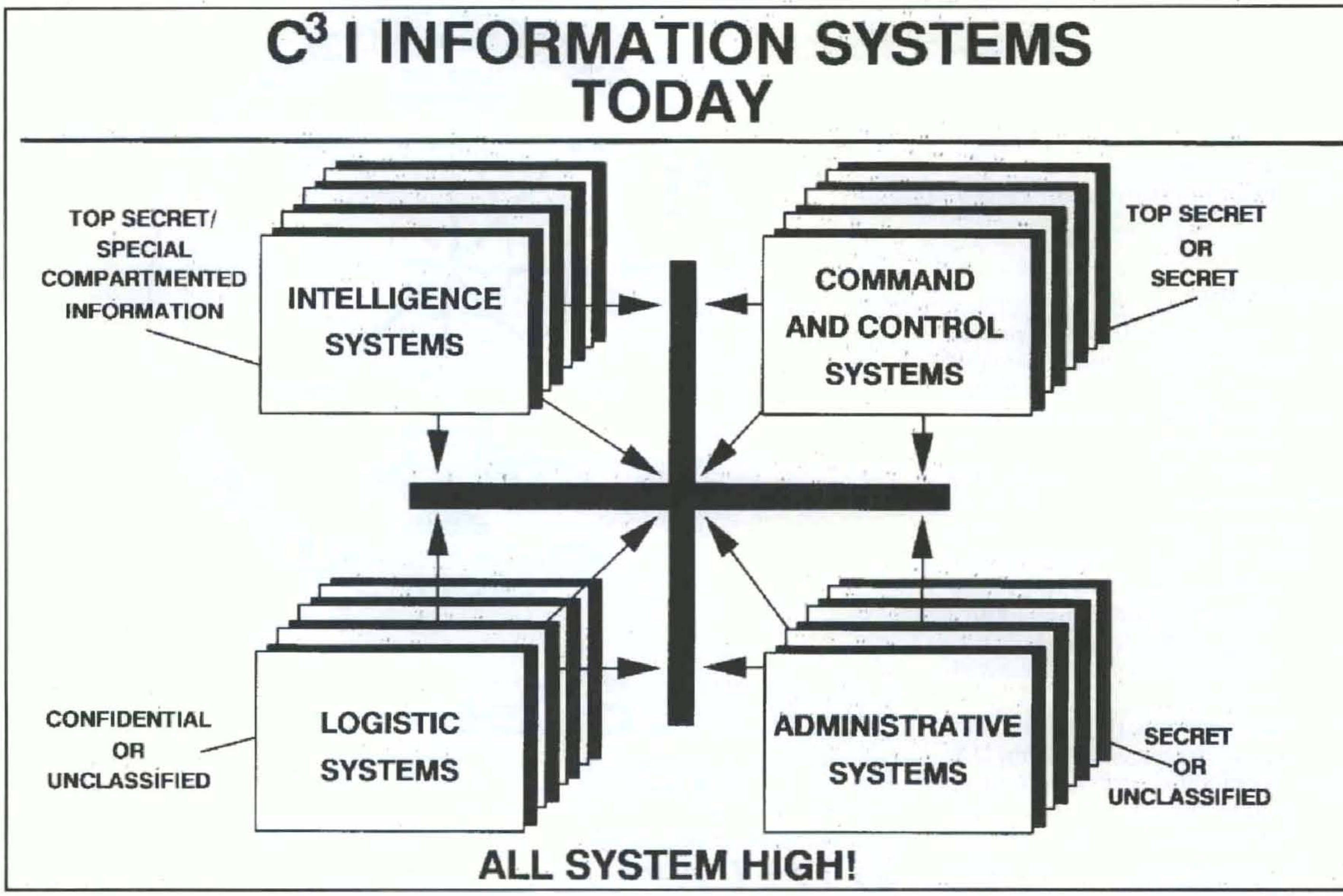
After the operation, the alleged public phone call during an ongoing U.S. Military operation contributed to more than a routine interest in assessing and improving command, control, communications, and intelligence (C3I) system processes that support the commanders-in-chief (CINC) of the unified and specified commands. Follow-up actions to the Grenada operation, code name "Urgent Fury," examined C3I system needs for the CINCs.

In 1988, a Joint Chiefs of Staff led assessment came from a team made up of personnel from DOD activities concerned with Joint C3I system performance. After compiling the results of their research, the team found there was at least one C3I improvement area where all of the CINCs were in agreement.

C3I Information Systems

The CINCs and their staffs reported that in handling different levels of classified, electronically generated information, they followed time consuming, cost intensive processes. The term "Sneaker Net" (staff personnel running between terminals in a command center), was coined to illustrate the purely human actions used in command centers to merge information from multilevel classified information sources.

Decision processes, in observance of security policy, were deemed ineffi-



cient, due to physical handling of message traffic. In addition, information systems were operating in a "system high" mode. What this meant was that all traffic for a given information source was required to operate at the highest expected classified traffic level. If a single message coming over a single system was top secret, (just once per year), and the rest of the time, all other messages were classified at a lower level, all traffic over that system would have to be treated as top secret. All personnel involved would require a costly top secret security clearance. Yet, the vast majority of message traffic did not require the system to operate at such a high security level. However, without a mechanism that would allow for automated management of the two classification levels, the system would be stuck with both a costly and inefficient system high, manual mode of operation.

Documenting the Requirement

A need existed then and continues to the present, for each CINC (and each military service as well), to overcome time consuming manual processes between different levels of classified and unclassified C3I information sources (i.e., stovepipes). In July of 1989, this need was established as a formal Joint Staff requirement, (RS JS2-89), *Multilevel Security in C3I Systems.*

Approximately 18 months later, after coordination with the entire DOD community, the vice chairman of the Joint Chiefs, on Feb. 11, 1991, signed a Joint Multicommand Required Operational Capability statement. This formally established the need for the creation of multilevel secure C3I systems to support both CINC and military service operations.

Automating the Merger of Data

To simultaneously merge different levels of classified and unclassified/sensitive data, in an automated and secure way, is referred to as multilevel security (MLS). The worth of MLS to military operations may be seen through recent lessons learned from Operation Desert Storm. Transfer of intelligence information from one source to another, in a timely manner, has been identified as one area in need of improvement. MLS processes can provide for automated separation of intelligence compartments.

To rely totally on human processes for classified information transactions, in the heat of a conflict, has proven to be operationally slower than what may be achieved through automation. In addition, with significant reductions of personnel projected during the coming years, continued operation with "human intensive" military information systems (e.g., military message and communication centers) in the 90s and beyond is a luxury that is no longer affordable. This is a fact of life according to a recent Defense Management Resource review.

U.S. Transportation Command

The Military Airlift Command (MAC) at Scott AFB, Belleville, IL, a component of the U.S. Transportation Command (TRANSCOM), has the DOD mission of

Getting quick, accurate, and decisive decisions—faster than the other guy can—may be the ultimate "force multiplier."

delivering both personnel and materiel on time to locations throughout the world. As with most mission oriented military organizations, it is constantly on the lookout for and is highly motivated to identify anything that can improve "on time" performance.

Based on their experiences, in support of operation Urgent Fury, where some mission delays were experienced, (attributable to manual processes in handling of different levels of classified information), the MAC Command Center staff began to explore opportunities to automate the merger of data from different classified systems.

Additionally, in 1988, the MAC Command Center was identified as a "Joint Model Command Center" and was encouraged to begin examining ways of improving total command center system performance.

U.S. industry efforts to develop multilevel secure automation products in the 80s, provided an opportunity in 1988 for the MAC Command Center staff to take the first step toward establishing an automated interface between two different levels of classified mission information. The MAC Command Center staff began a small experiment with a new commercial off-the-shelf device called a multinet gateway (MNG). In 1988, this device was a prototype.

The multinet gateway functions as a traffic cop. It receives and sends data using either Transmission Control Protocol/Internet Protocol or File Transfer Protocol. The MNG supports either local or wide area networks. The MNG receives data packets from the low side, (in this case unclassified), checks to insure that the delivery address of the data is correct, attaches a classification label to the packets equivalent to the security level of the system to receive data and then forwards the data to the high side, (in this case secret).

Data received from the low side that is not properly addressed is discarded by the MNG. The MNG also ensures that data packets will not pass from the high system to the low system and provides a complete audit trail of all data received, discarded, and/or sent.

Subsequent to those initial events in 1988, much of the MAC Command Center multinet gateway experimental activity might have gone unnoticed. However, about a year and a half later, another unexpected crisis occurred—the invasion of Panama. Another rapid reaction mission was about to require the MAC Command Center staff to go through the same human intensive process they had experienced in their support of Urgent Fury. This time, however, things were handled differently. Once the operation began, and with well over a year of experimentation, the commander of MAC made a "command decision" to use the multinet gateway in the real ongoing (Panama) operation—Just Cause.

Subsequent assessments by the MAC staff and others concluded that operational efficiency was greatly improved as a result of their use of the multinet gateway. As the Panama mission ended, it was determined that the multinet gateway had contributed directly to mission success. MAC and the U.S. TRANSCOM are currently engaged in extending additional multilevel security components into the MAC Command Center environment.

Importance of MLS to the Army

Why is MLS of importance to the Army? Commanders at all levels always want to remain inside the enemy's decision cycle. Getting quick, accurate, and decisive decisions—faster than the other guy can—may be the ultimate "force multiplier."

Multilevel secure automation enables commanders and their staffs to process decision critical information via standardized message formats. In the heat of a rapidly developing future crisis, the multilevel security automation process can also assist in overcoming human error through the quick and accurate handling of unclassified and classified security policy controlled information.

As with any conflict, the person who can make the quickest decision and can subsequently disseminate those decisions first, has a better chance of winning an engagement. The need for rapid dissemination of information, in times of crisis, will be of increasing importance in the years to come.

With fewer military personnel available, but, with no change in the potential volume of missions, the more the Army can automate the secure processing and merger of classified and unclassified data should help to simplify mission accomplishment.

Conclusion

In January of 1990, the Joint Staff directed the Defense Communications Agency (now the Defense Information Systems Agency) to establish a formal program for multilevel security technology (product) insertion into DOD-wide systems. The Multilevel Security Technology Insertion Program (MLS TIP) was officially established then. In addition, the Military Airlift Command, the command center discussed earlier, was officially established as a DOD multilevel security (product/system) testbed.

In July of 1990, the assistant secretary of defense for C3I established the need for the Defense Wide Information System Security Program (DISSP) to deal with overall DOD security policy, security architecture and system security operational requirements. The MLS TIP is now a component of that program.

The next installment of this series will address both the DISSP and MLS TIP Programs.

COL W. H. FREESTONE is manager of the Joint Multilevel Security Technology Insertion Program at the Defense Information Systems Agency. He is also a member of the Army Acquisition Corps.

WRAIR STUDIES CELLS ON SPACE SHUTTLE

By Chuck Dasey

The top-rated military life sciences research project for the space shuttle is a cell culture system designed to support the study of the rapid degradation of the immune system, muscle and bone in space. These studies may yield important information for treating combat injuries, health problems associated with long-term space flight, muscular dystrophy, bone failure and immune disorders.

The Space Tissue Lost Model was designed by scientists from the Walter Reed Army Institute of Research (WRAIR) and the National Aeronautics and Space Administration (NASA), and is supported by the Armed Forces Institute of Pathology. It is self-contained in an automated compartment designed by WRAIR and the U.S. Army Biomedical Research and Development Laboratory (USABRDL). It will be placed in a payload locker on two shuttle flights this year, the first of which lifted off on March 23, 1992.

The ultimate objective of this study is the development of pharmaceutical products and treatment regimens to limit immune system compromise and tissue loss following trauma and treatment. Many of the changes noted in past structural and biochemical studies of space flown organisms and tissues are also noted in combat casualties. Anticipated benefits for the Army include savings from reduced need for physical therapy and enhanced unit coherence through more rapid return of injured soldiers to duty. Data and treatment regimens derived from the study will also be directly applicable to space atrophy, bone demineralization and immune compromise in astronauts.

Cultures of human cardiac muscle cells, rat heart cells, human and rat bone cells, and human lymphocytes and endothelial cells are perfused with growth media and an air-like mix of 20 percent oxygen, five percent carbon dioxide and 75 percent nitrogen.

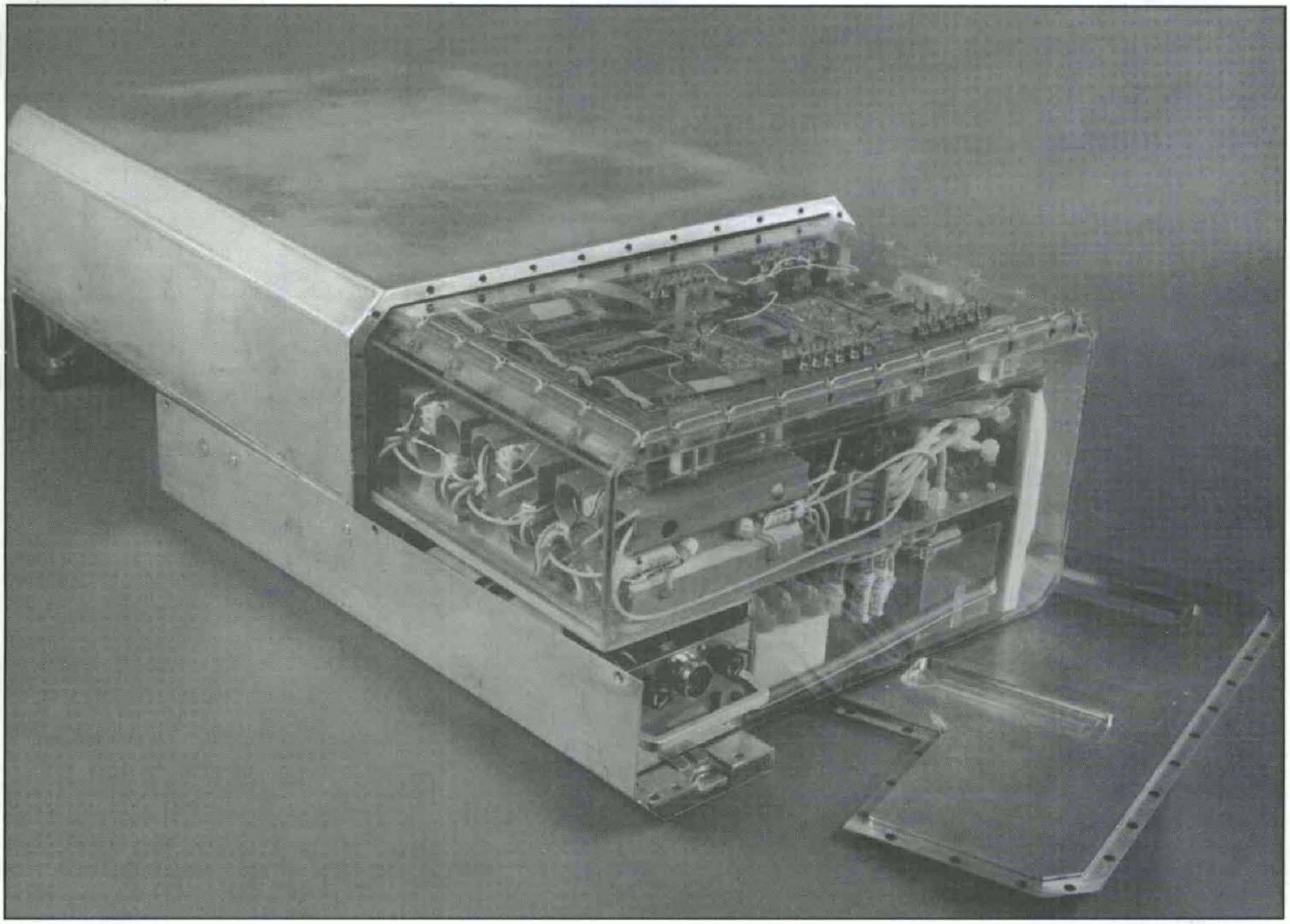
An automatic drug delivery system will supply candidate pharmaceuticals for testing. Cell vitality and physical environment inside the compartment will be continuously monitored and communicated on a display module.

The alteration of muscle function and structural integrity during space flight has been well documented. Up to 20 percent weakening of muscle performance, shifts in metabolic pathways to support contraction, and various structural changes have been observed.

Muscle cell studies on the shuttle will attempt to delineate the major pathways, describe the control mechanisms, and identify the cellular level signalling and activating mechanisms associated with muscle weakening and structural changes. Bench-mark data for future reference will be derived from a detailed description of the biochemical, physiological and structural detail changes taking place in muscle cells in space.

Space scientists extrapolate from known data to predict that a year-long space mission would result in a 25 percent loss in body calcium. The phe-

Investigators expect to apply knowledge gained about the bone loss phenomenon to future space exploration as well as to earth-bound treatments for bone diseases.



The space tissue loss model module was designed by engineers at the Walter Reed Army Institute of Research and the U.S. Army Biomedical Research and Development Laboratory.

nomenon of bone loss in space is not fully understood. Normal mineralization of bone cells will be observed on the shuttle, and in a control cell culture on the ground, with the cell culture environments identical except for gravity.

Investigators expect to apply knowledge gained about the bone loss phenomenon to future space exploration as well as to earth-bound treatments for bone diseases. They also hope to validate earth-bound models for bone loss study such as extended periods of inactivity.

Studies of the effects of space flight on lymphocytes suggest the possibility of immune system collapse in astronauts, resulting in the potential for life-threatening infection caused by normally non-pathogenic organisms (as occurs in immune suppression therapy or in HIV infection).

Immune system compromise occurs frequently after battlefield trauma. Investigators hope to advance the understanding of immune system changes by studying the effects of weightlessness on lymphocytes and endothelial cells.

The tissue culture module contains the cells under study, all media for sustained growth, an automated drug delivery system for testing candidate pharmaceuticals, vital activity and environment monitors, and integral fraction collection, data logging and cell fixation capabilities. The tissue culture areas are hermetically sealed to provide a totally controlled environment. A one-quarter inch layer of lexan and a one-quarter inch layer of aluminum complete the exterior protection of the module.

The Space Tissue Loss Model compartment will be prepared for flight by life sciences support personnel before installation on the shuttle. In orbit, a shuttle crew member will push a button to establish a time mark, monitor the display module periodically, and push the same time-mark button as the crew prepares to return to earth. Ground personnel will recover the compartment and prepare it for shipping back to the laboratory for analysis.

After the two shuttle flights this year, a second round of studies is planned in conjunction with the European Space Agency.

CHUCK DASEY is the public affairs officer at the U.S. Army Medical R&D Command. He holds a B.A. degree in English from Fordham University and is a graduate of the Army's Advanced Public Affairs Course.

A Fortuitous Anomaly. . .

INFECTIOUS DISEASE RATES IN OPERATIONS DESERT SHIELD/STORM

By LTC Gaylord C. Lindsay

During Operation Desert Shield/Storm, U.S. forces experienced the lowest rates of infectious diseases that this or any other nation has ever experienced in conflict. While this is good news, the assumption that infectious diseases have been removed as a threat to military deployments is a dangerous one.

