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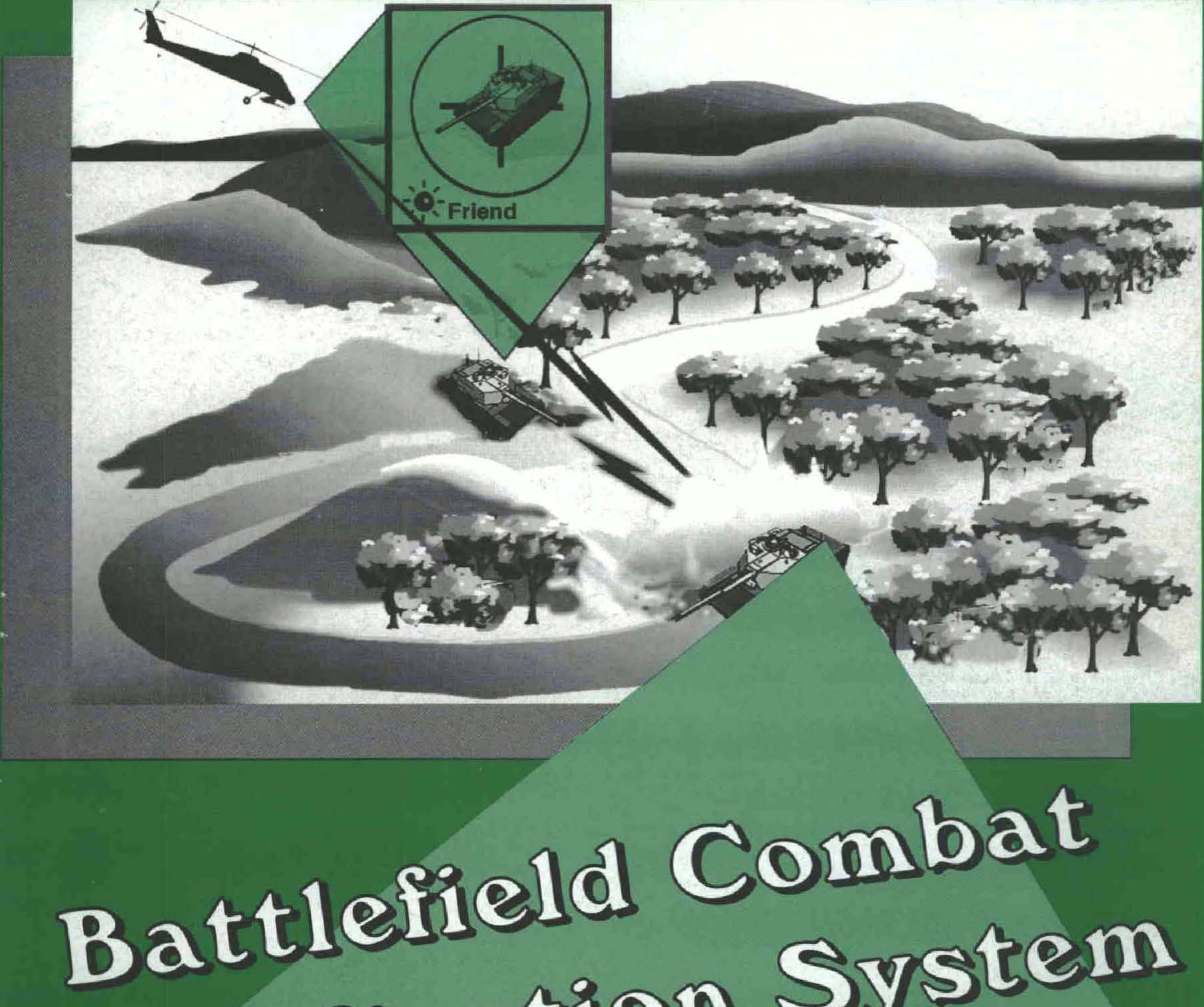

Battlefield Combat Identification System

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Research Development Acquisition

ARMY RD&A BULLETIN

Professional Bulletin of the RD&A Community

FEATURES

DEPARTMENTS

COVER

This issue highlights the process of horizontally inserting combat identification technologies across a wide family of Army weapon systems.

A TEAM CONCEPT FOR DEVELOPING THE BATTLEFIELD COMBAT IDENTIFICATION SYSTEM

By MAJ Glenn J. Geoghegan and Dr. Wayne T. Calabretta

Introduction

Fratricide during Operation Desert Storm gained national attention and was a matter of grave concern to the U.S. Army's leadership. Current combat identification capabilities suffer from numerous shortcomings since identification of vehicles and troop formations is a largely visual or visually-aided process.