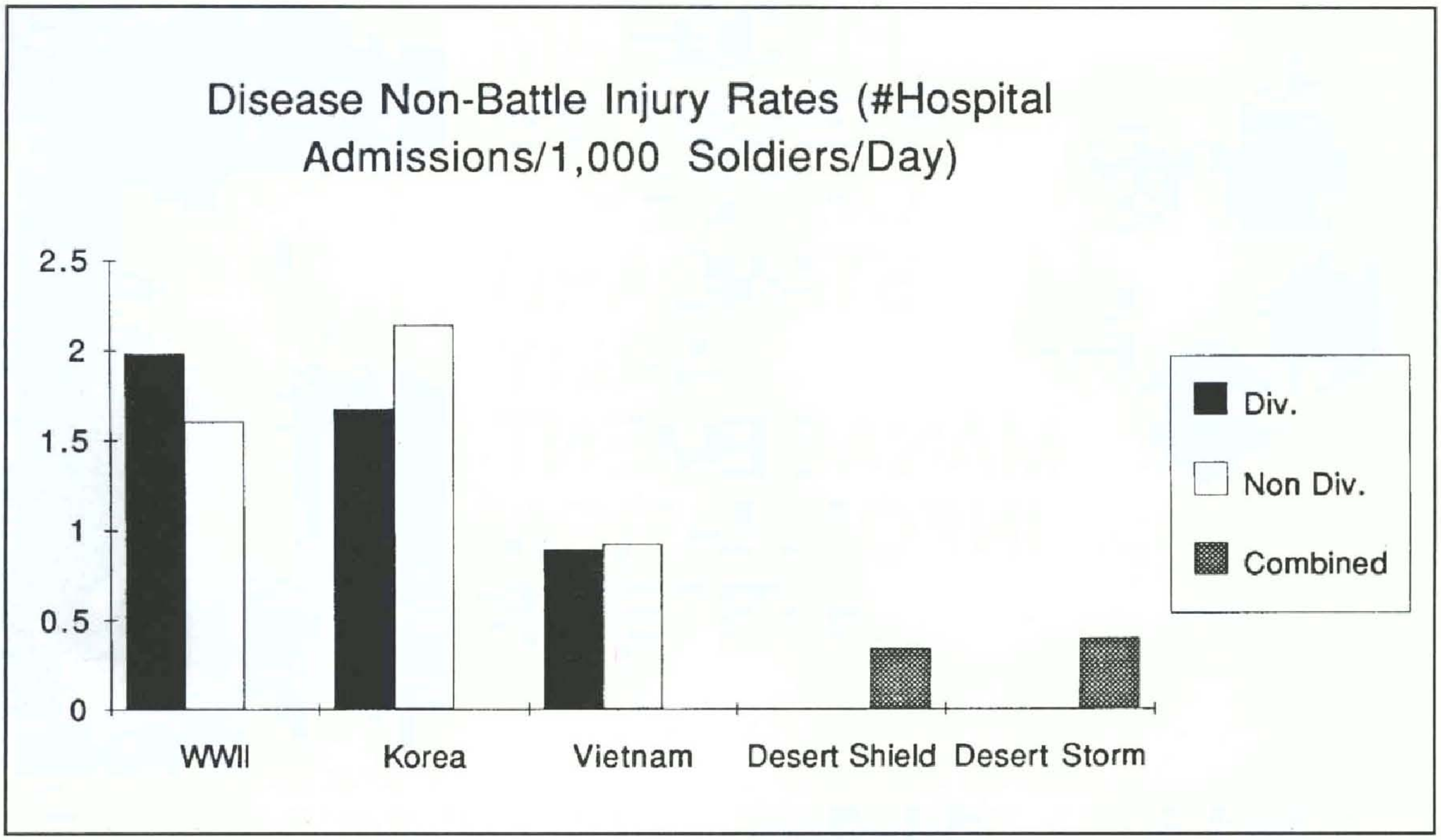
"Boil your water and bury your dung" was the advice given to Alexander the Great by his teacher, philosopher and physician, Aristotle. From the earliest times in the history of war, the chance of a soldier dying from disease was far greater than dying from battle wounds. As MAJ W.S. King, U.S. Army surgeon and medical director, commented after the first battle of Bull Run, "Diseases destroy more soldiers than do powder and the sword" (Woodward and Otis 1870). The fact that disease caused more deaths to soldiers remained statistically valid through World War I.

In U.S. history, infectious diseases have caused 56 to 86 percent of all hospital admissions of U.S. forces. After World War I, the development of antibiotics and vaccines began to turn slightly the statistics of history. Even so, in World War II the U.S. Army lost 296 million man-days to disease; or the equivalent of 11 divisions every year were not available for combat. Similarly, two-thirds of all hospital admissions in Vietnam were caused by disease.

Operations Desert Shield/Storm were carried out with the lowest disease rates in any previous U.S. military action. Many critical factors contributed to unusually low rates. This was the first time that forces had deployed virtually with a rifle in one hand and commercial bottled water in the other. The major sources of water for coalition forces were either from bottled or local desalinization plants. This factor, when linked with the virtual lack of surface water, virtually negated the risk of water-borne disease.

For the thousands of U.S. forces stationed in urban areas of Saudi Arabia, the modern infrastructure, waste management facilities, and government public health programs also helped keep disease rates low. Seasonal variations also proved to be critical to the low incidence of infectious diseases. Fall and winter are periods of relatively low insect activity which reduces the risk of

From the earliest times in the history of war, the chance of a soldier dying from disease was far greater than dying from battle wounds.



insect-borne infectious diseases. The recent fielding of the Army's new extended duration insect repellent also contributed to the low incidence of insect-borne diseases.

Food is another major source of infectious diseases. Health hazards are increased with locally procured foodstuffs and from food consumed in local dining facilities. The Meal-Ready-to-Eat (MRE) and the Field Feeding system contributed to the significant reduction in food-borne illness. During the early phases of Operation Desert Shield, diarrheal diseases from contaminated lettuce led to the Marines establishing a ban on locally procured produce. Dining in local facilities was infrequent to non-occurring.

The religion of the host nation also contributed to the health of U.S. forces. The Moslem religion forbids prostitution and the use of alcohol or drugs. Alcohol related injury and illness were virtually eliminated when U.S. forces, in respect to the host nation religious observances, abstained from alcohol. The non-availability of prostitutes and drugs led to a significant reduction of venereal diseases and drug-related disease (e.g., hepatitis), respectively.

Pre-deployment preventive medicine training teams from the Academy of Health Sciences (now the Army Medical Department Center and School), Fort Sam Houston, TX, were sent to deploying units to provide an update on field hygiene and surviving in the desert.

Command emphasis in the area of operations on individual hygiene may have been a contributing factor to the low incidence of infectious disease. However, the benefits derived from water, food, religion and seasonal influences (insects) reduced both the pressure on the unit leader and the ability to discern the benefit of command emphasis.

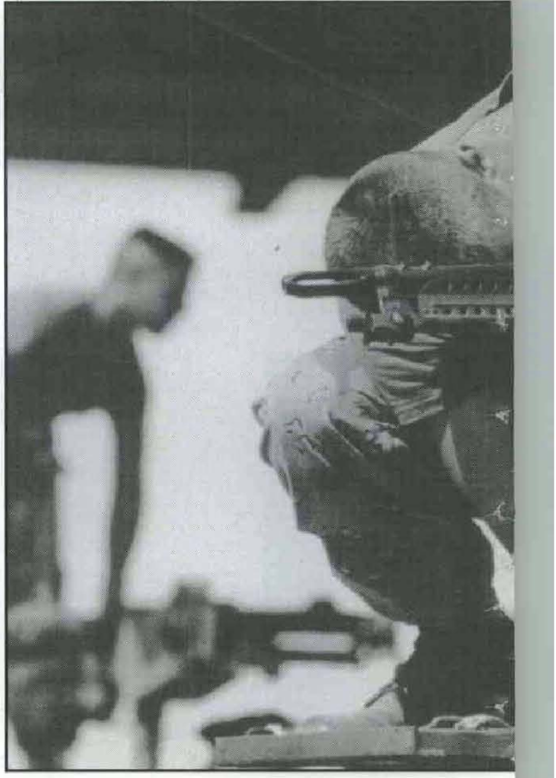
Tactical operations, such as feinting, relocating and security discipline not only denied the enemy information on friendly unit size, location and intent, but prevented the buildup of open waste dumps. The absence of uncovered waste also contributed to reduced health hazards since rodents and insect vectors were neither attracted nor provided an environment which encouraged the buildup of these pests.

There is little doubt that the incidence of infectious diseases would have been greater if U.S. forces had deployed to a tropical region; if the country had been underdeveloped without an infrastructure; if there had been an abundant supply of surface water; and if drugs, alcohol, prostitutes, and restaurants were readily available.

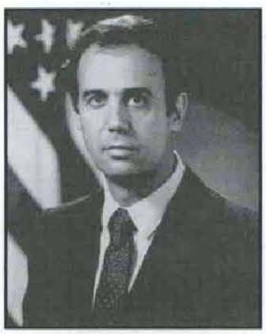
While there were myriad factors that led to the lowest incidence of disease ever seen in deployed forces, the possibility of all the factors occurring at the same time is exceptional and fortuitous. To give undue weight or emphasis to the infectious disease data from Operation Desert Shield/Storm in establishing a model or planning factors for future military operations would be disastrous, except for an operation in the same region of the world, at the seasons of the year and given the same infrastructure.

LTC GAYLORD C. LINDSAY is the U.S. Army Medical R&D Command's liaison officer to the U.S. Army Medical Department Center and School. He holds a B.S. degree in microbiology and a Ph.D. in immunology from Texas A&M University. He is a graduate of the U.S. Army Command and General Staff College and the Army Medical Department Officer Basic and Advanced Courses.

PROGRAM EXECUTIVE OFFICER— STANDARD ARMY MANAGEMENT INFORMATION SYSTEMS



PEO-STAMIS



Anthony M. Valletta

Anthony M. Valletta is a 1971 graduate of the University of New Haven and Yale University ROTC. His primary background is in electrical engineering with graduate work in engineering and industrial management. Valletta was selected for the senior service school and attended the Industrial College of the Armed Forces class in 1984. His prior civilian positions include: technical advisor and executive assistant to the DISC4; deputy director of the Architecture Directorate, Army Staff; chief of the Tactical Division, Office of the Assistant Chief of Staff for Information Management; and force integration staff officer, Office of the Assistant Chief of Staff for Automation and Communications in the Network Integration Directorate. Valletta's military experience includes: extensive communications engineering assignments with the Army Signal Corps; company commander and operations officer with the 11th Signal Brigade, Fort Huachuca, AZ; and engineering and development of the TRI-TAC Digital Group Multiplex family of equipment while assigned to the Signal Processing Division, U.S. Army Communications Research and Development Command, Fort Monmouth, NJ.

Missions and Organizations

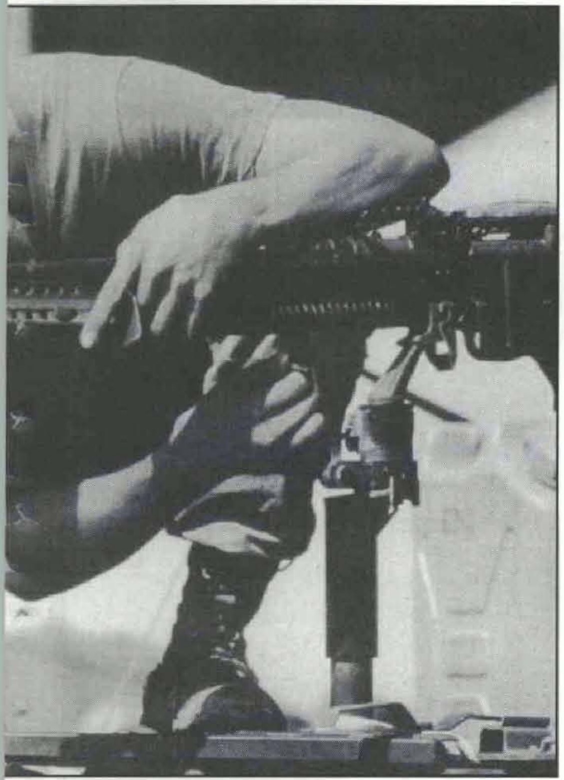
As PEO-STAMIS, Valletta exercises Department of the Army program management of development, systems engineering, integration, testing, logistics, fielding, and resource management of the Army's most critical information systems software/hardware programs.

The PEO-STAMIS reports to the Army Acquisition Executive for selected information systems. Valletta is responsible for the planning, design, development, acquisition, and fielding of highly complex management information systems under the direction of the Army Acquisition Executive. The PEO-STAMIS has an authorized headquarters staff of 43 military and civilians who provide expertise in systems engineering and integration, planning and programmatics, as well as resource management.

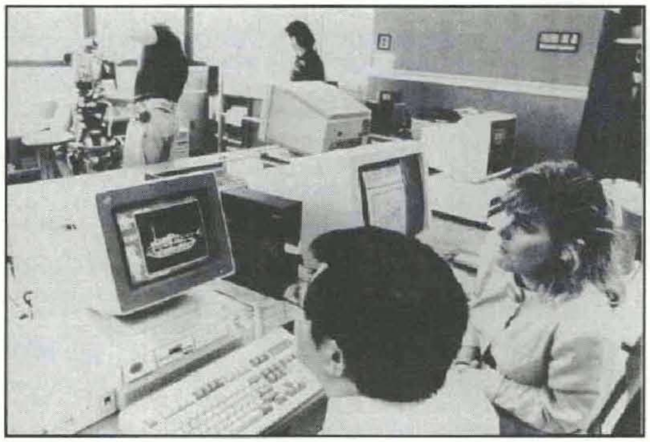
Current programs under the PEO STAMIS direction are diverse, based on the size and variety of products produced (hardware and software systems) and the breadth of customers. The span is worldwide and Defense-wide, extending from the Project Management Office for Integrated Logistics Systems (ILOGS) with responsibility for programs such as the Objective Supply Capability (OSC), Standard Army Ammunition System (SAAS), Standard Army Maintenance Systems (SAMS), Standard Army Retail Supply System (SARSS), Standard Property Book System-Redesign (SPBS-R), Unit Level Logistics System (ULLS), to the Theater Army Medical Management Information Systems (TAMMIS) and the Joint Computer-Aided Acquisition Logistics Systems (JCALS).

One of the major program offices under the PEO-STAMIS is the Tactical Management Information Systems (TACMIS) Project Office. The tactical hardware that was used so effectively during Desert Storm provided, for the first time, battlefield application. The overall evaluation was that the reliability and value was of significant importance and reinforced the fact that the modern era of computerization is a main-stay for our soldiers.

The Personnel Electronic Record Management System (PERMS) is one of the newest programs under PEO-STAMIS. The PERMS program will oversee the transformation of military personnel records from a paper intensive arena into the



STANDARD ARMY AMMUNITION SYSTEM (SAAS)
The SAAS will replace the Army's manual systems for managing ammunition. SAAS is a management information system that will assist with the control and distribution of conventional ammunition, non-nuclear guided missiles and large rockets in divisions, separate brigades, or armored cavalry regiments. Other phases of SAAS include stock control accounting and supply management. The program operates on the tactical Army combat service support computer system (TACCS).



JOINT COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT (JCALS)
JCALS is an automated system for implementing the Department of Defense and industry strategy for transitioning from paper-intensive weapon system support processes to a largely automated and integrated mode of operation. JCALS will modernize the Joint Services/DLA processes for the capture, storage and processing of logistic technical information (both weapon system hardware and software) required for weapon system acquisition, design, manufacturing and support.

new age of optics and optical disks. This will mean permanent protection of valuable personnel data and rapid retrieval of information.

The Sustaining Base Information System (SBIS) will transition Department of the Army sustaining base information processing to an Open Systems Environment (OSE). The program will address the modernization of validated and prioritized applications software and equivalent functionality and the infrastructure to support it in OSE. The infrastructure will provide processing platforms, associated communications, work stations, operating systems, software tools and other common user items. The PM for Sustaining Base Automation (SBA) is charged with the SBIS program and has the mission to reduce hardware/software maintenance costs, produce standardization, increase compatibility and eliminate costly proprietary systems by transitioning to an Open Systems Environment.

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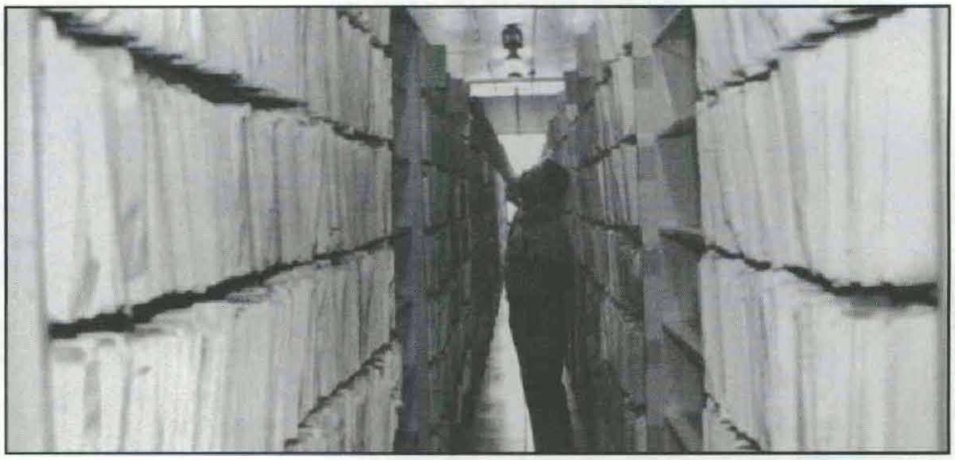
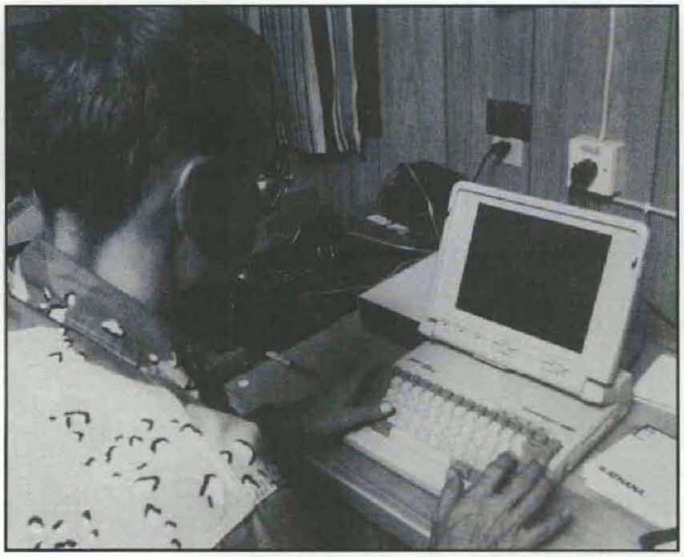
PERSONNEL ELECTRONIC RECORD MANAGEMENT SYSTEM (PERMS)

PERMS directly supports the Army's military personnel records management mission in peace, mobilization and war. It will provide an automated system for the record keeping function at the headquarters level Army Personnel Record Management Centers. Supporting active Army, Army National Guard and Army Reserve requirements, PERMS will replace the current personnel paper and microfiche record keeping architecture with commercially available optical digital imagery technology to enhance record quality and optimize record storage and retrieval operations. PERMS will replace 27 miles of paper using optical digital imagery.