Relative to today's weapon ranges, visual identification ranges are marginal in daylight, and deficient during darkness and limited visibility. To reduce fratricide in future conflicts, the Army moved out on a broad front and developed a program that implements doctrine and training changes, and a complementary materiel solution.

Immediately following Desert Storm, the Army implemented several "quick fix" programs that provided some initial, limited improvements. In August of 1992 a Defense Acquisition Board approved a more comprehensive program naming the Army as the lead to develop a ground-to-ground and air-to-ground combat identification solution. The Army's response is a near-term program for early fielding, and mid- and far-term programs that incorporate improvements including embedded, fully integrated situation awareness and identification capabilities.

Executing the near-term Battlefield Combat Identification System (BCIS) Program will require intensive management throughout its life cycle. Much of the program's risk is associated with the horizontal technology insertion of BCIS on many different combat platforms while still achieving the challenging program schedule. The Army's response to this challenge was to create Team BCIS. This article describes the application of the team concept.

The deputy chief of staff for operations (DCSOPS) and the Training and Doctrine Command (TRADOC) defined the primary threat countered by the near-term BCIS as the highly lethal fire of friendly forces during continuous operations on an intense, fast paced, non-linear battlefield. The fielding requirement is to equip a Force Package 1 unit with the near-term capability before the end of 1997.

Initially, BCIS will be fielded only to the most likely sources and victims of fratricide; namely those platforms that normally operate forward of the brigade support area. Current plans call

System Description

The Battlefield Combat Identification System (BCIS) will provide a cost effective solution for protecting soldiers from friendly ground and rotary wing fire. BCIS is envisioned as a point of engagement ID system. Just before trigger pull of a direct-fire weapon, the target is interrogated. A friendly response from the target automatically informs the weapon gunner of the presence of a friendly vehicle. The gunner uses his training and the rules of engagement to determine if a cease fire is appropriate.

The BCIS is a millimeter wave question and answer system. It consists of several components: an interrogator that's mounted on the attack platform and aligned with the weapon, an omni-directional transponder mounted on the target platform, and a small signal processor. The standard BCIS components will be installed using platform unique installation kits.

Though technically complex, the BCIS does not require state-of-the-art advances in millimeter wave technology, since many of the system's basic components are commercially available. The program's evolutionary acquisition strategy allows a core capability to be initially fielded, with planned growth to accommodate potential mid and far term enhancements. A modular system architecture provides for upgrades as user requirements are refined or become technically feasible. This permits rapid fielding and cost effective integration of new technologies as they mature.

for fielding about 1600 systems to a horizontal division slice of combat platforms and rotary wing aircraft.

The Team Concept

The Team BCIS charter was recently signed by LTG William H. Forster, the military deputy to the assistant secretary of the Army for research, development and acquisition. The charter sets the tone and establishes the framework for team work. The horizontal technology insertion of the BCIS requires active cooperation from several Program Executive Offices (PEO), the Army Materiel Command (AMC) major subordinate commands, and TRADOC proponent schools.

The testing and fielding of BCIS involves several research laboratories, technical and operational test commands, and Forces Command (FORSCOM) units. The project manager, combat identification (PM CI) was assigned the overall responsibility for integrating BCIS. Team BCIS supports the PM in resolving the design, integration, test, and fielding issues that will arise.

Team BCIS is formally composed of three parts: Process Action Teams (PAT), a Management Working Group (MWG), and the Executive Steering Committee (ESC). PATs have been established for aviation, combat, and tactical platforms in addition to those working the PM BCIS acquisition process. PATs meet whenever necessary to discuss pertinent issues and problems, and develop solutions.

The product manager BCIS acts as team co-leader on each PAT. PAT results are passed along to the Management Working Group for review, comment, and guidance. The PM CI chairs the MWG, which provides guidance and direction to all the PATs, and assimilates PAT input for presentation to the Executive Steering Committee. The ESC is chaired by the PEO intelligence and electronic warfare, and provides senior level oversight and direction to the MWG. Issues that need high level decisions are raised to the ESC. Our prime contractor, once selected, will become an integral member of Team BCIS.

Working Together from the Beginning

The urgency of the program and the many activities and participants forced initial operations under an ad-hoc team concept before a formal charter was approved. The team faced several major challenges early. The program was formed in late July 1992 before its scope or system technology had been

BCIS Platforms

M3A2 Bradley Cavalry Fighting Vehicle (CFV)

M1A2 Abrams Main Battle Tank (MBT)

M1A1 Abrams Main Battle Tank (MBT)

M2A2 Bradley Infantry Fighting Vehicle (IFV)

M998 Scout HMMWV

M981 Fire Support Team Vehicle (FISTV)

M577/1068 Armored Command Post (ACP)

M93 Fox Nuclear, Biological, and Chemical (NBC) Reconnaissance Vehicle

Marine Light Armored Vehicle (LAV)

M728 Combat Engineer Vehicle (CEV)

M9 Armored Combat Earthmover (ACE)

Avenger Air Defense System

AH-64A+ Apache

M113A3 Armored Personnel Carrier (APC)

M1064 Mortar Vehicle

OH-58D Kiowa Warrior

M270 Multiple Launch Rocket System (MLRS)

M109 Self Propelled Howitzer (Paladin)

M992 Fast Attack Ammunition Support Vehicle (FAASV)

M60 Armored Vehicle Launched Bridge (AVLB)

PM Combat Identification

PM Combat Identification (PM CI) is one of seven project managers reporting directly to the Program Executive Officer for Intelligence and Electronic Warfare A.R. D'Angelo. PM CI is responsible for overall direction and guidance for the design, development, acquisition, testing, fielding and materiel change programs for numerous combat identification systems and technologies, including the Battlefield Combat Identification System (BCIS). PM CI responsibilities include management of combat identification tech base funding and combat identification advanced technology demonstrations, leading to the planning and execution of mid- and far-term programs. COL Thomas V. Rosner, OD, is the current project manager for combat identification. LTC Robert R. Sigl, AR, is the product manager for BCIS.

decided. As platforms were added and operational parameters changed, the contract specification and procurement data package was frequently revised. Many of the generic requirements in areas such as cost reporting, software development, packing and crating, and workmanship standards, were developed by the Communications and Electronics Command (CECOM) Project Control Board (PCB) acting as a subset of the "pre-contract" PAT.

After generating the necessary documentation, the expanding pre-contract PAT scrubbed the requirements and conducted coordination and reviews. In mid-October, based on the recommendation of a TRADOC/AMC combat identification task force, a millimeter wave question and answer system was approved as the BCIS technology. The draft documents quickly took shape and were released to industry.

Once the draft solicitation was available, the technical details were coordinated among the platform PMs and other government organizations. Other ad hoc working teams were soon established including a "red team" for addressing integration concerns of the aviation community. The red team included experts from the Aviation Troop Command (ATCOM), CECOM, TRADOC, PM Aviation Electronic Combat, and PM CI. As the aviation red team grappled with the challenges of integrating a millimeter wave device onto aircraft, it became clear that several risk reduction concepts should be incorporated in the Acquisition Strategy. The team recommended that an alternate approach, which maximized use of the aircraft's onboard systems, be included in the Request for Proposal.

Through successively higher-level briefings, the aviation red team quickly refined the aircraft integration plan into the one that was ultimately approved by the Team BCIS Executive Steering Committee. Because the team concept was working, a change of this magnitude did not affect the program schedule.

As the technical details firmed up, the pre-contract team incorporated streamlining initiatives advocated by the AMC Road Show and Department of Defense Instruction 5000.43 into the solicitation. Subsequent scrubs by PATs and the MWG reduced contractual requirements to only those that are the most cost effective and essential. Announcements in the *Commerce Business Daily* beginning in July 1992 initiated formal contacts with industry.

Early release of a draft specification and Statement of Work, contractor inspections of the host platforms, and establishment of the BCIS Electronic Bulletin Board (EBB) were the direct result of the pre- contract PAT's activities. On Jan. 8, 1993, only five and half months after beginning the process, the BCIS solicitation was released to industry via the EBB. No hard copies were offered; contractors downloaded all information directly from the EBB.

Future Activities

In conclusion, the team concept is essential where horizontal technology insertion is required. Team BCIS members have brought a wide variety of talent and experience to the program's activities. Now that proposals have been received, many of the early BCIS team members are serving in critical positions on the Source Selection Evaluation Board. The participation of these PAT and MWG members assures technical continuity and a smooth transition to the source selection and evaluation process.

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DR. WAYNE T. CALABRETTA, is the senior procurement analyst with PM Combat Identification, with more than 13 years of contracting experience. He has degrees in computer science, business management and psychology.

ARMY UNIVERSITY CENTERS

By David Seitz and Dr. Gerald Iafrate

Background

More than any other service, the Army is planning major changes and reductions in force structure as it moves toward the more versatile, deployable, higher technology force of the 21st century. The recent experience of Desert Storm has shown the overwhelming advantages afforded by high technology systems in successfully accomplishing the Army's mission. As the nation moves toward a more commercially driven science and technology base, the Army will focus on basic research to enhance sustainability, affordability, and modernization while fostering dual-use applications.