UNIT LEVEL LOGISTICS SYSTEM (ULLS)

ULLS is a standard automated logistics system for unit prescribed load list and maintenance management operations. Repair parts supply documentation, maintenance management operations, and historical document data are automated to improve accuracy and timely availability.



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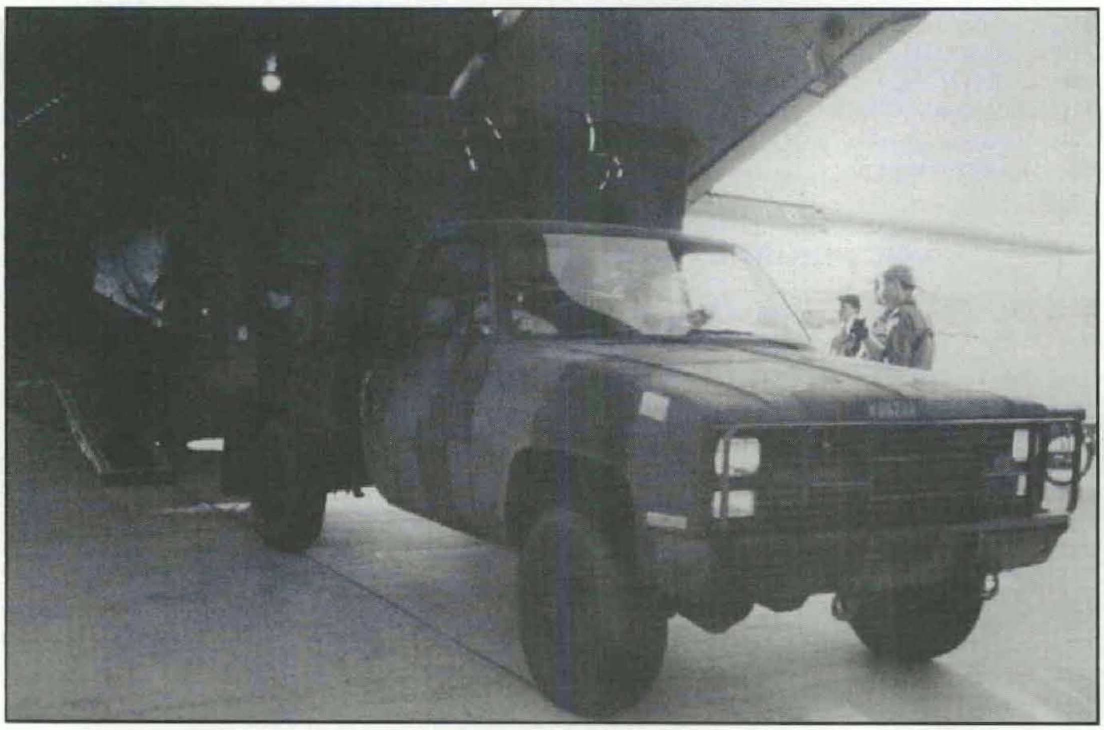
SUSTAINING BASE INFORMATION SYSTEM (SBIS)

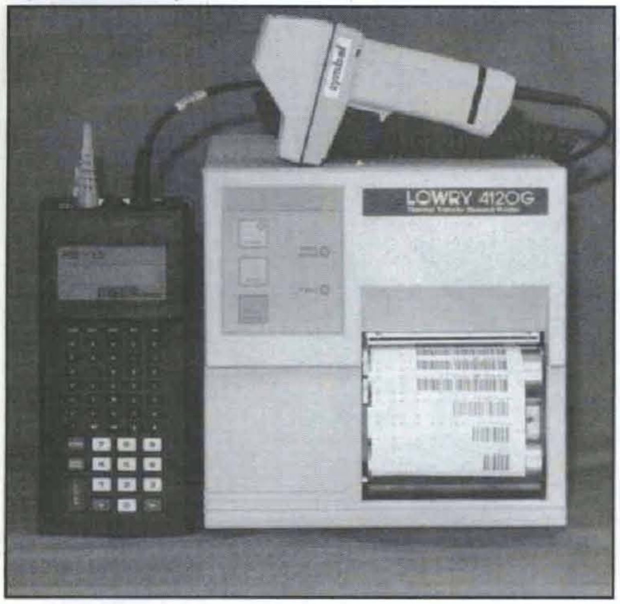
(No photo is available at this time.)

The primary purpose of the SBIS program is the acquisition of OSE compliant applications software and associated infrastructure, and the integration of these technologies with the remaining automation baseline to minimize total sustaining base operating costs for the Army. The scope of the program addresses the information requirements that serve the active component installations, MACOMs, and HQDA sustaining base needs.

CORPS THEATER ADP SERVICE CENTER PHASE II (CTASC-II)

The CTASC-II is designed to provide a transportable capability for critical wartime Theater and Corps ADP Standard Army Information Systems. The CTASC-II is more survivable, has greater data storage and processing capability, and requires less personnel than alternative systems. The CTASC-II, housed in rigid walled shelters and mounted on CUCVs, represents an improvement over existing systems through an enhanced central processing unit; the Unix operating system; and a full set of communications for both installation and tactical uses.



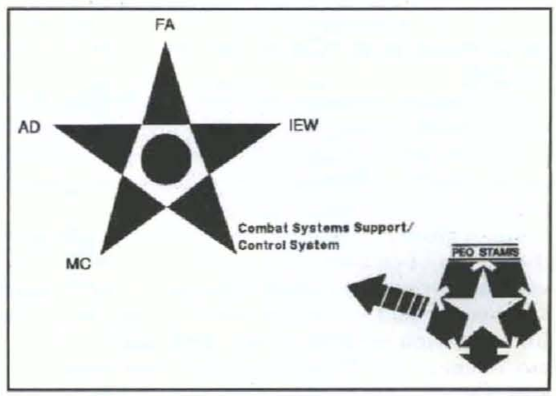


AUTOMATIC IDENTIFICATION TECHNOLOGY (AIT)

AIT is comprised of a family of technologies that provide for rapid and accurate data capture and retrieval. AIT is incorporated into automated systems through programs like LOGMARS. LOGMARS is a DOD initiative which requires the implementation of bar coding in all systems where its use enhances readiness or provides cost savings. There are two LOGMARS programs—tactical and nontactical. The tactical program is DOD-wide and implements bar coding and scanning equipment at installation level and throughout the wholesale logistic community.

THEATER ARMY MEDICAL MANAGEMENT INFORMATION SYSTEMS (TAMMIS)

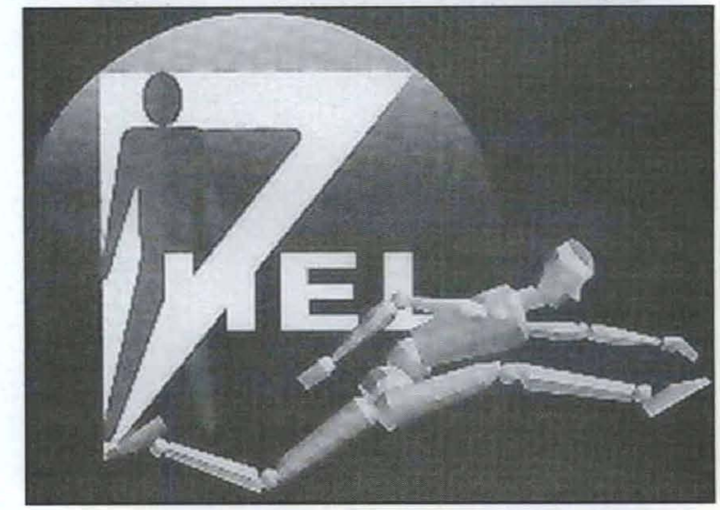
TAMMIS, an automated medical information management system, was designed to support field medical units during wartime as well as peacetime. The need for TAMMIS became apparent with the realization that manual medical information systems could not support the anticipated battlefield workload of the future. The system operated flawlessly during Desert Storm and proved its worth time and time again. TAMMIS is a family of nine systems covering such areas as blood management, patient accounting and reporting, medical logistics and optical fabrication.



OBJECTIVE SUPPLY CAPABILITY (OSC)

OSC is the program with responsibility for making the Army supply system more responsive. The OSC automated system centralizes the asset balance files maintained by the various retail logistics systems and enables the user to quickly locate and request needed supplies. The goal of the system is to reduce costs, increase asset visibility, improve unit readiness, reduce unit-level excess stocks, improve the use of communications, and provide real-time requisition status to customers.

HUMAN ENGINEERING LABORATORY DIRECTOR RETIRES



By Virginia Doleman Bailey

Amid a host of well-wishers, a pioneer in the Army's technology base research and development community retired on Jan. 31, 1992. Dr. John D. Weisz had served as the director of the U.S. Army Human Engineering Laboratory (HEL) from February 1957 until his retirement.

A personal tribute to Dr. Weis written by a former employee appears on page 35 of this issue of *Army RD&A Bulletin*.

Dr. Weisz dedicated his life to research in human factors. He came to HEL in 1953 and is nationally known as a leading expert on human factors.

The Dallas, SD, native received his B.A., M.A., and Ph.D. degrees from the University of Nebraska. While serving in WWII from 1943 to 1946, Dr. Weisz attained the rank of first sergeant with the 16th Infantry Regiment, 3rd Battalion—better known as the Army's Big Red One.

Dr. Weisz is credited with building HEL from 30 personnel in the early 1950s to its present total of 257 military and civilian employees. Under his leadership, the laboratory gained a national and international reputation based on its outstanding contributions and quality of research in the human factors field.

HEL's mission is to provide human factors engineering support in the design of combat vehicles, aviation, artillery air defense, and combat service and support equipment, individual weapons, personal equipment, communications and the life support equipment for protection in nuclear, biological, and chemical contaminated environments. Dr. Weisz believed in this mission and strove to constantly make equipment better to protect soldiers worldwide.

Among his many accomplishments, Dr. Weisz initiated the first robotics in-house technology base research and development program in the U.S. Army in 1980. He was also directly involved in the concept development of the first Kevlar helmet to replace the M1 helmet. The Kevlar helmet provides ballistic protection when hit by fragments or bullets without causing serious trauma to the wearer.

Dr. Weisz has authored numerous technical reports and articles in technical journals in the field of human factors engineering, psychosomatic medicine, mental retardation, and experimental physiology.

He has also chaired several NATO human factors working groups and participated in numerous DOD and DA level working groups. He implemented a total quality management effort within the laboratory that is being emulated throughout other military organizations and agencies.

Although Dr. Weisz was offered many other positions with DOD over the years, he remained at HEL.

"I was happiest being out here in the field," he said. Dr. Weisz attributed his many successes to his aggressiveness and to laboratory employees and their support throughout his career. "This has been a rewarding career, but there have been some tough times, too," he said. Dr. Weisz said one of his hardest struggles over the years was having enough funds for an entire year. "I've lost a lot of sleep over that one," he said.

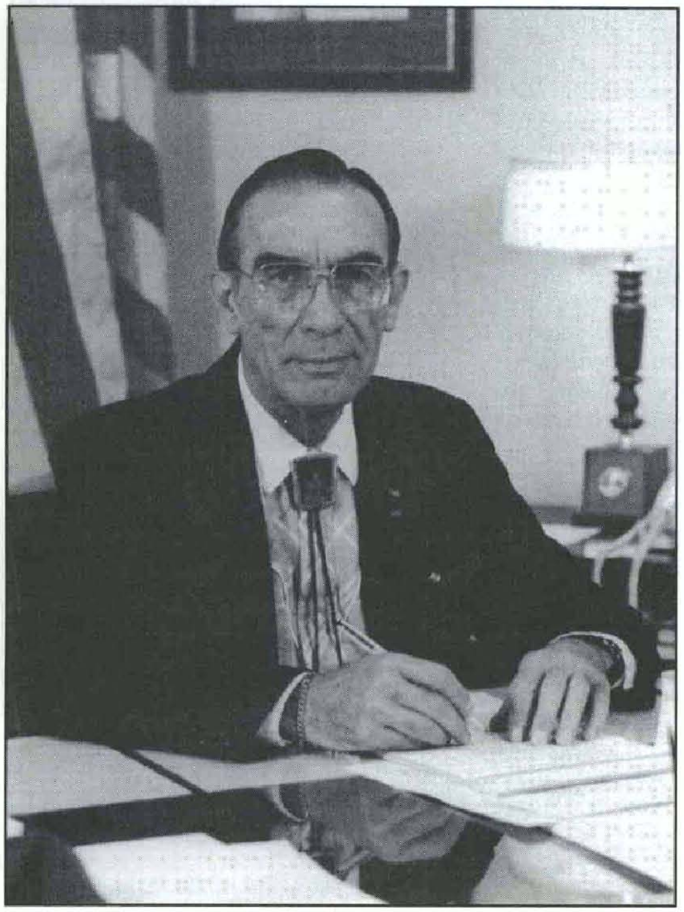
In the near future, HEL will undergo a reorganization and become a part of the new Army Research Laboratory. Dr. Weisz spoke about his view of the future of HEL and the changes that will occur.

"I see nothing but success for HEL in the future. The laboratory should gain personnel strength and funds. We will widen the scope of research and development efforts, and we can also do a better job in the area of manpower and personnel integration (MANPRINT). Change is always difficult in the beginning, but in the end, it will always work out. The in-house laboratories should market their products and keep their customers happy with the quality of services and products. That is the strength of their survival. Employees should pull together and make this new structure work."

Dr. Weisz also had these words of wisdom for new scientists and engineers entering government service: "Young scientists and engineers should strive to be the best, and strive for the best education possible. There are a lot of opportunities in government service. Fine tune your skills and keep up with changing technologies. This country must support its research and development programs; that is the future of this country," he said.

Dr. Weisz had this personal note to all HEL employees. "Thanks to all of my past and present HELers. I've never achieved anything without the support of all of you. No one can ever achieve anything alone. We always worked together as a team and a family. Keep up the good work and make the best of the coming changes. The laboratory may change names, but I'll always think of it as HEL."

VIRGINIA DOLEMAN BAILEY is the public affairs officer for the U.S. Army Human Engineering Laboratory. She holds a B.A. degree in telecommunications from Alabama A&M University, Huntsville, AL, and is a graduate of the Defense Information School Public Affairs Officer and Editors courses.



A TRIBUTE TO HEL DIRECTOR JOHN D. WEISZ

Human Factors Activist—Consumer Advocate for the Soldier

Author's Note: Dr. John Weisz, renowned director of the U.S. Army Human Engineering Laboratory for more than 35 years, retired recently following a highly distinguished career. What follows is a personal tribute to an outstanding professional.

By Jerry Chaikin

First Impressions

Back in the dim, red dawn of time, when the earth was cooling, I wandered into the Human Engineering Laboratory (HEL) and met John Weisz for the first time. Back in the olden days, when I was private, E1, newly assigned to HEL, John was still the director. My wife and I had just moved to Aberdeen Proving Ground (APG), MD, had recently learned that (then) private, E1, was definitely not a privileged grade, and were well aware that we were the "new kids on the block." As a result, we were pleasantly overwhelmed when John's immediate supervisor (Ruth Weisz) welcomed my wife to the "HEL family" and invited her to a tea we assumed would be attended only by the wives of officers and senior civilians. What a refreshing way to be initiated into an organization: The director's boss invites the most junior person's boss to a social event. We never forgot the gesture.

This experience seemed to be the first of many, over 34 years, suggesting to me that Ruth and John Weisz's ethic must be "everybody is important." I can't think of a better ethic for one of this century's leaders in the human factors field and the U.S. Army's key consumer advocate for the soldier: "Everybody is important."

He Was There, He Made Things Happen, He Made the Difference

If I were to condense my reactions to John Weisz's human factors contributions to past, current, and future Army system acquisitions into a few words, I would say, "He was there, he made things happen, he made the difference."

The HEL, where I worked in the late 50s with about three dozen other soldiers and civilians, occupied an old motor pool building at APG. A handful was doing research, a field liaison team was looking at Army equipment to generate lessons-learned, and another group was doing system application work based on the scarce literature of the day, limited research, and lessons-learned. Now it's 1992. HEL is headquarters for over 200 people, is known worldwide, has generated a myriad of formal reports and thousands of pages of human engineering design criteria and guidelines for hundreds of military systems, contributes to all Army RD&A, is supported by impressive facilities, and has detachments and field offices around the country. Rather spectacular, I'd say. Why did it happen? Because John Weisz was there, he made it happen, he made the difference.

If You Need Work Done or a Favor, Ask a Busy Person

In late 1966, the Army Missile Command (MICOM), where I worked, was preparing an engineering practice study in response to a Department of Defense (DOD) request to unify the key Army, Navy and Air Force human engineering specs and standards. When I asked John if he might help us with this work, he sent the best he had (Bob Chaillet, a human engineering standards and guidelines pioneer who retired from AMC several years ago). When the other [illegible]s and industry were represented at the final approval meeting by an impressive array of executive-level human factors people, I phoned John and asked if he or his deputy would come to Huntsville to represent the Army. He was on the next plane down. DOD had a MIL-STD-1472 and a MIL-H-46855 in short order.

Help for the Outlanders

In the early 70s, most of us human factors engineering (HFE) types in the field were unknown to Army Materiel Command (AMC) headquarters unless we had done something wrong. To remedy this sad state of affairs, John Weisz, who had only an hour to give the AMC commander his yearly brief on HEL, generously relinquished most of his time by inviting us commodity command types to accompany him, give short briefings on our local HFE programs, and display ourselves and our work to the AMC commanding general and his deputy.

This same AMC commander and deputy later approved John's HFE detachment concept on a trial basis. Today, a score of HEL detachments and field offices are located around the country providing on-site support to materiel developers and combat developers. These detachments and field offices didn't just appear. John crusaded for them all by himself and, after several years of rejections by decision-makers and apathy by others (including me, I'm afraid), his persistence, salesmanship, and promises finally succeeded in obtaining approvals for several demonstration groups in 1975. Establishing HEL detachments and field offices was strictly a John Weisz show—at least from the standpoints of conceiving, selling, organizing, staffing, and funding them. He was there, he made it happen, he made the difference.

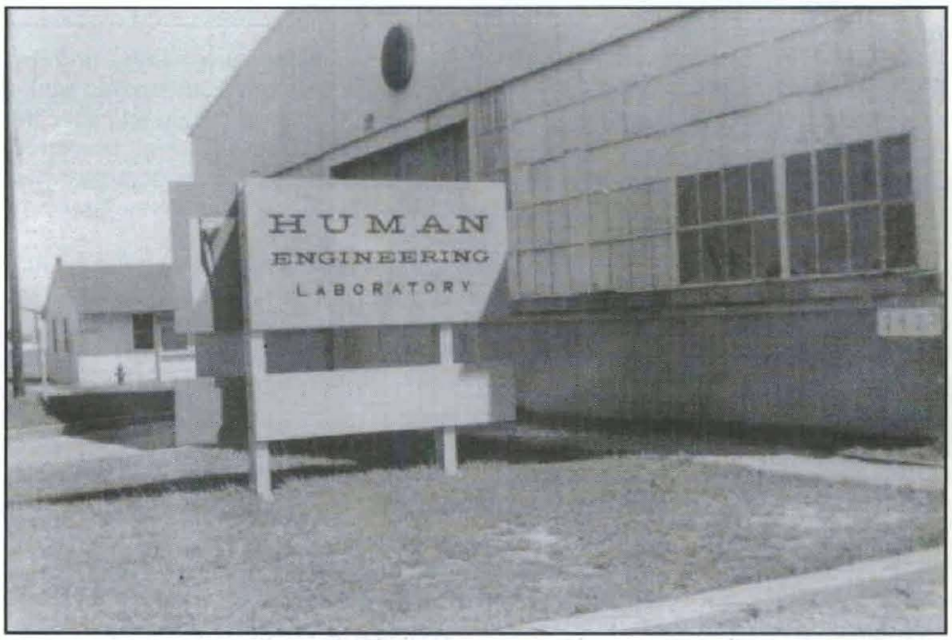
Getting the Word Out

In the early 80s, when John reflected on more than 20 years of HEL air defense display symbol research he felt that applying results widely to Army air defense systems was overdue. To quickly convert HEL's research into an application mechanism, he gave his full support to preparing a standard. That meant setting a top priority, allocating resources as needed, obtaining help of a preparing activity, enlisting the support of the user community, and perhaps most motivating, setting a limit of 60 days to get the job done. (I think he did these things in 15 minutes.) As a result, MIL-STD-1477, *Symbols for Army Air Defense System Displays,* was generated, coordinated, and approved in record time.

Let Us Help!

In the late 70s, when DOD was looking for Service leadership to shepherd a DOD/industry group though a task to prepare a workable selective application and tailoring guide for applying human engineering (and other) requirements to DOD acquisitions, John Weisz said, "we'll help," and promptly provided the government co-chair and the Army participant. (Of about eight resulting products, the human engineering guide was the first document on the street.) In the early 80s, when the U.S. Food and Drug Administration (FDA) and the Association for the Advancement of Medical Instrumentation (AAMI) started collaborating on preparation of a voluntary standard that became AAMI HE-88, *Human Engineering Design Guidelines and Preferred Practices for Medical Devices,* and asked for some DOD support, who said, "we'll help," and then provided continuing technical advisory support? Why John Weisz, of course. In the mid-80s when the NASA started a hectic year of activity to generate the first version of Man-System Integration Standards, NASA-STD-3000, and asked for some Army support, who said, "we'll help"? Why John Weisz, of course. And so it was with most new and innovative programs.

Of course, some might suggest, "John didn't do all these jobs himself; his people and others he influenced did them." Well, maybe so, but when John's people



The Army Human Engineering Lab in 1959.

pursued these initiatives, someone had to take the heat for moving them from other work (then seeing that the other work, somehow, got done), quickly reallocating resources, and cutting red tape; someone had to make promises to high officials with long memories. That was John. Anyone who doesn't think these actions weren't important or instrumental hasn't had a final step of a solid accomplishment threatened by a lack of authorization, time, resources, or even something as seemingly trivial as travel allocation for a single trip.

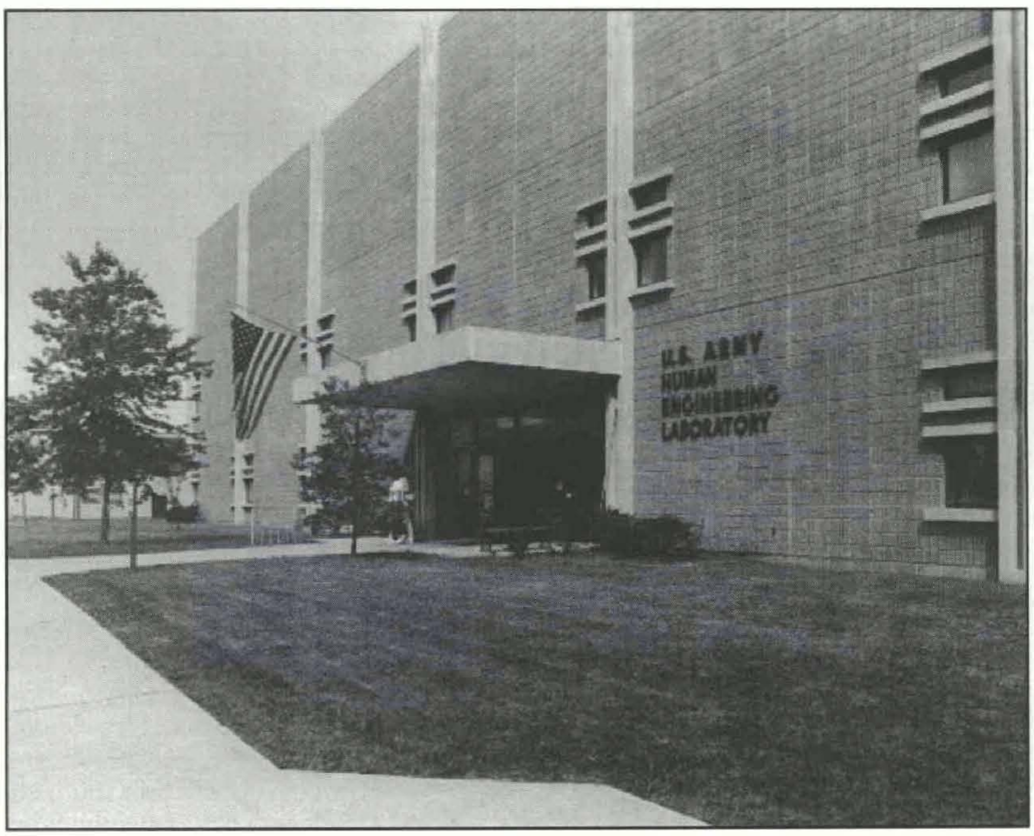
Equal Employment Opportunity (EEO) in Action

More important than being perceptive about prevailing imperatives from high places, John always seemed to be driven to "do the right thing" and applied this drive to programs he influenced. In the 1970s, before it was "fashionable" to do so, he insisted that Army systems, equipment, and facilities be designed to accommodate the characteristics of women. His pioneering efforts directly resulted in equipment designs that no longer excluded women as operators, maintainers or controllers. In essence, he turned human engineering into an EEO mechanism. Today, the services require designs to accommodate users with applicable dimensions and strength characteristics ranging from the fifth percentile female to the 95th percentile male. This accomplishment was in place a long time ago and John saw that it was carried out quickly and without much fanfare.

At the beginning of this piece, I suggested that John always felt that everybody is important. While this approach logically drove him to be the soldier's consumer advocate, he also extended this viewpoint to the HEL organization (Employer of the Year several years ago for his providing employment opportunities to the handicapped) and to outside interests (accomplishments with Maryland retarded citizens' organizations).

Manpower and Personnel Integration (MANPRINT)

In the mid-1980s, the Department of the Army created the MANPRINT Program to turn up the gain on people-related characteristics of development and acquisition—HFE, system safety engineering, health hazards assessment, manpower, personnel, and training. Perhaps the most important product of the MANPRINT program was and continues to be design influence. Just as system safety engineering is concerned with designing to enhance safety and eliminate health hazards, HFE is concerned with designing to achieve required human performance and ensure compatibility with manpower, personnel, and training resources with minimum impact. Naturally, the Department of Army turned to John Weisz to "work things out." John scrambled and got the job done. Of course, much of HEL's existing creations found



The Army Human Engineering Lab today.

their way into the MANPRINT Program. For example, the HFE Analysis, which HEL had been doing for years, graduated and expanded into a MANPRINT Assessment. Close to a dozen guides and standards that HEL had been instrumental in preparing or supporting immediately found their way into the MANPRINT Program as key source documents.

John's Open Door

I do believe that John had only one truly serious disagreement with me. About 20 years ago, while visiting HEL I watched John go through a particularly difficult morning with people parading into his office asking for support, favors, quick-reaction approvals (or disapprovals), and the like. I didn't work for John at the time and it was probably none of my business, but I closed the door to his office and quietly suggested that his door was "open so wide" that it diluted the time he had available for director-type business (or talking with me). I suggested that he allow perhaps a half-hour a day before starting time, for anyone to come in and discuss personal problems and leave the professional, technical, and other work problems for the supervisors to resolve. He walked me over to his office door, introduced me to the door, opened it as wide as it could go, and informed me rather abruptly that the door was always going to be open to anyone in his organization who could feel free to come in at any time to discuss any problem. Everybody's problems were important.

I got the message and therefore started sending every HEL employee—particularly very junior people—who approached me with an "inconvenient" problem through John's open door. ("Just walk into the director's office and kick your problem around with him!" "Are you serious?" "Of course! If it's inconvenient for you, just call him up any time.") Funny thing was. . .they all came back to me and said, "Gee, I'm glad I talked to him." (I hope that was the only serious disagreement John had with me. I do believe I had only one serious disagreement with him on any HEL-inspired product—the one that proceeded to completion after he familiarized me, in an indirect way, with the interesting concept that he was the boss.)

Why We Work

From the 1950s to the 1990s, John never forgot the primary reason for HEL's existence—to help ensure that the human element was incorporated into the design of Army systems. John never lost sight of the fact that HEL was the consumer advocate for the soldier. While the temptation to create an organization focused entirely on research offered many professional benefits, he always always maintained system concept and application organizations as the raison d'etre for HEL's research and all its other work, and place applications work in privileged positions to facilitate support to developers.

Accordingly, in the 1950s HEL started with a strong systems support organization to apply results of its field liaison team surveys and its research efforts to systems design and acquisition. In the 1960s, John continued this approach with a Human Engineering Applications Directorate to apply results of its Behavioral Research and System Performance/Concepts Directorates not only to systems design and acquisition, but also to conceptual and preliminary design activities. In the 1970s, John created HEL detachments and field offices to better serve Army materiel and combat developers, respectively, via on-site support. Finally, in the 1980s, he focused even more of his resources on applications via the MANPRINT initiative by developing new policies, emphasis areas, tools, and organizational approaches, then supported them.

The Payoffs

As the 1990s began, HEL and John Weisz could take pride that their research, conceptual, and application work of the previous three decades provided a better fit of machines to the U.S. soldier during the Gulf War and thereby contributed to the effectiveness of our efforts during that conflict—whether involvement helped training, made equipment more "user-friendly," resulted in lighter, more portable equipment, increased accuracy a little bit, eliminated or reduced the chances of human error, made things safer, or just saved a few seconds of reaction time. The "Operation Desert Storm Army RD&A Contributions" feature in the May-June 1991 issue of *Army RD&A Bulletin*, illustrated the extent of and payoffs from this type of work by providing a history of "HEL and the PATRIOT Air Defense System."

His Way

By now, it's probably obvious to most readers that my view of John Weisz only reflects his involvement with my own work—HFE application to Army missile systems and development of standards and guidelines. Yet, I'm sure he supported other work in the same proactive way, focusing on new initiatives and technology, perceiving potential people-type problems, conceiving new approaches and solutions, providing leadership and resources to carry them out, remaining deeply involved in the efforts through their initial successes, turning over successful programs to others, then moving on to new challenges.

And so it was with his recent retirement. He developed the HEL to solve problems, provided the leadership and carefully orchestrated the resources to carry out the programs he had crafted, remained personally involved in the efforts of HEL (without trying to micromanage), and has now turned this successful organization over to others as he moves on to new challenges and accomplishments.

John Weisz was there, he made things happen, he made the difference.

JERRY CHAIKIN worked for HEL from 1958 to 1960, for the U.S. Army Missile Command (and predecessor organizations) from 1960 to 1975, and for HEL again from 1975-1988 when he retired from federal service. A human factors engineering specialist for more than 30 years, he holds a B.S.M.E. from Purdue University. He currently works part time as a senior engineer at NAS Inc. in Huntsville, AL.

DEFENSE EXPORTS AND DEFENSE PROCUREMENT

By John McDonnell
Chairman and Chief Executive Officer
McDonnell Douglas Corporation

The following is based on remarks delivered by John McDonnell at the U.S. Pacific Command Security Assistance Conference in Honolulu, HI, Dec. 10, 1991.

The U.S has not had a coherent defense trade policy since the Carter Administration, when the policy was one of actively discouraging defense exports. For too long now, U.S. policymakers have exhibited a great deal of ambivalence and schizophrenia about defense exports. Generally, they want to encourage exports to friendly nations, but are concerned about the transfer of U.S. technology.

Today, there is an urgent need for a new set of U.S. policies aimed at promoting U.S. defense exports through closer cooperative arrangements with other nations.

This would serve a number of important objectives. Besides putting U.S. weapons into the hands of U.S. allies dedicated to the preservation of world peace, it would also benefit U.S. defense procurement by keeping production lines warm that will otherwise go cold years before replacement weapon systems are delivered. It would allow the U.S. to remain active in the years ahead as a supplier of front-line fighter planes, tanks, helicopters, and other weapons to friendly nations, while providing our own government with a much shorter procurement lead time in the event of future conflicts. Through cost sharing with foreign partners, it would reduce the cost to the U.S. government of improving and extending existing programs. It would provide the U.S. defense industry with some much-needed sustenance at a time of declining U.S. spending on defense procurement.

The formation of a new set of policies must start with a recognition of how much the world has changed over the last couple of decades—and especially over the last couple of years.

The Cold War is over. We won. However, we cannot delude ourselves into thinking that violence and conflict have been banished from the world stage. The disintegration of the Soviet empire and the collapse of a number of communist governments have created a witch's brew of political, religious, and cultural instabilities.

Though vanquished for now, Saddam Hussein is the perfect example of the dangers of a multipolar world. How prepared are we to launch another Desert Storm against another madman later on in this decade—or in the early part of the next century? Will we be able to meet the challenge of another test similar to the one that we passed with flying colors last year?

The troubling answer is "probably not"—not unless we devise a strategy for plugging some gaping holes in our defense posture over the near term. Under current U.S. procurement plans, many of the same weapons that starred in Operation Desert Storm are scheduled to go out of production in the next few years. And it will be almost a decade before next generation weapon systems can be delivered in quantity.

Operation Desert Storm was an "inventory war" in the sense that the U.S. and allied forces were not forced to step up present production to meet the requirement for fighter planes and other weapon systems. The next time, we may not be so fortunate.

There is another matter that should be of further concern to U.S. policymakers. Do we want to concede the field to the Europeans (and Russians and Chinese) when it comes to supplying weapons to other nations?

The Advanced Tactical Fighter and other next-generation U.S. weapon systems like the LH helicopter will not be available for export for several decades, if ever. If production of our current front-line fighters and helicopters is discontinued, the U.S. will indeed be conceding the field to other suppliers in equipping friendly nations with the means to defend themselves. In turn, that will cause a reduction in U.S. influence and a loss of control over the use of advanced weapons by other nations. If the U.S is the supplier, it can cut off support, spares, and know-how.

I am not arguing that we should rob Peter to pay Paul by eliminating next-generation programs to keep older programs going a little longer. Indeed, I believe the Administration and the Pentagon are doing the right thing in defying the critics and continuing to support advanced technology weapon systems. It is imperative that the U.S. maintain technological leadership. It has been our trump card ever since World War II, when the U.S. won the race to develop an atomic bomb. We will always need to have some "silver bullets" in our arsenal—weapon systems that are the most advanced and capable in the world.

But will the U.S. defense industry have the resources to develop and produce them?

Given a declining U.S. defense budget, the U.S. government can and should do more to generate additional business for the U.S. defense industry by promoting exports and cooperative arrangements with other nations. Three things are lacking here.

First is a clear strategy. Right now, for example, McDonnell Douglas and British Aerospace are working on a radar-equipped upgrade of the AV-8B Harrier II with broad export potential. Spain and Italy are committed both to sharing a substantial portion of the development cost and to purchasing a number of radar-equipped Harrier IIs. However, it is unclear at this time whether our own government will commit the relatively minor development and procurement funds needed to turn the improved Harrier into a sure winner in export markets.

A second set of obstacles preventing the export of U.S. arms for good and practical purposes involves a lack of political will—or outright political opposition. This problem is especially evident in sales to the Middle East.

The third main factor restricting the export of U.S. weapons is concern regarding a loss of control over critical technologies. The problem here is that we are still protecting some technologies that are long in the tooth and readily available from other suppliers—some in areas where the U.S. is not even a leader.

Old habits are hard to break, and the U.S. is in the habit of regarding technology—even mature technology—as something that should be hoarded as long as possible. This is a self-defeating attitude. In general, once a technology enters full-scale production, it becomes a perishable commodity—something that is likely to lose its value if it is not traded or upgraded. If U.S. companies are restricted in their ability to capitalize on mature technologies, they will be limited in their ability to invest in new technologies. In the long run, that can only hurt U.S. competitiveness.

Our competitiveness suffers from another cause: institutionalized contractor-bashing. Any company that wants to compete for defense work in the U.S. today must be prepared to run a gauntlet of difficulties and dangers, including the danger of criminal prosecution. It faces endless audits and investigations on one side of this gauntlet and a scandal-hungry news media on the other.

Many companies that have a relatively small defense business are deciding it just isn't worth the trouble or the risk, and are exiting the business entirely. As those companies depart, the U.S. defense industrial base is increasingly composed of companies that are solely dependent on government business, making it all the more crucial for the government to keep them alive in lean times like these.

To give you some perspective on how difficult it is to do business with DOD, let me quote a few statistics. In McDonnell Douglas' defense business we currently have well over 600 government people resident full-time in our facilities. We have undergone about 5,000 business-related audits by various government agencies over the past five years. On the C-17 alone we have about 2,000 government visitors per year. We are aware of 80 investigations (some criminal) of our company in the past seven years.

By contrast, in our commercial transport business, which is about two-thirds the size of our defense business, we have a total of only 35 customer representatives on our premises and our main customer visitors come only to take delivery of airplanes. And we don't get audited or investigated.

We see cooperation as a means of better meeting the challenge of global competition. In our commercial aerospace business, we are already seeking to share risks, rewards, and resources through alliances with international companies in Asia and elsewhere. So are our competitors Boeing and Airbus Industrie (itself an international consortium of European aerospace companies).

U.S. policymakers should take note, because many of the same benefits can be achieved from cooperation in defense procurement. I am not suggesting that U.S. defense contractors can and should cooperate with other nations in developing the most technologically advanced weapon systems, like the Advanced Tactical Fighter or the LH helicopter. It is imperative that we maintain technological leadership in advanced weaponry. However, there is wide scope for cooperation with other nations in the development and production of defense products utilizing technologies that are mature or non-critical.

But Congress, the executive branch, and the defense industry need to work together in fashioning a coherent defense trade policy which not only permits but encourages closer cooperative arrangements with other nations.