Basic Research Strategy

The Army has acknowledged the need for a sustained basic research program, and has committed itself to stability and continuity for that program. Moreover, the Army has structured a coherent basic research program that integrates the Army Research Laboratory (ARL) and the research, development and engineering center (RDEC) programs with the extramural university research centers and single investigator programs of the Army Research Office (ARO) so that basic research (6.1) seeds its exploratory development (6.2) and advanced technology development (6.3A) programs. University centers are the centerpiece of academic linkage to Army RDECs and ARL.

The Army Research Office has responsibility for the development and management of the Army's extramural basic research program and its integration into the overall Army program. To this end, the ARO program is a complement of single investigators and university research centers.

Both the single investigator and university center efforts are fundamental to shaping the future of the Army, but with different returns on investment. The single investigator program focuses on generating new science and technology opportunities from a broad spectrum of scientific areas. The university research centers, on the other hand, focus a critical mass of resources on Army-specific technological areas with an eye toward technology transfer, infrastructure investment, and personnel training.

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Types of Centers

ARO manages research centers through two project elements: Army Centers of Excellence are funded with ARO core funds, and the Army-managed University Research Initiative (URI) Centers and block grant programs are funded by the Department of Defense. Both address specific Army needs with center thematics decided by senior Army leadership through the deputy assistant secretary of the Army for research and technology. Research emphasis of the centers is interdisciplinary, and presently covers areas such as rotorcraft technology, high performance computing, artificial intelligence, training, high-frequency electronics, manufacturing science and other topics central to Army key operational capabilities.

Army Centers of Excellence

Army Centers of Excellence are an integral part of ARO's research investment strategy along with single investigator programs. These centers are funded at approximately $1 million per year and have proven to be highly effective in many applications-oriented projects in areas such as rotary wing technology and electronics.

Interdisciplinary research requires the joint efforts of many scientists and engineers and sometimes requires the use of costly research instrumentation that is typically difficult for a single investigator to acquire. Center programs link the state-of-the-art research programs and broad-based graduate training to increase the supply of scientists and engineers in areas of critical importance to the Army.

Table 1 identifies the present Army Centers of Excellence, provides a listing of the specific universities involved, and summarizes selected research programs and educational functions, and includes highlights of future plans.

The two newest centers, Training Research and Information Sciences, are

Table 1.
Army Centers of Excellence.

RESEARCH AREAS / PARTICIPATING UNIVERSITIES	SCOPE	FUTURE PLANS
ELECTRONICS Columbia University	•Large-scale reliable systems •Optoelectronic devices •Carrier transport phenomena •Solid-state materials	•Reaction path specificity of condensed materials •Submicron field effect transistors •Quantum engineering of materials
Georgia Inst of Technology	•Large-scale reliable systems •Optoelectronic devices •Electromagnetics	•Data processing technology
Massachusetts Inst of Technology	•Optoelectronic devices •Carrier transpsort phenomena •Solid-state materials •Electromagnetics •High-electron-mobility transistors	•Reaction path specificity of condensed materials •Submicron field effect transistors •Quantum engineering of materials •Ultrasmall structures
Stanford University	•Solid-state materials •High-electron-mobility transistors	•Submicron field effect transistors •Quantum engineering of materials •Data processing technology •Ultrasmall structures
ROTORCRAFT Rensselaer Polytechnic Institute	•Hybrid composite laminates •Fatigue in composite tubes •Manueverability dynamics •Composite blade models	•Composite material design for rotorcraft structure •Composite material tailoring
University of Maryland	•Composite blade models •Rotor aerodynamics •Rotor-airframe interference flows •Aeroelestic stability of hingeless blades	•Aerodynamics for composite rotor blades •Aeroelastic instabilities & dynamics of composite blades •Rotor-body interference experiments
Georgia Institute of Technology	•Composite blade models •Rotor aerodynamics •Rotor-airframe interference flows •Aeroelastic stability of hingeless blades	•Composite material tailoring •Aerodynamic for composite rotor blades •Aeroelastic instabilities & dynamics of composite blades
MATHEMATICS Cornell University SUNY at Stoneybrook University of Puerto Rico City College of CUNY	•Nonlinear dynamic systems •Stochastic analysis •Physical mathematics •Computational geometry and computer algebra	•Nonlinear phenomena •Computational algebra & algebraic geometry •Applications of logic & automated analysis
HIGH PERFORMANCE COMPUTING RESEARCH University of Minnesota Howard University Jackson State University Purdue University	•Efficient algorithms •Automatic battle management •Large-scale scientific computing •Efficient utilization of high performance architectures	•Parallel algorithms for novel architectures •Large-scale scientific computing •High performance computing
ARTIFICIAL INTELLIGENCE University of Pennsylvania	•Natural language processes •Reasoning under uncertainty •Robust software •Computer vision	•Prototype software •Reasoning knowledge representations
TRAINING RESEARCH Morris Brown College	•Computer simulation •Memory strategy •Auditory enhancement •Critical decision making •Team performance	•Critical skills for trainers •Individual learning variables •Team performance characteristics •Cognitive conceptual behavior
INFORMATION SCIENCES Clark Atlanta University	•Distributed databases •Probabalistic modeling •Multimedia software •Software Re-usability •Computer Optimization	•Heterogeneous databases •Models for software •Interactive data analysis

Table 2.
University Research Initiative Centers.