With increased economic and military cooperation, it is within our power to create a future of peace, harmony and growing prosperity for the U.S. and the entire globe.

But we must develop a less adversarial relationship between government and the defense industry. Cooperation should begin at home.

AWARDS

Carlon Named AMC Engineer of the Year

Dr. Hugh R. Carlon, a research engineer with the U.S. Army Chemical Research, Development and Engineering Center (CRDEC), has been named the Army Materiel Command Engineer of the Year for 1992. Carlon, who competed with engineers throughout the command, was also among the top 10 candidates for the Federal Engineer of the Year Award.

A registered professional engineer, Carlon was cited for leading an engineering program during Desert Storm that evaluated Iraqi threat field dispersers capable of delivering biological aerosols on friendly personnel. His results were invaluable to the intelligence community and in setting future directions for engineering developments in U.S. Army field hardware.

Award Recipients Named

Listed by agency, the following Army Acquisition Corps personnel are recent recipients of key awards.

Strategic Defense Command: LTC John L. Pannier, Legion of Merit (LOM); and LTC Benjamin M. Adams, Meritorious Service Medal (MSM).

Army Acquisition Executive Support Agency: LTC Jerry Craig, LOM; COL Earl Finley, LOM; LTC Herbert Carr, MSM; MSG Wesley Hensen, MSM; COL Robert Huston, LOM; MSG Jimmy B. Holaway, MSM; LTC William I. Oberholtzer, MSM; COL J. B. Holeman, LOM; MSG Jeffrey P. Pelot, MSM; MAJ George B. Foulkes, MSM; and CW3 Charles E. Lewis, LOM.

DEFENSE ACQUISITION WORKFORCE IMPROVEMENT ACT (P.L. 101-510)

This is the fifth installment of extracts from the Defense Acquisition Workforce Improvement Act:

"Subchapter IV—Education and Training

Section 1741. POLICIES AND PROGRAMS: ESTABLISHMENT AND IMPLEMENTATION

(a) POLICIES AND PROCEDURES.—The Secretary of Defense shall establish policies and procedures for the establishment and implementation of the education and training programs authorized by this subchapter.

(b) FUNDING LEVELS.—The Under Secretary of Defense for Acquisition each year shall recommend to the Secretary of Defense the funding levels to be requested in the defense budget to implement the education and training programs under this subchapter. The Secretary of Defense shall set forth separately the funding levels requested for such programs in the Department of Defense budget justification documents submitted in support of the President's budget submitted to Congress under section 1105 of title 31.

(c) PROGRAMS.—The Secretary of each military department, acting through the service acquisition executive for that department, shall establish and implement the education and training programs authorized by this subchapter. In carrying out such requirement, the Secretary concerned shall ensure that such programs are established and implemented throughout the military department concerned and, to the maximum extent practicable, uniformly with the programs of the other military departments.

Section 1742. INTERN PROGRAM

The Secretary of Defense shall require that each military department conduct an intern program for purposes of providing highly qualified and talented individuals an opportunity for accelerated promotions, career broadening assignments and specified training to prepare them for entry into the Acquisition Corps.

Section 1743. COOPERATIVE EDUCATION PROGRAM

The Secretary of Defense shall require that the Secretary of each military department conduct a department-wide cooperative education credit program under which students are employed by the Department of Defense in acquisition positions. Under the program, the Secretary shall enter into cooperative arrangements with one or more accredited institutions of higher education which provide for such institutions to grant undergraduate credit for work performed in such a position.

Section 1744. SCHOLARSHIP PROGRAM

(a) ESTABLISHMENT.—The Secretary of Defense shall establish a scholarship program for the purpose of qualifying personnel for acquisition positions in the Department of Defense.

(b) ELIGIBILITY.—To be eligible to participate in the scholarship program, an individual must—

(1) be accepted for enrollment or be currently enrolled as a full-time student at an accredited educational institution authorized to grant baccalaureate or graduate degrees (as appropriate);

(2) be pursuing a course of education that leads toward completion of a bachelor's, master's, or doctor's degree (as appropriate) in a qualifying field of study, as determined by the Secretary of Defense.

(3) sign an agreement described in subsection (c) under which the participant agrees to serve a period of obligated service in the Department of Defense in an acquisition position in return for payment of educational assistance as provided in the agreement; and

(4) meet such other requirements as the Secretary prescribes.

(c) AGREEMENT.—An agreement between the Secretary of Defense and a participant in the scholarship program established under this section shall be in writing, shall be signed by the participant, and shall include the following provisions:

(1) The Secretary's agreement to provide the participant with educational assistance for a specified number (from one to four) of school years during which the participant is pursuing a course of education in a qualifying field of study. The assistance may include payment of tuition, fees, books, laboratory expenses and a stipend.

(2) The participant's agreement (A) to accept such educational assistance, (B) to maintain enrollment and attendance in the course of education until completed, (C) while enrolled in such course, to maintain an acceptable level of academic standing (as prescribed by the Secretary), and (D) after completion of the course of education, to serve as a full-time employee in an acquisition position in the Department of Defense for a period of time of one calendar year for each school year or part thereof for which the participant was provided a scholarship under the scholarship program.

(d) REPAYMENT.—(1) Any person participating in a program established under this section shall agree to pay to the United States the total amount of educational assistance provided to the person under the program if the person is voluntarily separated from service or involuntarily separated for cause from the Department of Defense before the end of the period for which the person has agreed to continue in the service of the Department of Defense in an acquisition position.

(2) If an employee fails to fulfill his agreement to pay to the Government the total amount of educational assistance provided to the person under the program, a sum equal to the amount of the educational assistance is recoverable by the Government from the employee or his estate by—

(A) setoff against accrued pay, compensation, amount of retirement credit, or other amount due the employee from the Government; and

(B) such other method as is provided by law for the recovery of amounts owing to the Government.

(3) The Secretary may waive in whole or in part a required repayment under this subsection if the Secretary determines the recovery would be against equity and good conscience or would be contrary to the best interests of the United States.

Section 1745. ADDITIONAL EDUCATION AND TRAINING PROGRAMS AVAILABLE TO ACQUISITION PERSONNEL

(a) TUITION REIMBURSEMENT AND TRAINING.—The

Secretary of Defense shall provide for tuition reimbursement and training (including a full-time course of study leading to a degree) under section 4107(d) of title 5 for acquisition personnel in the Department of Defense for the purposes described in that section. For purposes of such section 4107(d), there is deemed to be, until September 30, 2001, a shortage of qualified personnel to serve in acquisition positions in the Department of Defense.

(b) REPAYMENT OF STUDENT LOANS.—The Secretary of Defense may repay all or part of a student loan under section 5379 of title 5 for an employee of the Department of Defense appointed to an acquisition position.

Section 1746. DEFENSE ACQUISITION UNIVERSITY STRUCTURE

(a) DEFENSE ACQUISITION UNIVERSITY STRUCTURE.—(1) The Secretary of Defense, acting through the Under Secretary of Defense for Acquisition, shall establish and maintain a defense acquisition university structure to provide for—

(A) the professional educational development and training of the acquisition workforce; and

(B) research and analysis of defense acquisition policy issues from an academic perspective.

(b) CIVILIAN FACULTY MEMBERS.—(1) The Secretary of Defense may employ as many civilians as professors, instructors and lecturers in the defense acquisition university structure as the Secretary considers necessary.

(2) The compensation of persons employed under this subsection shall be as prescribed by the Secretary.

(3) In this subsection, the term "defense acquisition university" includes the Defense Systems Management College."

Civilian Acquisition Corps Accession Board Results

During the period July 29 through Aug. 2, 1991, an accession boardwas held to review the files of those individuals who applied for membership into the Army Acquisition Corps (AAC) under the civilian candidate pool announcement. Congratulations to the individuals listed below who were accepted into the AAC.

ABEYTA, Richard D.
ABONDOLO, Jerome J.
ACKLEY, James B.
ADAMS, Alayne A.
ADAMS, Tony L.
AHLER, Wayne G.
AHMAD, Syed I.
ALBERT, Roy C.
ALLEN, Edward K.
ALLEN, Julius W.
ALLEN, Robert C.
ANDERSON, Cary
ANDERSON, Curtis
ANDERSON, Gary L.
ANDERSON, Michael P.
ANDERSON, William
ANNUNZIATO, Peter F.
ARBOGAST, Walter W.
ARMSTRONG, Robert C.
ARNETT, William H.
ATZINGER, Erwin M.
AUMANN, Vincent A.
AVERY, Wayne M.
AWAD, Madgi M.
BAGWELL, Thomas H.
BAILEY, Carolyn
BAKER, Forest L.
BALDWIN, Vincent D.
BALOUGH, Michael J.
BALUNIS, George T.
BARCUM, Lawrence V.
BARNETT, Daphne M.
BARNETT, Harrell R.
BARRECA, Joanne L.
BARRETT, Pamela
BARRIERES, Elie L.
BAUER, Roger J.
BAZZY, Richard S.
BEAULIEU, Carl A.
BEDNARIK, George J.
BEHNEN, George M.
BEHRINGER, Donald C.
BERG, Jom R.
BERGMAN, Robert W.
BELMONTE, Richard B.
BERRY, Patrick L.
BEUSTR, Alan R.
BISHOP William Y.
BLANKENBILLER, Robert A.
BLOMQUIST, John A.
BOON, Garfield W. Jr.
BOUSQUEST, Kenneth P.
BOWLES, Bobby G.
BOYD, Ray G.
BOZZARD, James R.
BRACKETT, James V.
BRADFORD, Daniel Q.
BRADFORD, Richard J.
BRAHAM, Gaylon E.
BRAMWELL, Barry H.
BROWDER, William R.
BARTH, Dennis G.
BLACK, Jan D.
BLOCK, Laurie A.
BRANCH, Reegor
BROCK, Donna L.
BROCK, Elizabeth K.
BROTHERS, James R.
BROWN, William H.
BUCIEN, Roger D.
BUCKELEW, Robin B.
BUCKNER, Randy L.
BURGNER, Charles W.
BURRATT, Ned L.
BYERS, John E.
CAMERON, Luray E.
CANCEL, Donna A.
CARLISLE, George W.
CARLTON, Paul R.
CARR, Hugh E.
CARTELLI, Joseph F.
CASWELL, Jonathan H.
CERVINI, John T.
CHAMBERS, Diana P.
CHANDLER, Thomas L.
CHANEY, Watson T. Jr.
CHARNICK, Vrian E.
CHEN, Peter P.
CHIEFS, Michael A.
CHILDRESS, Richard M.
CHRISTIAN, Deborah A.

CAREER DEVELOPMENT UPDATE

CHRISTENSEN, Allen C.
CHRISTENSEN, Todd C.
CIEKURS, Richard A.
COBB, Michael K. Jr.
COLBURN, Edward F.
COLE, James O.
COLONA, Marlene
COLVIN, Randy D.
COMER, Roger C.
CONNORS, Jack V.
CONWAY, Dennis J.
CONWAY, Kevin E.
COOGAN, Jack O.
CORWIN, James R.
COTHRAN, Julian L.
CRAFF, Alberto
CROSSWHITE, Billy L.
CROUCH, Billy J.
CSERI, Geza
CUSMANO, Ronald
DAGOSTIN, Frank A.
DALY, Clifford
DALTON, Michael J.
DAVID, Brian J.
DAVIES, William E.
DAVIS, Ronnie J.
DELORENZO, Joseph J.
DEMENT, William A.
DENICOLANTONIO, Gail L.
DEROCHE, Lynn E.
DIAMOND, David B.
DIEDALIS, Drew P.
DIORIO, Frank
DOLL, Don G.
DOGGETT-QUINN, Karen
DOMINIAK, Maryann
DONLIN, Noel E.
DORSEY, Tony L.
DOWNS, David S.
DOYLE-BOOTHE, Kathleen L.
DUGGAN, Michael L.
DUMAS, Neil S.
DUVALL, Lawrence C.
EASTON, Patrick J.
EATON, Richard E.
EBERT, Donald E.
EDGETON, Robert L.
EDWARDS, Eugene
EDWARDS, Kathleen J.
EDWARDS, Terrence M.
EHLE, Paul E.
ELBE, Ronald E.
ENGLISH, David M.
ERICKSON, Merlin L.
FAHEY, Kevin M.
FAIR, David F.
FAIRBANKS, Bernard
FALK, Martin E.
FAVALE, Ralph A.
FAW, Elizabeth E.
FAWKES, Maryann
FEASTER, Eugene N.
FEDYNA, Roman
FENECK, John J.
FENNELL, Edward M.
FERDINAND, Gregory E.
FERRITER, John M.
FINAFROCK, John W.
FIORANI, William C.
FISHER, Ivory J.
FISHER, Matthew J.
FIX, Leo F.
FLAMING, Stanley D.
FLYNN, Michael J.
FOLK, James F.
FORD, Melba C.
FORTUNE, William D.
FOSTER, Debra D.
FOX, Clarke J.
FRANCIS, David J.
FRANKE, Richard E.
FRATANGELO, Marylyn S.
FRAZIER, Carolyn S.
FREEMAN, Celeste L.
FRIAR, Glenn S.
GALGANO, Victor J.
GALLAGHER, William S.
GALONSKI, Alan J.
GAINES, Tony M.
GARRELL, Rex D. Jr.
GATLEY, Timothy J.
GATTENBEE, Robert J.
GELDMEIER, Lawrence R.
GENSIB, Sharon A.
GEOFFROY, Thomas A.
GHERARDINI, John C. III
GIBBE, Jerry L. Jr.
GILBERT, David H.
GILLESPIE, James B.
GIUFURTA, Charles J.
GOBLE, Gerald W.
GOLDMAN, Joel M.
GOSE, Rosalyn M.
GRAVATT, James J.
GRAVES, James W.
GRAY, Jerry O.
GRIEGO, Joseph A.
GRIFFITHS, John J.
GROSS, Deanna S.
GULATI, Jagjit
GUTTWEIN, Haas E.
HAGAN, Lucy B.
HAGGAR, H. Lindsey
HAJDUK, Victor C.
HANKS, Leroy
HANSON, Julie E.
HARRIS, James E.
HARRIS, Rosetta C.
HART, Michael L.
HARTZELL, Donald E.
HATCHETT, James E.
HATHAWAY, Jo Ann
HAUGAN, Daniel P.
HAYDUK, Michael J.
HAYNES, Hillard
HEBERLEIN, David C.
HEDDERICH, John F.
HELBACH, Kenneth S.
HENDON, George B. III
HENNING, Elmer J.
HENNING, Stephen J.
HENSLEY, Raymond L.
HERMAN, Jeffrey
HEYDERMAN, Arthur J.
HICKMAN, Lemar W.
HILL, James B.
HINES, Sherman C. Jr.
HINKLE, James S.
HIRLINGER, John M.
HIXSON, Walter D.
HOHENSTEIN, Marvin R.
HOLLERN, James P.

CAREER DEVELOPMENT UPDATE

HOMER, William F.
HOOD, Robert D.
HOPFNER, John M.
HOPKINS, Homer
HOPPES, Robert C.
HOSLER, Mary M.
HOWERTON, John W.
HUBER, Carol M.
HUDGINS, Mark W.
HUDSON, Eugene C.
HUGHES, Timothy J.
HUNTER, Millard E.
HUSTON, Norman R.
HUTCHINGS, Thomas D.
HUTTENLOCK, David K.
INMAN, James T.
IRVIN, Ricky L.
JACKSON, Peggy A.
JACOB, Charles R.
JACOBSON, Sherwin J.
JAHAN, Henry I.
JAMISON, Thomas P.
JANOW, Chris
JEZEK, Bruce W.
JOHNSON, Allen W.
JOHNSON, Bertel R.
JOHNSON, Curtis D.
JOHNSON, Jesse Jr.
JOHNSON, Michael D.
JOINSON, Roger E.
JOLY, Alfred L.
JONES, Denise E.
JONES, Derrick R.
JONES, Donald G.
JONES, Donald H.
JONES, Glenda L.
JONES, Robert M.
JONES, Willie Jr.
JUDD, Michael G.
KAHENY, Richard W.
KARADSHEH, Samir I.
KARAS, Gary S.
KASPER, William M.
KATRINIC, Edward P.
KAUFMAN, Matthew B.
KEARLEY, Kenneth L.
KEHN, Stanley D.
KELLERMAN, George A.
KEMP, Patricia A.
KETTERING, Scott S.
KING, Myra S.
KINGSTON, Carlos B.
KIRKWOOD, Barbara H.
KISATSKY, Paul J.
KOFALT, Patrick J.
KOMINOS, Catherine
KORNWEBEL, Norma V.
KOWALSKI, Robert T.
KOWELLIK, Richard
KUMA, David G.
KWATNOSKI, Richard
KWINSKI, Gregory A.
LAGNA, William N.
LAIBSON, Lawrence R.
LAMPKIN, William M.
LANDON, Gregory C.
LANGFORD, Gilbert B.
LASTER, Paul E.
LAUER, Josephine P.
LAWING, Byron D.
LAWRENCE, Dolores F.
LAWRENCE, Olga E.
LEE, Harvey K.
LEHNINGER, Axel W.
LEINWEBER, Charles A.
LEVETT, Nicholas J.
LEWIS, Herbert I.
LICHVAR, Gary M.
LILLEY, James E.
LINDBERG, Arthur W.
LINKER, Kenneth L.
LITTLE, Carol J.
LOEHRL, James G.
LOGENBACH, J. Russell
LOILAND, Randal H.
LONGINO, Roy J.
LONGBOTTOM, John T.
LONGSHAW, Clifton V.
LOTT, Joan G.
LOVE, Kathleeen T.
LUBRANA, Rose F.
LUCAS, George J.
LUCKEN, Susan K.
LUMPKIN, James R.
LYNCH, Elizabeth M.
LYNCH, Manfred A.
MACKEY, Raymond A.
MACGRADY, Howard F.
MADDUX, Ann W.
MAGNER, Jeffrey L.
MAHR, Aaron L.
MALATESTA, Edward T.
MALGERI, Theodore J.
MALONE, Thomas E.
MANZIONE, John A.
MAPLEY, Stephen R.
MARCINKIEWICZ, Edmund J.
MARINEAU, Mary M.
MARKS, Daniel W.
MARSHALL, Henry L.
MARTIN, Warren G.
MAZZA, Thomas N.
MCDOWELL, H. C.
MCELVEEN, Wesley F.
MCEWEN, Robert A.
MCGLONE, Sally A.
MCGUIRE, Dennis J.
MCILVAINE, Paul J.
MCKIRVIGAN, James L.
MCLAUGHLIN, John T.
MCPHERSON, Gary L.
MEED, Anne C.
MERRITT, Ira W. Jr.
MILLER, Allen A.
MILLER, Jacob M.
MILLER, Theresa R.
MILLS, James D.
MILWAY, William B.
MIMS, Ralston L.
MOELLER, Robert A.
MONTJAR, Janet W.
MOREIRA, Robert M.
MOREO, Dominick
MORRIS, James E.
MOSHIER, Gary S.
MILLINIX, Jerry D.
MURPHY, Billy G.
MUSCH, James C.
MUSOTTO, Mario J.
MUZZO, Kenneth W.
NASH, Carolyn J.
NELSON, James E.