Research Area/ Participating Universities	Scope	Future Research Plans
Biology Scripps Research Institute U. of Texas Southwest Medical Center University of Missouri - Columbia	- Combinatorial library of Human immunoglobulin - Antibody reaction with antigens - Epitope library	- Immunoglobulin which reacts with designated antigens - Useful reagents for assay of immunogens
Advanced Propulsion University of Wisconsin Ohio State University Purdue University	- Engine combustion - Rotorcraft propulsion systems - Materials for engines - Lubrication/tribology	- Combustion dynamics predictive models - High temperature lubrication - Turbine aerodynamics
Materials Brown University U. of California - San Diego Case-Western Reserve Boston University University of Pennsylvania University of Maryland Virginia Polytechnic Institute Rensselaer Polytechnic Institute	- Dynamic Behavior of Materials "Brittle" materials "Ductile" materials - Biomimetic processing of materials - Biotechnology for materials application - Smart materials and structures - Mathematical modeling of microstructures	- Micromechanical models of nucleation of defects - Materials with reversible phase transformations - Bonding between particle and matrix phases - Self-assembling materials for microelectronics and photonics - Multifunctional macromolecules for motor systems
High Frequency Microelectronics University of Michigan	- Solid-state materials - Carrier transport phenomena - Optoelectronic devices - High-electron-mobility transistors	- Quantum engineering of materials - Submicron field effect transistors - Two-terminal MMW devices - Ultrasmall structures
Electro-Optics University of Rochester	- Optical communications, components and computers - Infrared systems - Photonics	- Optical engineering design tools and testing - Development of optical materials
Nanotechnology Purdue University Princeton University	- Manipulation of materials at nanoscale - Techniques for nanofabrication	- Subnanosecond real-time micro-dynamics of material structures - Physical basis of barrier problems
Energy University of Southern California Pennsylvania State University Auburn University	- Fast reaction kinetics - Modeling of energetic materials - Mobile power technology	- Molecular photodecomposition - Power storage and electrical distribution - Opening switch technology
Manufacturing Science University of Delaware	- Automated manufacturing processes - Reliability and maintainability - Concurrent engineering	- Process simulation - Computer-aided manufacturing - Intelligent non-destructive testing
Environmental Sciences Cornell Pennsylvania State University University of Massachusetts Massachusetts Institute of Technology University of Delaware University of Texas - Austin Texas A&M University University of North Carolina	- Supercritical water oxidation - Diagnostics probes for combustion - Biodegrative microbiology and biochemistry - Transfer process in mixed phases - Coastal processes - Remote Sensing - Atmospheric boundary layer processes	- Kinetics and mechanisms of reactions in supercritical water - Biocatalytic chemistry of degradation compounds - Adsorption/desorption processes - Mesoscale meteorological modeling - Models of boundary layer processes - Wind generated transport of noncohesive sediments
Intelligent Control Systems Massachusetts Institute of Technology	- Computer vision - Systems and control theory - Machine learning	- Representation at different scales - Learning algorithms - Synthesis of artificial perception

University centers are an effective institutional mechanism for the Army to advance key Army technology areas of the future.

significant in that they were the first to be awarded solely to historically black colleges and universities (HBCUs). These two centers will bring together critical masses of university researchers to advance these militarily relevant technologies.

In addition, cooperative programs have been established between a nonminority, major university and HBCUs. In this regard, the Army High Performance Computing Research Center (AHPCRC) at the University of Minnesota, involves a subcontract with Howard University at a funding level of more than $4 million for research, equipment, and infrastructure support. An additional subcontract with Jackson State University is also in place. The AHPCRC-HBCU initiative has become a prototype for expanding the linkage of Army research programs to HBCU schools. In the future, all Army Centers of Excellence will be formed in partnership with an HBCU.

In the future, industry will be encouraged to "buy into" future Army Centers of Excellence to enhance technology transfer and to leverage industrial investment in these collaborative efforts wherever possible. A prototype for industrially cosponsored Army Centers of Excellence exists in the rotocraft area.

In the recent cycle of competition for these centers, ARO's broad agency announcement required cost-sharing and/or co-funding on a matching dollar basis from industry, university and/or state funding sources. As a result of this competition, grants for three centers were awarded. The total yearly funding for all three centers is $2,078,000 with $750,000 provided by ARO, $589,000 provided by the universities, and $739,000 provided by industry. All of the major domestic helicopter manufacturers are represented in the industry funding for the centers.

URI Centers and Block Grants

The URI program was initiated in 1986 and included 13 interdisciplinary centers of excellence. The program had a five-year cycle, and came to a close in 1991. A follow-on, five-year URI multidisciplinary research program was initiated in 1992. The URI Center and block grant research areas supported under this program reflect current and future Army needs (see Table 2). The present five-year program includes research in environmental sciences, needed to remediate military toxic waste, and mobile power research, required to meet the energy needs for a wide array of soldier-as-a-system components.

Most of the URI efforts in the current cycle are smaller in scale than those previous URI Centers so as to cover a broader range of Army research needs given the limited funds available. Funding levels range from $400,000 for block grants to $1.2 million for the largest URI Center.

Management of Centers

In keeping with the Army's strategy for the conduct of extramural research, ARO has forged its university research centers and block grant programs into a close linkage with the Army's inhouse centers and laboratories. In order to ensure this linkage, and at the request of the deputy assistant secretary of the Army for research and technology, ARO established an Executive Advisory Board (EAB) and a Technical Advisory Committee (TAC) for each of the Army Centers of Excellence and URI Centers and block grant programs. The EAB is comprised of proponent Army laboratory and center senior executive leadership to provide oversight and to ensure compliance with Department of the Army policy.

The TAC is comprised of senior scientists and technologists from the appropriate Army laboratories and centers who work in concert with the EAB to accelerate science and technology transition from academia to the Army user. Each center is also assigned an executive coordinator who serves as a facilitator for the EAB and as the chairperson of the TAC. The executive coordinators also serve as the ARO contracting officer's technical representatives for the centers.

Conclusion

University centers are an effective institutional mechanism for the Army to advance key Army technology areas of the future. Moreover, close interaction with Army R&D organizations is emphasized, so that the center technical staff gain a greater appreciation of user needs, while the Army R&D community gets to interact with academic peers.

The Army's investment in these centers is highly leveraged, for many of the centers have attracted additional sources of support to enhance their strengths and capabilities. Through these Army and URI Centers, the Army R&D community closely interacts with top-flight American universities to provide the soldier with the utmost in a technical winning-edge.

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A PARAMETRIC MODEL FOR SOLDIER INDIVIDUAL POWER

By Keith Dugas,
Selma Nawrocki,
and Eleanor Raskovich

Introduction

In the future, soldiers' fighting capabilities will be enhanced through the addition of new technologies—microclimate cooling, a soldier computer, individual navigation, enhanced hearing, night vision, helmet displays, voice/data communications, and weapon ranging. These technical refinements will be integrated into a safer, more effective Soldier System. But without power, these components cannot operate.

The goal of the Soldier Individual Power Program is to develop and test a lightweight, backpack power module which will provide reliable power to cool the dismounted soldier in Mission Protective Posture IV (MOPP IV) protective clothing. The module will also power the advanced suite of electrical components of the Soldier System as shown in Figure 1.

To help select the most appropriate technology or technologies to power the Soldier System, the Belvoir Research, Development and Engineering Center (BRDEC) developed a parametric model computer program that calculates how the weight, size, and cost of candidate power systems vary as scenarios are varied (see Figure 2).

Background and Initial Work

BRDEC is one of the lead agencies for Soldier System power generation. In 1991, BRDEC began a front-end analysis to determine feasible approaches and select the best power source(s) for the Soldier System. Seven candidates were identified as feasible power sources for the Soldier System, as shown in Table 1.

Since the mission determines the power requirement, a range of operational scenarios representative of the dismounted infantry soldier using the Soldier System was defined. For each scenario, detailed calculations determined the weight and size of the power source for each of the seven candidate technology areas. These calculations became the basis for equations in the model to perform extrapolations to other mission power and energy requirements. During the validation process, the working group members determined through additional calculations that the model would be useful in an approximate range of 50 to 1000 watts power.

The seven candidate technologies were evaluated for a full range of mission lengths, cooling modes, operating hours, quantity procured, soldier equipment loads, metabolic cooling requirements, and technological maturity. The parametric model output predicts a relative life-cycle cost, size, and weight for each technology with similar operating requirements, and quantitatively presents the best solution for a given scenario. This output displays the technologies available today and predicts the technologies available in the near future.

Scenario Descriptions

The mission scenarios, developed at BRDEC, include input from the Program Manager—Soldier, the Infantry School, and Special Operations Forces. Each scenario defines the environment, equipment, activity level, and weight limitations necessary for a given mission. Two of these scenarios served as the basis for development of the parametric model.