NELSON, James H.
NICOLAIDES, Ruth
NIDHIRY, Emmanuel J.
NILES, Franklin E.
NOVAD, Joseph J.
OATKEN, Mark O.
O'BRIEN, George C.
OGRAYENSEK, Donald F.
OLSEN, Lloyd A.
OMLIE, Lisa A.
ONUSZANCZ, Jeroslaw
O'REILLY, George A.
O'SHEA, Patricia H.
OTTO, John H.
PALUGHI, Donald J.
PAP, Geza
PATEL, Anil C.
PAYNE, Gordon H.
PEARCY, Stephen R.
PEMBERTON, Jimmy R.
PERRY, Shirley A.
PERRY, Violet T.
PETERSON, John C.
PETERSON, Marc A.
PETROSKI, Michael R.
PIAD, Carlos A.
PIEPER, Joseph A.
PIEPLOW, Thomas C.
PIKE, Danny H.
PINDER, Lawrence M.
PINKARD, Samuel E.
POBADINSKY, Denise A.
POTTER, Bruce W.
POTTS, Joe T.
POWELL, Richard L.
PRESTON, Jimmy D.
PRUITT, Gregory W.
PUZYCKI, Frank P.
QUALLS, James R.
QUARTULLO, Judith A.
RANDAL, Steven K.
RAO, Vemula P.
REAVES, Jerry L.
REDMOND, William H.
REESE, Dean C.
REEVES, William C. Jr.
REGBER, Norman
REINECKE, Albert J.
REMPTER, Edward J.
RICHTER, Maxine
RINGWOOD, Terrence M.
RIVARD, George B.
ROBINSON, Margaret S.
ROSEN, Irwin S.
ROUSE, William J.
ROUTLEDGE, Eric M.
ROUX, Richard G.
ROWAN, James D. II
RUCKER, William A.
RUPPE, David L.
RUTH, Robert J.
RUTHVEN, Joyse
RUTKOWSKI, James J.
SACHAR, Thomas V.
SALSBURG, Mark J.
SAMPAR, David G.
SANDERS, Edna L.
SARVER, Emory W.
SAVAGE, James J.
SCARBOROUGH, Duane W.
SCHARRENBURGER, Ross K.
SCHLAUCH, Mary M.
SCHNEIDER, Mark S.
SCHNEIDER, William R.
SCHULLER, Gary K.
SCHULTZ, Gary E.
SCHULTZ, Roger L.
SCHUHMANN, Frederick P.
SCHWARTZ, Joseph R.
SCOLERI, David A.
SEALE, Rebe S.
SEBASTO, Anthony J.
SEGREST, Fred M.
SHARPE, Mryna W.
SHEFF, Larry T.
SHEPARD, Jaceena F.
SHIELDS, James
SHISLER, Vernon E.
SHORT, Paul M.
SHUM, Julie H.
SIIRILE, Arthur D.
SIMAN, Dale R.
SINGH, Gajinder B.
SINGH, Nirmal
SITARS, Roger G.
SLOSS, David A.
SMALLEY, Lavelle W.
SMITH, Charles M.
SMITH, Clarence D.
SMITH, Richard L.
SMITH, Thomas W.
SOLOMOND, John P.
SOMEEL, John R.
SPARKS, Michael H.
SPARKS, Vincent W.
SPENCER, Roscoe E.
SPIEGEL, Burton L.
SPITNOGLE, Bradley J.
SPITZER, Hermann J.
SPRINGER, Leon F.
SPRINKLE, Phillip E.
STARR, Lyle D.
STAUFFER, Peter M.
STAUNER, Robert L.
STEPHANY, Michael E.
STERN, Robert A.
STREILEIN, James J.
STROLLO, Carmen J.
STRONG, Rosita D.
STUDEBAKER, Wayne e.
STURGEON, Ronald C.
STURTEVANT, Susan S.
SURPRENANT, Kenneth E.
SUTTERFIELD, James S.
SUTTON, James C.
SWISHER, Joe A.
SZECHTA, James M.
TALPES, Edward G.
TAYLOR, Charles E.
TEKOTTE, Thomas F.
TERRACCINO, Joseph P.
TERRY, James H. III
THAKUR, Rashpal
THOMAS, Charles C.
THOMAS, John C.
THOMAS, Thomas D.
THOMPSON, Robert H.
THOMPSON, Virginia C.
TIPPIT, Tilden S.
TOM, Anthony M.
TOMPKO, Robert M.
TORNGA, Charles E.

TOWNSEND, Phillip E.
TRAVEY, Betsey B.
TREADWELL, Thomas S.
TRIER, Edwin A.
TRIFILETTI, Robert A.
TURNER, Richard E.
ULMAN, Bina R.
UNTERKOFLER, Joseph W.
VAN LIEU, Edna M.
VICKERS, Susan E.
WARD, Kay R.
WARRINGTON, James K. Jr.
WASHINGTON, William N.
WATSON, Winfred T.
WEAVER, Richard C.
WELLER, David J.
WELLHOUSE, John
WENGROWSKI, Bruno S.
WESSON, Wayne A.
WILKS, Robert G. Jr.
WILLIAMS, Richard M.
WILLIAMSON, Bruce D.
WILSON, Jerry L.
WILSON, Robert E.
WISE, Elizabeth M.
WITZLING, Gary
WOESSNER, Edward E.
WOLFE, Gary W.
WOLFSON, Mark M.
WYSKIDE, Betty L.
WYMER, Richard L.
YOUNG, John J.
YOUNGBERG, Dean A.
ZACHARIN, Alexey T.
ZACHARKEVICS, Edmund
ZIEGLER, Laura J.
ZIGLER, Richard N.
ZIMANY Roger J.
ZUEST, Harold

Army Senior Service Colleges Selection Board

Out of 372 Acquisition Corps lieutenant colonels eligible for Senior Service Colleges in academic year 1992-3, the board selected 22 (one officer was revalidated). Selection rate was 5.7 percent versus the Army average of 6.5 percent.

FUNCTIONAL AREA 51

NAME	RANK	BR/FA
ARMBRUSTER, Robert E.	LTC	3551
BAILOR, Richard O.	LTC	1351
BARNES, John W.	LTC(P)	2551
FALLON, Andrew J.	LTC	1451
GRIMES, Walter B.	LTC	9151
HOLLY , John W.	LTC	1251
JOHNSON, Nelson P.	LTC(P)	9151
KUFFNER, Stephen J.	LTC	1451
SHEAVES, William B.	LTC	1351
SHIVELY, Robert G.	LTC	2551
WANK, James A.	LTC	2151
*WHITE, Philip O.	LTC	9151
WOLFGRAMM, Paul E.	LTC	2551
YAKOVAC, Joseph L.	LTC	1151

**Revalidated officer*

FUNCTIONAL AREA 53

NAME	RANK	BR/FA
ARROL, Lawrence G.	LTC	3553
GARCIA, Albert B.	LTC	2553
GLIATTA, Leonard	LTC(P)	53

FUNCTIONAL AREA 97

NAME	RANK	BR/FA
CLAGETT, David O.	LTC	97
DAVIS, Frank C.	LTC	9197
HARRINGTON, Edward M.	LTC	9297
LHEUREUX, Roy W.	LTC(P)	97
PETERSON, Blair A.	LTC(P)	97

FUNCTIONAL AREA 15C35

NAME	RANK	BR/FA
POOLEY, Gerald R.	LTC	1535

In addition, 119 Acquisition Corps lieutenant colonels were selected to participate in the Army War College Corresponding Studies Course.

Army Establishes Acquisition Career Program Board

Sections 1202 and 1706 of the Defense Acquisition Workforce Improvement Act (Title XII of the National Defense Authorization Act for FY 1991) requires the establishment of an acquisition career program board in each of the military services to assist the service secretary in managing the acquisition workforce.

The first meeting of the Army Acquisition Career Program Board (AACPB) was on Jan. 13, 1992. During this meeting the board discussed its proposed charter.

The purpose of the AACPB is to advise and assist the Army acquisition executive (AAE) in managing the accessions, training, education, retention and career development of military and civilian personnel in the acquisition workforce and in selecting individuals for the Acquisition Corps. The charter states that the board membership will consist of the Army director of acquisition career management and executive-level representatives from the Office, Assistant Secretary of the Army (Manpower and Reserve Affairs), comptroller of the Army, the Army staff, the procurement commands, and the proponents and functional chiefs of the acquisition functional areas and career programs. The general counsel of the Army is the legal advisor to the board. The Army director of acquisition career management shall serve as the board chairman on behalf of the AAE, in his absence. Additional members and advisors may be appointed by the AAE at his discretion.

Specific members of the AACPB are: director, acquisition career management, Office of the Assistant Secretary of the Army (RDA); deputy chief of staff for logistics; the chief of engineers; commander, Strategic Defense Command; director, information systems for command, control, communication and computers, Office of the Secretary of the Army; comptroller of the Army, Office of the Assistant Secretary of the Army

(Financial Management); commander, Information Systems Command; principal deputy assistant secretary of the Army (manpower and reserve affairs); deputy assistant secretary of the Army (procurement), Office of the Assistant Secretary of the Army (RDA); deputy assistant secretary of the Army (research and technology), Office of the Assistant Secretary of the Army (RDA); director of civilian personnel, Office of the Deputy Chief of Staff for Personnel, Army Staff; deputy general counsel for acquisition, Office of the General Counsel, Office of the Secretary of the Army; deputy commanding general (research, development and acquisition), U.S. Army Materiel Command; deputy chief of staff for personnel; proponent for Functional Area 53, and the deputy director, acquisition career management, Office of the Assistent Secreatary of the Army (RDA). The deputy director, acquisition career management serves as the executive secretary of the board.

According to the charter, subordinate boards may be established to assist the AACPB in carrying out its responsibilities. Each subordinate board established will be chartered by the AAE. Individuals designated to chair subordinate boards will be invited to attend meetings of the AACPB and will report on subordinate board activities which further Army acquisition professional development.

The AACPB will meet semi-annually, or at the request of the chairman.

DOD Acquisition Management Functional Board

The DOD Acquisition Management Functional Board recently held its third meeting since its establishment earlier this year. The primary purpose of the board is to advise and support the under secretary of defense (acquisition) in determining education, training, career path requirements and mandatory course competencies for personnel performing duties in the acquisition management functional area.

Master's Candidates Prepare for New Careers

In May, 1992, six Army officers will graduate from the M.B.A. program at the University of Alabama, ready for a new career in materiel acquisition.

The officers completing the Alabama M.B.A. are: MAJ Ralph Merrill, CPT Daniel Cottrell, CPT William Lamb, CPT David McGlown, CPT Robert Renner, and CPT Perry Smith. In addition, three other Army officers are completing their first year of study.

The officers will graduate along with approximately 175 civilian students. The degree will conclude almost two years of study in Tuscaloosa, AL.

The Army officers have been an asset to the university, according to the director of the M.B.A. program, Robert J. Allen, a retired Air Force colonel. "These Army officers have been our best students, and their motivation and energy have reflected positively upon the many students that have never met Army personnel," Allen said.

Allen continued by saying that the Army has benefitted and so has the University of Alabama. "We are proud to have them and will be proud to call them alumni," said Allen.

The management courses emphasize decision making, management strategy, communications, computer models, research and development, logistics, distribution and acquisition. All of these topics will assist these officers in their new careers as they strive to insure that scarce dollars are being wisely spent to support Army requirements.

Command and General Staff College Selections

Congratulations to those officers selected for the Command and General Staff College. Of first time considered, the board selected 48 out of 354 acquisition officers eligible. Selection rate was 13.6 percent versus the Army average of 10.9 percent.

FUNCTIONAL AREA 51

NAME	RANK	BR/FA
AKINS, George Jr.	CPT(P)	2551
BAZEMORE, Debbie V.	CPT(P)	8851
BERNHARD, John P.	MAJ	1251
BOYD, Robert J.	CPT(P)	9151
BRAY, James G.	CPT(P)	1151
BRIGGS, Ralph W.	MAJ	1251
BROOKS, Gordon B.	CPT(P)	1351
BROWN, Gilbert Z.	CPT(P)	1151
CARPENTER, Constance M.	CPT(P)	8851
CORNELL, Jerry L.	CPT(P)	1551
CRIZER, Scott H.	CPT(P)	1351
DAVIS, Darrell R.	CPT(P)	3551
DELLASILVA, Joseph J.	CPT(P)	7451
DELRE, James F.	CPT(P)	1351
FORRESTER, Patrick G.	MAJ	1551
FULLER, Peter N.	CPT(P)	1251
GRAHAM, Dalton D.	CPT(P)	1451
GUTKNECHT, Donald A.	MAJ	1351
HOBBS, Eli Jr.	MAJ	2551
JOHNSON, Bradley N.	CPT(P)	1451
KNUTILLA, Thomas R.	CPT(P)	9151
LITAVEC, Douglas J.	CPT(P)	1151
MALTO, Benson O.	MAJ	1151
MCCLELLAN, Harry W. Jr.	MAJ	2151
MCVEIGH, Joseph W.	MAJ	1551
MILLER, Scott K.	MAJ	9151
MISHKOFSKI, Stephen T.	MAJ	1151
MYLER, Craig A.	MAJ	7451
NORGAARD, Kevin R.	CPT(P)	1351
SPILLER, John M.	MAJ	2551
TANNER, Albert B.	MAJ	1151
THORESEN, David P.	MAJ	2551
TIEDE, Corwyn B.	MAJ	1151
WALLER, Henry H. III	MAJ	1551
ZAAT, Stephen V.	MAJ	1551

FUNCTIONAL AREA 53

NAME	RANK	BR/FA
BUCK, Stephen D.	MAJ	53
CROMWELL, Joel C.	CPT(P)	2553
JOHNSON, Eric J.	MAJ	2553
LARSON, Steven W.	MAJ	4253
SCHIEFER, Christopher M.	CPT(P)	9253

FUNCTIONAL AREA 97

NAME	RANK	BR/FA
ARTHUR, Steven L.	MAJ	1597
BOSHEARS, Steven R.	MAJ	97
BURDETTE, Linda F.	MAJ	7497
CASTALDO, Albert A.	MAJ	9197
LEATHERWOOD, Jayne A.	MAJ	3597
MARTIN, Frank A. III	CPT(P)	9297
MILLER, Gregory S.	MAJ	9297
ROBINSON, Undra	MAJ	97

Major Promotion Results

Congratulations to the following Acquisition Corps captains selected for promotion to major.

NAME	FA	BR	YG
ABERCROMBIE, Henry R.	53	AG	82
ABSALONSON, Stephen C.	53	AG	81
ACHS, Jack H.	51	FA	81
ADDISON, Christopher J.	51	EN	81
ANDERSON, Thomas D.	51	OD	81
BARBERA, Richard S.	51	AD	81
BARNETTE, Patrick B.	51	SC	81
BARRY, Paul P.	51	QM	81
BATEMAN, Gary M.	51	MI	81
BEERY, Michael D.	51	OD	81
BEGEMAN, Paul J.	51	AR	81
BERGQUIST, Craig A.	51	OD	81
BETZ, Andrew P.	51	IN	81
BISHOP, Brad J.	51	AD	81
BLUE, James R. Jr.	51	OD	81
BLYTH, Jeffrey B.	51	SC	81
BUCHHEIT, Nathan A.	53	TC	81
BUCKMAN, Bruce A.	51	MI	82
BUMGARNER, Ronal L.	51	FA	81
CABIGON, Heather J.	51	AD	81
CAIN, Wayne C.	51	AD	81
CAREY, Philip J.	51	FA	81
CARSON, Peggy R.	97	OD	81
CHARLTON, Charles H. II	51	OD	81
CHIPP, Robert A.	51	FA	81
COLON, Angel L.	51	SC	81
COMER, Robert E.	51	OD	81
COUTTEAU, Charles G.	51	AV	81
DELAHOUSSAYE, Perry J.	51	AD	81
DIVELY, Walter L. Jr.	51	IN	81
DOWLING, Jon N.	51	AD	81
DRIESSNACK, Charles H.	51	AD	81
EBERLE, Nathan R.	51	AV	81
ENGER, Jahn R.	51	FA	81
FAGAN, Matthew B.	51	AV	81
FICHTEN, Mark A.	53	SC	81
FLEMING, Michael B.	97	OD	81
FLORIO, Michael A.	51	FA	81
FORTANBARY, Michael W.	51	FA	81
FRUGE, Keith J.	51	AV	81
FRY, Christopher C.	35	AV	81
GASSMAN, Thad A.	97	OD	81
GILLEY, Paul D. Jr.	51	FA	81
GIVENS, Eddie E.	51	EN	81
GOGGIN, James D. IV	51	MI	82
GRAB, William A. Jr.	51	MI	82
GREENE, Warren O.	51	OD	81
GROVE, Michael J.	51	EN	81
GRUBB, Susan K.	97	OD	81
GUYLL, James E.	97	AR	81
HAMILL, Neil J.	51	FA	81
HARRELL, David A.	51	OD	81
HARVILL, James T. Jr.	51	AD	81
HEALY, Edward A. Jr.	51	AV	81
HILL, Benita K.	51	MI	81
HODGES, Georgia B.	53	AG	81
HUNEKE, Stephen P.	51	SC	81
INCORVATI, Anthony R. II	97	QM	81
JONES, Winston M.	53	QM	82
KLEIN, Dale E.	51	SC	82
KLIMA, Brian L.	51	IN	81
KOUFAS, Theodore W.	51	QM	81
KWAN, Hon C. Jr.	51	SC	81
LAMBKIN, Glen D. Jr.	51	SC	81
LEAP, Richard B.	51	FA	81
LEE, Timothy J.	51	FA	81
LIBERATORE, Nicholas S.	51	AD	81
LOPER, Charlene M.	51	MI	81
LOSCUDO, Daniel T.	51	FA	81
LUDWIG, Mikio E.	51	SC	81
MACHIN, James R.	51	AR	81
MADDUX, Jonathan A.	51	SC	82
MARR, Patrick M.	51	MI	81
MCCABE, Curtis L.	53	TC	81
MCGUIRE, Paul A. Jr.	51	AD	81
MEDLER, Lawrence P. Jr.	51	AV	81
MONTFORD, Leonard R. Jr.	53	SC	81
MOORE, Steven R.	51	AV	82
MOORE, Steven W.	51	CM	81
NEUMANN, Susan B.	51	OD	81
NEWTON, Robert A. II	51	AD	81
NUGENT, Michael F.	51	AR	81
OBEN, Roger R.	51	AR	81
PAWLAK, James M.	51	SC	81
PAYNE, Robert A. Jr.	51	FA	81
PINTER, Steven S. Jr.	51	IN	81
RALPH, James R. III	53	SC	81
RAYNOR, Cleon W.	51	OD	81
REA, Ricky J.	51	FA	81
RECK, Keith F.	53	SC	81
RIDER, Mark D.	51	FA	81
RIVERA, Enrique	51	AD	81
RUNYON, Carl	97	QM	82
RUSSELL, Glenn D.	51	IN	81
SALYER, Ronald F.	51	AV	81
SANGIORGIO, Donna J.	51	SC	81
SCARBROUGH, Jess A.	51	AD	81
SEEBODE, Gary W.	53	SC	81
SHARKEY, Stephen T.	53	SC	81
SLAGLE, George P.	97	AV	81
STANLEY, Gary R.	51	TC	81
STASS, Andrew M.	51	IN	81
STEWART, Kevin S.	51	FA	81
STOLESON, Michelle D.	51	OD	82
SUTTON, Brian	51	FA	81
SVISCO, Thomas	51	TC	81
THIE, Gary E.	51	IN	81
TODAS, Rolando I.	97	OD	81
TRONTI, Lyn O.	51	AD	81
TURNER, Clarke D.	51	QM	81
ULSH, Gregory J.	51	AV	81
UNGER, Mark W.	51	FA	81
VANSLAGER, Christopher P.	51	IN	81
VARNADO, Frank	51	OD	81
VEECH, David S.	97	IN	81
WALCZAK, April L.	51	OD	81
WALTER, Robert C.	51	AR	81
WARSHAW, Harvey S.	51	MI	81
WILLIAMS, Jonathan	51	AD	81
WIRTH, Walter M. Jr.	51	AV	81

AATD Facilities Develop Aircraft Survivability Technology

Army rotorcraft are designed to survive small arms impact by retaining sufficient structural integrity to continue their mission or return home safely. This survivability design and associated damage characterization is demonstrated by ballistically damaging rotorcraft components at the Ballistic Test Range for Aircraft Component Survivability (BTRACS) facility at the Aviation Applied Technology Directorate (AATD), Fort Eustis, VA. The damaged component is then transported to the Air Vehicles Structures Division Test Laboratory, also at the AATD, where static and fatigue testing is conducted to determine the residual strength of the part.

Currently, the two facilities are testing the survivability of the UH-60 Black Hawk main rotor blade under the Joint Live Fire Program. Sections of the blade are impacted at a specified angle and location with a High Explosive Incendiary (HEI) projectile. The blade section is then transported to the Structures Test Lab where simulated flight loads are applied while monitoring strain gages and other instrumentation (see photo).

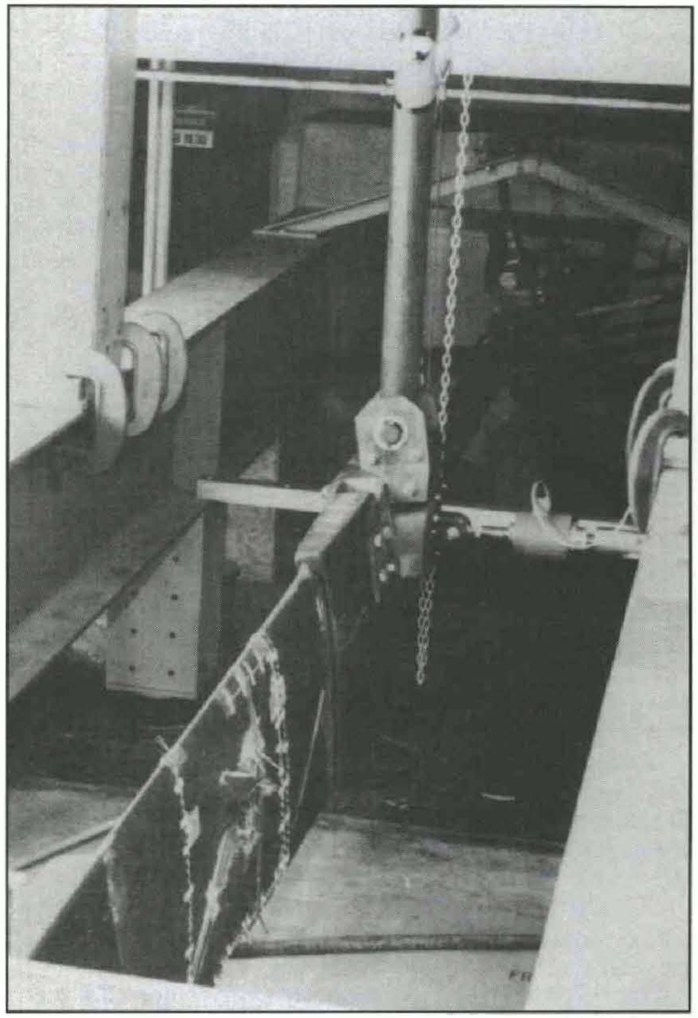
The fatigue testing is continued until the blade section fails or it withstands repeated loadings to demonstrate the residual flight life (generally 30 minutes to several hours, depending on the threat and component range). Current plans call for performing the same testing on the AH-64 main rotor blade.

"The BTRACS facility consists of two outdoor ranges and one indoor range," said Frank Keesee, aerospace engineer assigned to the Safety and Survivability Division. "All ranges are equipped to measure and record 30 channels of transducer data, 14 channels of thermocouple data, operate six high speed photograph cameras simultaneously, and obtain live TV coverage from two color cameras. The main data acquisition system (Pacific 5700) is capable of recording 16 channels at a MHz frequency," said Keesee.

This facility is capable of testing aircraft components from the smallest item to a full scale ground operable airframe. Various ballistic calibers are available for testing up to and including the Russian 30mm. An average year of testing includes 25 experiments with 210 rounds fired, supporting both government and industry research and development programs.

"The Structures Test Laboratory provides an in-house capability for experimental research in structures technology and testing to support fielded systems," explained Gerard Hufstetler, aerospace engineer. Hufstetler notes that "this facility is equipped with a rotor blade fatigue test machine, a torsional test machine, and other load frames capable of both static and dynamic testing of major structural components."

A Multi-Purpose Structural Load Frame provides the capability to shake-test full-scale helicopter airframes. It also serves as a load frame for both static and dynamic testing of numerous other large structural components such as helicopter tailbooms, rotor blades and cargo handling equipment.



A High Explosive Incendiary damaged UH-60 Black Hawk Main Rotor Blade is fatigue tested to demonstrate residual flight life.

Hufstetler said testing in the lab ranges from coupon tests to determine material properties to dynamic testing of large aircraft structures. Tests are conducted on advanced material specimens to establish structural characteristics, including static tensile, compressive, bending strengths and vibratory fatigue.

Damage tolerance, residual strength after damage, and dynamic vibratory load characteristics are performed on both in-house and contractor-developed components.

Central to test lab operations is the Automated Data Acquisition and Control Room, said Hufstetler. All test fixture loads are controlled and data is acquired and processed by a dedicated computer, he added.

Several fatigue tests and one dynamic test can be conducted simultaneously, including the automatic acquisition of a large number of data channels. Critical load and stroke parameters are monitored continuously and the control system is capable of automatic shutdown if any test variable exceeds specified limits, allowing unmanned around-the-clock test operations.

Army Research Laboratory Comes to APG

The future construction of the Army Research Laboratory (ARL) at Aberdeen Proving Ground (APG), MD, will bring more than 350 jobs to APG.

The laboratory is part of the plan to consolidate research and technology development operations which are currently at a number of locations throughout the United States. The Base Closure and Realignment Plan was approved by Congress and President Bush in 1991. The ARL, expected to be the Army's world-class laboratory satisfying future technology needs, will explore technology used to improve current military systems and to develop future military systems. APG is one of two sites in Maryland for the ARL.

The new facility will join APG's Human Engineering Laboratory and the Ballistic Research Laboratory with structural, computer and polymer technology activities formerly housed in Watertown, MA. In addition, the Secretary of Defense's 1991 Commission on Base Realignment and Closure recommended that elements of the Army Research Institute at Alexandria, VA, the Belvoir RD&E Center at Fort Belvoir, VA, and the Army Materials Technology Laboratory at Watertown, MA, be consolidated at APG.

According to COL Frank Finch, district engineer for the Baltimore Corps of Engineers, "The realignment will provide the Army with a combination of dependent research efforts at one location. The $80 million laboratory will require construction of a 180,000-square-foot building for research activities. Other facilities will include administrative offices, a waste-water treatment plant, a chemical storage facility, a hazardous material storage facility and a guard house."

The Corps of Engineers, Baltimore District, hosted a public scoping meeting to address the environmental impact of the planned construction of ARL facilities at APG. Nearly 70 people attended the meeting, which addressed the socio-economic impact of the laboratory and the siting for the construction.

An Environmental Impact Statement, prepared by the Corps of Engineers, will focus on potential impacts associated with fish and wildlife, wetlands, historic and archeological resources, toxic or hazardous materials which may be present and social impacts on the adjacent communities.

RASCAL Helicopter Makes First Research Flight

On Dec. 16, 1991, as scheduled, the Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL) took off to a hover to begin a long series of flight research programs involving advanced guidance, control, and display systems at NASA-Ames Research Center, Moffett Field, CA.

The RASCAL is an Army UH-60 Black Hawk helicopter which is being heavily modified by the Ames Aircraft Systems Branch to include a programmable, fly-by-wire flight control system, precision guidance and navigation system, advanced helmet-mounted display, and real-time image processing system. A similar flight control system and advanced pilot's display will be implemented on another Black Hawk for use as a demonstrator vehicle for the Army's Rotorcraft Pilot's Associate program.

This research aircraft will be used by the Ames Flight Dynamics and Controls Branch to conduct in-flight investigations of advanced flight control systems designed to maximize the maneuverability and agility obtainable in a helicopter and by the Aircraft Guidance and Navigation Branch to develop guidance algorithms and displays to aid the pilot in flight close to the ground and obstacles.

Army Sees Bright Future for Titanium

Engineers at the U.S. Army Tank-Automotive Command (TACOM), Warren, MI, have concluded that substituting titanium for traditional steel and aluminum in combat vehicles may become an economically practical way to reduce vehicle weight without sacrificing ballistic protection.

The engineers base their conclusion on research which indicates that titanium armor and other vehicle components are feasible with a potentially dramatic reduction in the price of titanium that will make it more competitive with other materials.

Titanium offers several advantages over other metals. It weighs about 40 percent less than steel. Despite its light weight, however, it has strength properties like those of steel and offers superior fatigue resistance. It also can withstand high temperatures and resists corrosion.

Though these benefits make titanium suitable for many uses, two major drawbacks have severely limited its use. One of these is that its high cost has made it economically impractical for most applications.

The current cost of armor plate made from titanium, for instance, would be more than $10 per pound compared to only $.75 per pound for armor steel and $2.50 per pound for armor aluminum. Thus, titanium's use has been confined mainly to specialized aerospace applications such as jet-engine components, where other materials would not suffice. And, with demand for titanium being low, domestic titanium production capacity—currently pegged at 55 million pounds annually—has also remained low, thereby helping to keep the price high.

But, according to TACOM material engineer James Ogilvy, there are potential applications in which a cheaper titanium made to non-aerospace specifications could be suitable for armor applications, because there are no high-temperature and durability requirements. "Titanium has been used in the valve train and other components in race-car engines," Ogilvy said, "and Ford has said it would like to start using titanium for the valve train and suspension springs. Also, the Bradley people are now developing a titanium commander's hatch for their vehicles.

"So I think we are at the point," he continued, "where we've got to go ahead and get more applications for titanium, and I think the supply will be there to meet the demand. Timet, the largest producer of titanium in this country has announced plans to build new capacity for 22 million pounds annually. Also, a Title III program may be funded to produce and evaluate the lower cost titanium. These factors should help to bring the price down, which in turn will create more demand for it."

Title III is a special funding category established by Congress during the 1950s. To qualify for Title III funding, a proposed program must meet several criteria. First, it must be initiated by a DOD agency. It must also involve research into technology having potential military application but for which domestic industry has not provided the capital needed to make it available because of the lack of a market. Moreover, the requesting agency must indicate how the proposed research would benefit the national defense.

The second drawback to titanium has been that it is a more difficult material to machine or form than conventional steels. But Ogilvy said alternative manufacturing methods can significantly reduce machining requirements and thus keep production costs down. He said near-net shape technology such as casting or advanced techniques in powder metallurgy—in which heat and high pressure are used to form parts out of powdered metal in a die—look promising.

During the past year, TACOM has been involved in a two-phase program aimed at promoting military ground vehicle applications of titanium. In the first phase, the command established a 22-member titanium steering committee comprised of representatives from the U.S. Bureau of Mines, Materials Technology Laboratory, the Defense Advanced Research Projects Agency, Idaho National Laboratories, the Foreign Service and Technology Center, the University of Idaho, the Army Research Office, the Air Force and Navy.

Ogilvy, who chaired the committee, said the consensus of the group at its initial meeting was that a non-aerospace titanium priced at $7 per pound would be feasible. But he said that in subsequent meetings with the three domestic titanium producers—Timet, Ormet and RMI corporations—the firms at first said they could not provide a lower grade of titanium at $7 per pound. "They did not take us seriously," Ogilvy recalled, "because in the Army we have always talked about how we like titanium but never got serious about using it.

But two things got their attention, he said. "One of these was an article entitled 'Super Metal May Replace Steel,' which was written here and published last year in the *TACOM Report* and other military publications. That article talked about TACOM's intention of applying for money under Title III for use in research aimed at finding other uses for titanium in hopes of creating an expanded market for it. What also got their attention was when the Bradley people made a bold but wise decision to use titanium. All of a sudden the titanium producers saw that we were serious and said they would provide a non-aerospace type of titanium for $6 to $7 per pound."

In the second phase, TACOM and the Bureau of Mines have jointly funded programs in which the Ballistic Research Laboratory and Materials Technology Laboratory tested armor targets and vehicle components made of a non-aerospace grade of titanium to determine its suitability for combat-vehicle use. The tests were highly successful, and TACOM has developed material specifications based on the test results.

Ogilvy said an even lower price for titanium may be in the offing. He said TACOM and the Bureau of Mines hope to convince the Army Materiel Command to fund research to develop improved titanium production methods which, if successful, could further reduce the price.

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

Helicopter Air Bag Crash Protection System Developed

The Aviation Applied Technology Directorate (AATD), Fort Eustis, VA, awarded a 24-month, $478,004 Phase II Small Business Innovative Research (SBIR) contract to Simula Inc., Pheonix, AZ, to conduct component and system design and testing for the purpose of developing a helicopter air bag crash protection system.

"Secondary cockpit strikes of the head and upper torso account for two out of three of all major and fatal injuries in potentially survivable Army helicopter crash impacts," said Kent Smith, project engineer, AATD. "It is intended to investigate the application of air bag technology developed by the automotive industry to helicopter cockpits thereby reducing the potential for aircrew injuries in a crash impact."

Correction

On page 57 of the March-April 1992 issue of Army RD&A Bulletin, COL Robert C. Atwell was incorrectly listed as the Product Manager for Longbow Apache. His correct title is Project Manager, Longbow. We apologize for this error.

BOOK REVIEWS

Government Printing Office Releases Publications

The following books are available from the U.S. Government Printing Office:

SDI and The Alternatives by Simon P. Worden

Edition: 1991

Stock Number: 008-020-01228-9

Synopsis: The controversial, sometimes emotional national debate over strategic defense has been overshadowed recently by other, even weightier national and global issues. Research programs for the Strategic Defense Initiative continue, however, and the debate is likely to resume as visible results of that research begin to compete for a share of the nation's budget. It is in the national interest that this debate proceed in an atmosphere of rational, objective analysis.

Redesigning Defense - Planning the Transition to the Future U.S. Defense Industrial Base
Edition: 1991
Stock Number: 052-003-01249-9
Synopsis: The defense technology and industrial base (DTIB) is a crucial element of U.S. military strength because it provides the capability to develop, produce and support military systems in peacetime and to respond to additional military requirements in crisis or war. The recent conflict in the Persian Gulf once again demonstrated the vital importance of the DTIB, even as recent changes in the international security environment have raised fundamental questions about its future size and character.

Verification Technologies
Edition: 1991
Stock Number: 052-003-01248-1
Synopsis: This report examines the potential and limitations of cooperative aerial surveillance as a means of supporting the goals of a variety of international agreements. It surveys the types of aircraft and sensors that might be used. It reviews the status of and issues raised by the Open Skies Treaty negotiations as an example of an aerial surveillance regime. The report concludes with a quantitative analysis of one possible use of cooperative overflights: the search for potential arms control violations.

Fundamentals of Force Planning, Volume 2: Defense Planning Cases
Edition: 1991
Stock Number: 008-046-00143-0
Synopsis: This book treats force planning as the conceptual background to combat. From Korea through Iraq, no American commander has had the luxury of first building a force and then taking it to war, as we did against the Axis in World War II. Rather, our theater commanders fought with inherited forces. Some were blessed, some were cursed. But no matter what their operational brilliance, tenacity, and luck, all were influenced by decisions made in peacetime decades earlier.

Individuals who would like more information on any of these books can contact Mr. Thompson, U.S. Government Printing Office, Dept. SSMC, Washington, D.C. 20401; Telephone (202) 512-2413.

Management Information Systems: A Contemporary Perspective

By Kenneth C. Laudon and Jane Price Laudon, Second Edition, Macmillan Publishing Company, New York, 1991

Reviewed by CPT Thomas B. Gilbert, an Army Acquisition Corps officer attending Oregon State University

Don't be misled by the mundane title *"Management Information Systems: A Contemporary Perspective."* This book is in reality a concise and dynamic guide to the understanding, planning, procuring, and implementation of myriad levels of information systems. The authors have established a respected reputation among scholars and industry for their insight and systematic approach to systems development.

The book is divided into four broad sections for the reader to understand the development process in progressively greater detail. Spread throughout the material are contemporary case studies used to illustrate a specific learning point. The author's intent is to make the book informative to all levels of expertise while making it relevant to practical applications.

The first section identifies the state of the art in computer technology and the relationships of real world systems and how they fit into the scheme of organizational development. The authors provide an overview of existing management principles and literature reviews. They examine how a system has to be built to serve the needs of the organization and the adjustments required by competitive forces.

The second section identifies predominant computer hardware, software and connectivity capabilities and requirements. The concepts of database management were approached in a systematic and clear method that illustrates both the conceptual and practical theories behind the emerging technologies. This section would be of particular interest to software acquisition specialists. As technology leaps ahead, the distinction between mainframes, minicomputers, and microcomputers are blurring with rapidity. The future of telecommunications is examined in a manner that may shed new light on the subject for those of us accustomed to the military methodology. The area of connectivity and international standardization is explored with alacrity. Networking and related technical architecture are discussed at length.

The bulk of the book is tailored to system design and analysis and the "art of building systems." The authors make a clear case for very detailed planning of the users' needs and the system architecture before *any* procurement or quick fixes are conducted. They illustrate the fallacy of patchwork efforts in a field that depends on compatibility, expendability, and future relevance. The needs of the organization must be fully determined and comparative analysis must be conducted to achieve maximum benefit from the system. Thorough explanations of decision support systems and expert systems compliment the managerial approach to this edition. A theme throughout the treatise reflects the need for a clear strategic vision for the organization's systems architecture.

The book concludes with guidelines on the management of information systems. The effect of external change on the organization and internal organizational dynamics are examined as it effects the information system. Transition analysis is reviewed as a tool to assist the leadership in managing change.