Scenario 1. This scenario involves a dismounted infantry soldier in MOPP IV protective clothing using the Soldier System in a temperate or cool climate. The mission details are: Average Power Requirements: 55 watts; Peak Power: 125 watts; Total Mission Energy Requirements: 1325 watt-hours; Mission Length: 24 hours.

This scenario describes the soldier's operational requirements for a low energy, long duration mission. The soldier uses fan-driven forced ambient air cooling and has an electronic load consisting of thermal vision, thermal sight, flat display, enhanced hearing, navigation monitor, soldier computer, voice communications, local area network (LAN) communications, and chemical-biological monitor.

Scenario 2. This scenario involves a dismounted infantry soldier in MOPP IV protective clothing using the Soldier System in a temperate or hot climate. The mission details are: Average Power Requirements: 240 watts; Peak Power: 375 watts; Total Mission Energy Requirements: 2400 watt-hours; Mission Length: 10 hours.

This scenario describes the soldier's operational requirements for a medium energy, medium duration mission. The soldier uses chilled air cooling and has the same electronic load as in Scenario 1.

Model Considerations and Development

The software chosen for creating the computer model was Lotus Symphony for the PC (DOS). Symphony provides a powerful spreadsheet tool for making a reliable model and a data structure that can be modified easily. A modular design was chosen within Symphony, with each technology (data, formulas, and costs) for each timeframe occupying a block of cells. Separate areas of the spreadsheet are set aside for the input data, each power source calculation, the summary output information for 1992, 1994, and 1998, and the help screen. Each power source calculation includes areas to calculate size, weight, and cost of the power source. The resulting calculations are then extracted and placed in summary tables. Menus were developed for easier model manipulation. Twenty-two macros were written to ease movement within and around the spreadsheet.

The model allows the user to input a range of mission length values. The minimum and maximum are used as bounding values. Calculations are made using these two mission length values and nine data points equally spaced. Other important input variables for the model include: whether the soldier is cooled (using either ambient or refrigerated air); length of cooling time; type of electronics equipment the soldier carries; and if the equipment is used during the mission and for what length of time. From these data, calculations are made for peak power (watts) and total energy (watt-hours) required.

Table 1.
Working Group Members and Candidate Technologies.

Power Source	Working Group Member
PRIMARY NONRECHARGEABLE BATTERIES	Army Research Laboratory (ARL) Electronics and Power Sources formerly Electronics Technology and Devices Laboratory (ETDL)
SECONDARY RECHARGEABLE BATTERIES	ARL formerly ETDL
INTERNAL COMBUSTION ENGINES	Belvoir Research Development and Engineering Center (BRDEC)
VAPOR AND LIQUID CYCLE ENGINES	ARL formerly Harry Diamond Laboratories (HDL)
STIRLING CYCLE ENGINES	Natick Research Development and Engineering Center (NRDEC)
FUEL CELLS	BRDEC
RADIOACTIVE ISOTOPE POWER SOURCES	BRDEC