This book is useful for both the rank novice and the computer wizard. This edition has 940 power packed pages that may determine the difference between comprehension and guesswork in an ever complex—and costly—managerial arena. As defense related R&D expenditure declines, remaining funds must be spent wisely. Any professional working with the computer acquisition, specifically requirement definition, development or contracting owes it to themselves, and the taxpayers, to review this book and understand the evolving nature of information management systems.

SPEAKING OUT

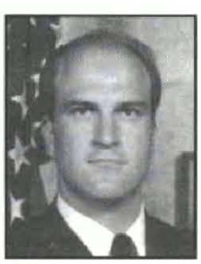
What Do You Expect to Gain and to Contribute as A Member of the Army Acquisition Corps?

Esther Morse
Procurement Analyst
Office of the Assistant Secretary of the Army (Research, Development and Acquisition)

Development of the Army Acquisition Corps (AAC) is indeed a giant step forward. In addition to fulfilling a major requirement of the Acquisition Workforce Improvement Act, it is a means by which the Army can build a stronger cadre of "the best and brightest" acquisition professionals. As we face the challenges resulting from downsizing and reduced budgets, it becomes increasingly imperative that our acquisition community consist of highly skilled, performance oriented personnel to manage our weapon systems programs. We can no longer afford the luxury of having personnel totally focused in one particular area. Both military and civilian members of the AAC must be multidisciplined, and this requirement is highlighted in the Corps membership selection process.

As a member of the Corps, I expect to expand my acquisition expertise by tapping into the vast composite knowledge base of fellow acquisition professionals from various functional disciplines. By the same token, my contribution will be the sharing of specialized procurement knowledge, skills, and experience with other Corps members. Additionally, my managerial/leadership skills will be enhanced through dynamic educational opportunities as those provided by the Defense Systems Management College.

The ultimate benefit of Corps membership may be summed up by saying the yield from collective skills, talents, and managerial techniques will be significantly greater than the SUM of all participating members; thus, strengthening our ability to ensure acquisition of high-quality weapon systems for the nation's defense.



MAJ Steve Cox
Proponency Officer
Army Acquisition Corps Proponency Office

Simply, I expect that the Acquisition Corps will provide me the opportunity to have a successful career in acquisition, with success being defined as filling a critical acquisition position (such as PM or procurement commander) at the colonel level.

It is the responsibility of the Acquisition Corps to ensure that through education, training and experience in the acquisition functions, that all members, whether military or civilian, are fully prepared to fill critical acquisition positions and to provide leadership in the Army's materiel acquisition process.

As a staffer in the Acquisition Corps Proponency Office, I can assure you that we take that responsibility very seriously. We are working numerous actions to build the foundation of an Acquisition Corps that provides each member with the opportunity for a successful career in acquisition. In the near future, you will read of the fruition of these actions in this bulletin. However, if you have any questions on the direction of the Acquisition Corps, please contact the Acquisition Corps Proponency Office.

CPT(P) William E. Riker Jr.
Student
Army Command and General Staff College

The Acquisition Corps is a great opportunity to contribute to total Army readiness, both at the macro and micro level. From a macro perspective, a career track in the Acquisition Corps enables an individual to directly influence a weapon system, research or procurement effort that can have a dramatic effect on the Army. Being a part of, and perhaps even leading such an effort is in itself exciting. However, attainment of a program's objectives depends on effectual execution at the micro level. This is where I feel the Acquisition Corps will really prove worthwhile by providing a force of dedicated professionals who can orient their careers toward optimizing those skills necessary to meet program goals.

What you personally gain as a member of the Acquisition Corps is certainly commensurate with the quality of work and dedication that you commit to each assignment. I feel that the career track allows an individual to draw together eight years of operational experience, graduate studies and acquisition related education into a consistently focused career of evolving technical expertise. Such a skilled individual can thus surpass understanding just the basic mechanics of the Life Cycle Model and be more innovative in applying these tools to enhance overall product effectiveness. In light of the shrinking availability of RD&A funds and the more

SPEAKING OUT

demanding system requirements, integrating this pool of professionals to creatively execute at the micro level is increasingly important. I want to be part of the team that makes a difference and feel that the Acquisition Corps will act as the catalyst to make such goals a reality.

CPT Donna L. Garnett
Company Commander
HHC 50th Signal Battalion
Fort Bragg, NC

The goal of the Army Acquisition Corps (AAC) is to provide soldiers with world-class equipment to meet any operational demand in sufficient quantity and in the shortest possible time, consistent with sound business practices and within affordability constraints. Selection to be a part of this unique group of professionals who will accomplish this goal is in itself rewarding. The AAC provides a challenging opportunity for professional and self development. Acquisition officers will receive advanced and specialized training in acquisition, business, and technical fields. Subsequent management and support assignments will provide, as well as demand, an understanding and knowledge of state-of-the-art technology. The acquisition work environment and its associated tasks will allow one to gain a greater understanding and appreciation of the broader issues involved in building and maintaining a world-class, constantly ready defense. Selection to the AAC is a unique opportunity to play a vital role that will contribute directly to our national economic well being, ensure the operational success of our soldiers, and maximize the Army's defense capability.

CONFERENCES

• The U.S. Army Natick Research, Development and Engineering Center will hold its 1992 Natick Science Symposium June 9-10. The papers presented will reflect research and development efforts for protecting, sustaining, and sheltering the individual soldier on the battlefield. A broad range of topics including individual survivability, textiles, aerial delivery, biotechnology and food preservation and characterization will be addressed. For more information, contact Thomas Sklarsky at (508)651-5330 or DSN 256-5330.

• The Fourth International Seminar on Battery Waste Management, sponsored by Dr. S.P. Wolsky, Ansum Enterprises Inc. will be held November 9-11, 1992. The seminar will treat technical, economic, administrative and general management concerns. Additional information can be obtained from Dr. S.P. Wolsky, Ansum Enterprises Inc., 1900 Cocoanut Road, Boca Raton, FL 33432; (407)391-3544, fax (407)750-1367.

• The Third International Cannon Artillery Firepower Symposium and Exposition will be held April 28-30, 1992 at The Skylands in Randolph, NJ. The theme is "Fire Support in the 21st Century." Subjects covered will include the U.S. Army's Advanced Field Artillery System, electromagnetic gun propulsion, future armored resupply vehicles, gun maneuver tactics, and extended range ammunition. System equipment displays will be highlighted by three of the world's most advanced 155mm self-propelled howitzers—the U.S. Army's M109A6, called the Paladin, the German PzH2000 and the British AS90. More information can be obtained by calling John Amerspek, (201)770-1644. Amerspek is head of the Picatinny Arsenal chapter of the American Defense Preparedness Association, which is collaborating with Picatinny Arsenal on the program.

Army Holds Acquisition Corps Candidate Officers Conference

A major career management orientation was provided for more than 150 newly accessed Army Acquisition Corps (AAC) officers during an Acquisition Candidate Officer's Conference, Feb. 23-25, in Springfield, VA.

The Army's acquisition goal, emphasized throughout the conference, is to provide soldiers world class equipment in sufficient quantity and in the shortest possible time, consistent with sound business practices and within affordability constraints. One of the primary vehicles for achieving this goal is development of a professional corps of acquisition specialists.

LTG August M. Cianciolo, director of acquisition career management and military deputy to the assistant secretary of the Army (research, development and acquisition), welcomed the attendees. He discussed the evolution of Army modernization strategies and acquisition philosophies. "As we get smaller, the modernization issue becomes easier because we have less forces to equip," he said, adding that the smaller size of the future Army makes modernization even more necessary.

Cianciolo was followed by an acquisition overview given by COL Al Greenhouse, deputy director of Army acquisition career management. He covered the history and implications of the Defense Acquisition Workforce Improvement Act. He explained credential requirements for acquisition corps members, incumbents of critical positions and program managers (PMs). Greenhouse also mentioned acquisition career management imperatives such as the involvement of leaders and the elimination of career barriers for females and minorities.

COL Thomas V. Rosner Jr., Army representative to the Office of the Director, Acquisition Education, Training and Career Development, Office of the Undersecretary of Defense for Acquisition, discussed policy on acquisition education, training and career development. He included training and experience requirements for PMs and deputy PMs, critical acquisition positions, program executive officers (PEOs), general and flag officers, senior executive service positions and senior contracting officials.

MG Dewitt T. Irby Jr., PEO aviation, spoke on the role of the program executive office in the acquisition process. He stated that improvements such as team focus, more flexible and sensible laws, rules and regulations, and upfront participation could improve the acquisition environment. According to Irby, examples of leader competencies are communication, supervision and team development.

MG William S. Chen, commanding general, U.S. Army Missile Command gave a presentation on the role of the systems command in the acquisition process. His address included business operations, functional support, matrix support, and AAC opportunities at the U.S. Army Missile Command.

BG John E. Longhouser, assistant deputy for systems management, Office of the Assistant Secretary of the Army (RDA), provided a broad discussion on project management. He stated that the pillars of program management are stability, accountability, trust and people. "It is important for the leadership of our Army to understand the texture of each and every one of the Army programs on a daily basis," he said, and added that PMs must keep their bosses informed.

LTC William Knight, director of the Military Acquisition Management Branch, U.S. Army Personnel Command, presented an update on the personnel implementation of the military AAC. Selection rates for promotion and school selection were included in his remarks.

Another conference highlight was the presentation of functional area (FA) briefings. These included FA 51 by MAJ Steve Cox, FA 51 proponency officer; FA 53 by CPT Gary Seebode, FA 53 proponency officer; and FA 97 by COL Michael R. Jorgensen, acting director for contracting, Office of the Deputy Assistant Secretary of the Army (Procurement), Office of the Assistant Secretary of the Army (RDA).

CPT Tom Knutilla, Department of the Army robotics officer, U.S. Army Artificial Intelligence (AI) Center, presented a briefing that included the missions of the AI Center, some examples of AI technology, and requirements for the AI-related skill codes 4K (artificial intelligence) and 4R (robotics).

CPT Jarrold Reeves, Professional Service Branch of the AAC, provided suggestions about advanced civil schooling and training with industry.

During the final session of the conference, the attendees divided into groups for functional area discussions.

COL Greenhouse closed the conference by summarizing some of the key speeches presented during the three-day gathering. He told the attendees, "You are responsible for putting in the hands of the soldier the very best equipment possible and keeping our Army number one in the world."

1992 Army Science Conference Scheduled for June

The 18th Army Science Conference will be held at the Hyatt in Orlando, FL, June 22-25, 1992. This biennial event was inaugurated in 1957 to provide a forum for presentation, discussion, and recognition of significant accomplishments by U.S. Army scientists and engineers in their efforts to support the combat soldier of tomorrow.

The 1992 conference will feature the presentation of 75 papers, which will focus on key emerging technologies, including systemic issues and supporting capabilities.

Throughout the conference, there will be exhibits demonstrating the latest technologies in government laboratories and research, development and engineering centers. This setting will encourage face-to-face discussions.

Defense industry representatives and U.S. Army personnel involved with new scientific initiatives and ongoing modernization activities should plan to attend this conference. Attendance will be beneficial to both management and technical personnel from industry and government who have an interest in the application of new scientific and engineering technologies.

Topics for discussion include: microelectronics, biotechnology and neurosciences, space, photonics, battlefield environment, advanced materials, materials processing and manufacturing technologies, robotics and artificial intelligence, advanced signal processing and computing, modeling and simulation, biomedical sciences and nutrition, protection/lethality, environmental sciences, advanced propulsion technology, and power and directed energy.

Some of the key speakers for the conference include: Hon. Stephen Conver, assistant secretary of the Army (RDA); Hon. Deborah Wince-Smith, assistant secretary, Department of Commerce; Dr. George Keyworth, Hudson Institute and former presidential science advisor; LTG (USAF Ret.) James Abrahamson, Hughes Aircraft Co.; Dr. Donald Langenberg, chancellor, University of Maryland and former president of the American Association for the Advancement of Science; Dr. Mark Wrighton, provost, Massachusetts Institute of Technology; Hon. Donald Atwood, deputy secretary of Defense; Hon. Michael Stone, secretary of the Army; Dr. Edward Teller, Lawrence Livermore National Laboratory; and various other distinguished speakers from academia, industry and Army activities.

For further information, write to the Army Science Conference, 4031 Colonel Glenn Highway, Dayton, OH 45431-1600, or call the Army Science Conference Registration Desk at (513)426-8530.

PERSONNEL

Raffiani Assumes Command of TACOM

MG Joseph Raffiani Jr., former deputy for program assessment and international cooperation, Office of the Assistant Secretary of the Army (Research, Development and Acquisition), has assumed new duties as commanding general of the U.S. Army Tank-Automotive Command (TACOM).

His responsibilities encompass the supervision of combat and tactical vehicle management including research, development, distribution, repair parts supply, operation and maintenance doctrine.

Raffiani previously served at TACOM as deputy commanding general for procurement and readiness and as project manager, M1A1 Abrams Tank Systems.

He holds an M.S. degree from Tulane and a B.S. from Rutgers.

Ross Assumes Command of AMC

GEN Jimmy D. Ross, former deputy chief of staff for logistics, Department of the Army, has assumed new duties as commander of the U.S. Army Materiel Command.

Ross holds a bachelor's degree in physical education from Henderson State University and a master's degree in business administration from Central Michigan University. His military education includes the Basic Officer Course at the Infantry School, the Transportation Advanced Officer Course, the U.S. Army Command and General Staff College and the Industrial College of the Armed Forces.

Ross was the commanding general, U.S. Army Depot System Command from 1986 to 1987, and the chief of staff, U.S. Army Materiel Command from 1984 to 1986.

His awards and decorations include the Distinguished Service Medal with Oak Leaf Cluster (OLC), the Legion of Merit with OLC, the Bronze Star Medal, the Meritorious Service Medal, two Air Medals, the Joint Service Commendation Medal and Army Commendation Medal with OLC. He has also been awarded the Combat Infantryman Badge, the Master Parachutist Badge and the Ranger Tab.

Whalin Named Director of WES

Earlier this year, Dr. Robert W. Whalin became the first civilian to be named permanent director of the U.S. Army Engineer Waterways Experiment Station (WES).

Whalin holds a bachelor's degree in physics from the University of Kentucky, a master's degree in physics from the University of Illinois, and a doctorate in oceanography from Texas A&M University.

He first joined WES in 1967 following six years in private industry in California. He has held a series of increasingly responsible management positions at WES, and was named WES technical director in 1985.

Whalin is a member of national and international professional organizations, and is the recipient of numerous honors and awards including the Presidential Rank of Meritorious Executive. He has co-authored more than 100 technical papers and is a registered professional engineer.

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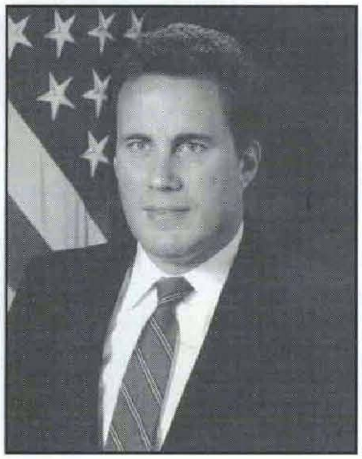

From the Army Acquisition Executive...

The Army's Fiscal Year 1993 amended budget request for Research, Development and Acquisition totals $12.2 billion—$5.4 billion for RDT&E and $6.8 billion for procurement of hardware systems. In recent months, I have testified before Congressional committees on our modernization strategy. I told Members of Congress that we will continue to develop our technology and that we will do our best to improve our fielded warfighting capability in the face of ever-decreasing dollars.

We in the Army have had time to absorb some of the shock associated with these declining resources. While our RDT&E funding remained fairly level, we watched our procurement budget fall from more than $14 billion to less than $7 billion in the last two budget years. Our challenge has been and remains figuring out the best way to allocate these rapidly declining funds so that we can fulfill our obligations to equip the soldier.

As many of you know, we have developed a goal to guide the Army's modernization efforts. That goal is to equip the soldier with world class equipment in sufficient quantity and in the shortest possible time, consistent with sound business practices and within affordability constraints. Three sets of principles guide us as we strive to reach our goal. My focus in this issue is principle number two, our resource allocation strategy or what we buy to support our modernization strategy.

I believe that procurement funding should be high in relation to R&D funding. In 1985, the Army was spending about $3.00 in procurement for every $1.00 in R&D. In our current budget, that ratio has fallen to 1.25 to 1. My concern is that R&D without procurement doesn't put any capability in the hands of the soldier.

As part of our resource allocation strategy, it is vitally important that we make the best possible use of every dollar that we have. Otherwise, we lose in two ways. First, as we spend a smaller percentage of our dollars on procurement, we slow the rate at which we can equip our soldiers. Second, as we buy in smaller quantities, the unit costs of our equipment go up and each procurement dollar actually buys less because of the inefficiencies that are inherent in very limited production. We need to buy all of our equipment at minimum efficient rates or greater, with possibly one exception.

That exception, in my view, is the very rare "silver bullet." A program of this nature would not be fielded to the entire force or even to all of Force Package One. Instead, only a few items would be purchased to give potential adversaries something to think about. Generally, though, if we cannot afford to buy at minimum efficient rates or greater, we should terminate the program. While some may disagree with me, I feel strongly that we need to build discipline in the system.

The Office of the Secretary of Defense (OSD) is helping to build discipline in the system by requiring the services to fully fund all programs, including R&D and subsequent production, or terminate them. It is an idea whose time has come.

Another part of our resource allocation strategy is the three criteria that we need to apply to any production or modernization that we contemplate. One, any proposed improvement or new program has to satisfy a strong user need. It has to help the soldier. Second, it has to be executable. We have to support programs that we can get through the acquisition process without major problems. Third, and perhaps more importantly, a program must be approvable by OSD and the Congress. If we have a program that we know will not get funded, let's not waste scarce resources by putting it in our budget.

A key component of our overall modernization strategy is to retire, at the earliest opportunity, our old and obsolete equipment. Criteria for retirement should focus on: high operating and support (O&S) costs, low combat effectiveness in our most likely scenarios, and little growth potential for technology insertion. We must take the savings generated by the retirement of these older systems and immediately plow them into the procurement of replacement systems. We need to dedicate these dollars to procurement early on or they will disappear quickly with nothing to show for the effort.

There are still other points in our resource acquisition strategy. We are taking steps to improve the efficiency of acquisition programs by driving down both contractor and government contributions to cost. We are trying on both sides to strip bureaucracy out of the process. On the government side, we are working hard to keep our functional requirements (logistics, testing, analysis, etc.) to a minimum. Under the present process, many acquisition programs seem to be laden with functional requirements and risk avoidance measures that inhibit our ability to get equipment into the hands of our soldiers quickly and at low cost. I have proposed that the burden of proof be properly placed on those who would add a functional requirement to a program. We must do everything possible to eliminate inefficient and ineffective government contributions to cost, just as we expect and demand our industry partners to do the same.

We all agree that today's Army is fully trained, highly motivated, and well-equipped. It is the finest, most capable fighting force in the world. Our challenge is to keep it that way.

Stephen K. Conver

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