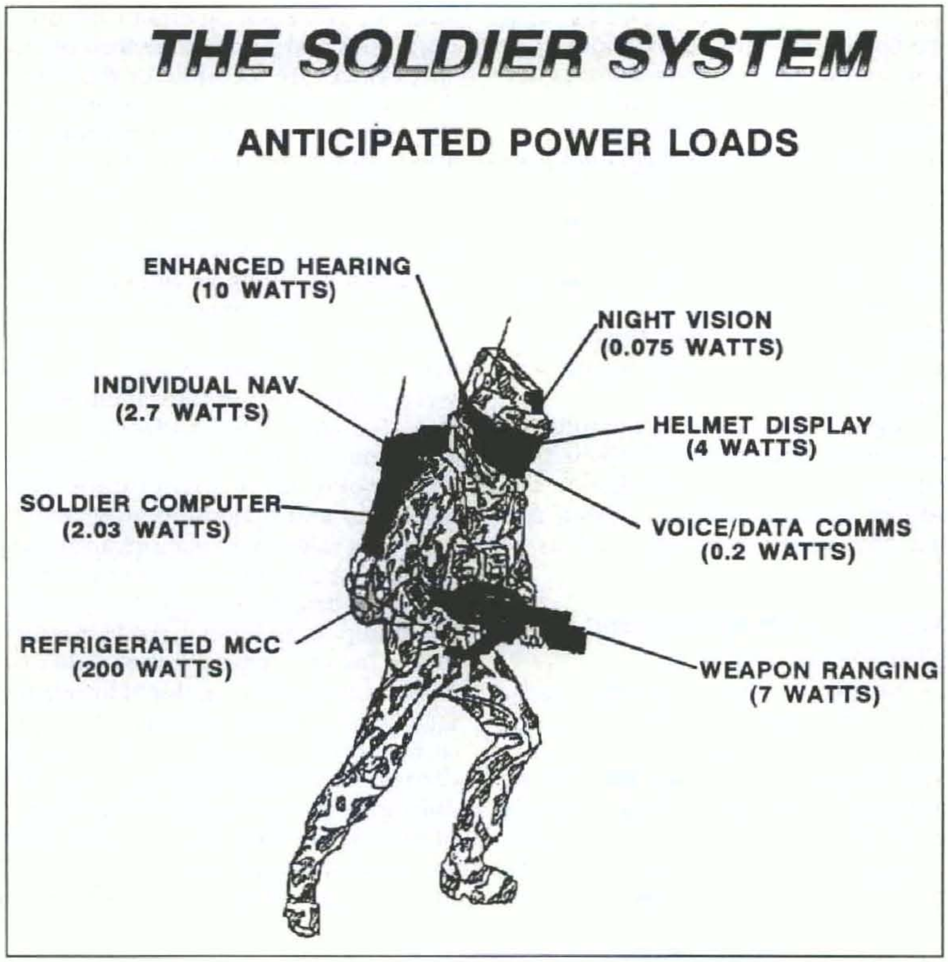

Figure 1.

This is the basis for calculating the size (cubic inches), weight (pounds), and cost (dollars) for each of the power sources.

It was important to build a model able to duplicate the results from the two scenarios already developed. Formulas were developed that represent scaling relationships for size and weight for each power source over a range of peak power and energy requirements. The Soldier Individual Power parametric model has been verified via working group review and validated by comparing results to the two scenarios hand calculated by the working group. The data points from the two existing scenarios serve as reference points to calculate the scaling relationship constants.

Model Input and Output

The parametric model input parameters include mission definition and an equipment list (menu). The model produces a power and energy estimate.

Input variables include: mission length (autonomous time); rest time; period of cooling; cooling mode (forced ambient air, chilled air, none); ambient temperature; annual operating hours (peacetime, wartime); quantity needed (peacetime, wartime); soldier equipment (type, power draw, utilization rate); amount of peak body cooling required; and technology level—present, 1994, or 1998.

Primary calculations include: power required (watts), which includes power for cooling, efficiency losses, and body cooling; and total energy required (watt-hours). Secondary calculations include: size/weight factors; costs; mean time between failure; replacement/replenishment; and quantity required. Outputs include: comparisons of candidate solutions; size; weight; and relative cost. The model allows for uncertainty/flexibility by inputting hi/lo mission scenarios. The difference in output gives the impact of the mission range.

Once the input process is completed, macros help the user move to the summary tables in the case of the single mission input option. The tables list the power and energy requirements, the seven power sources, and the size, weight, and life cycle costs for each power source. For the multiple mission length input option, size, weight, or life

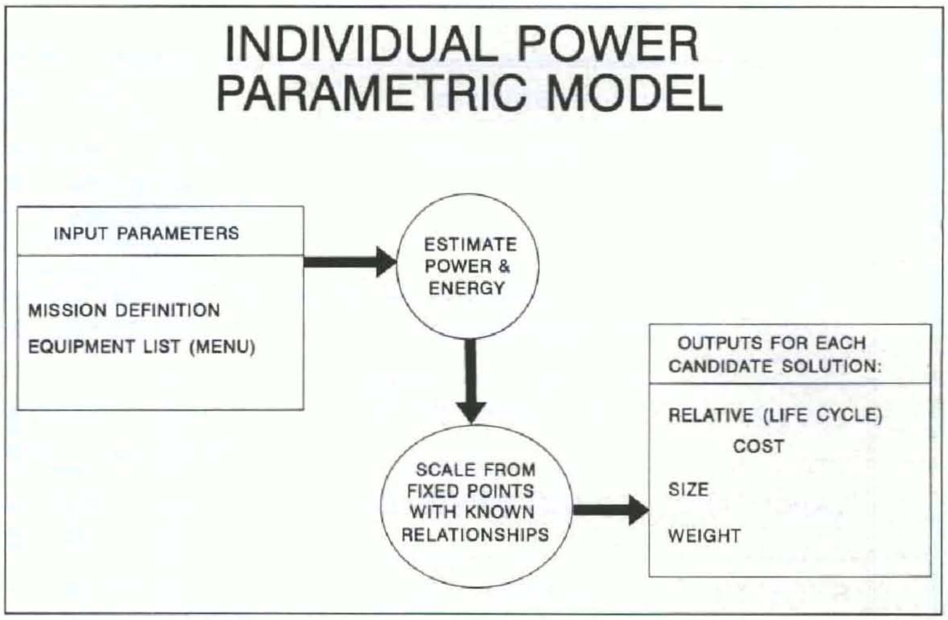

Figure 2.

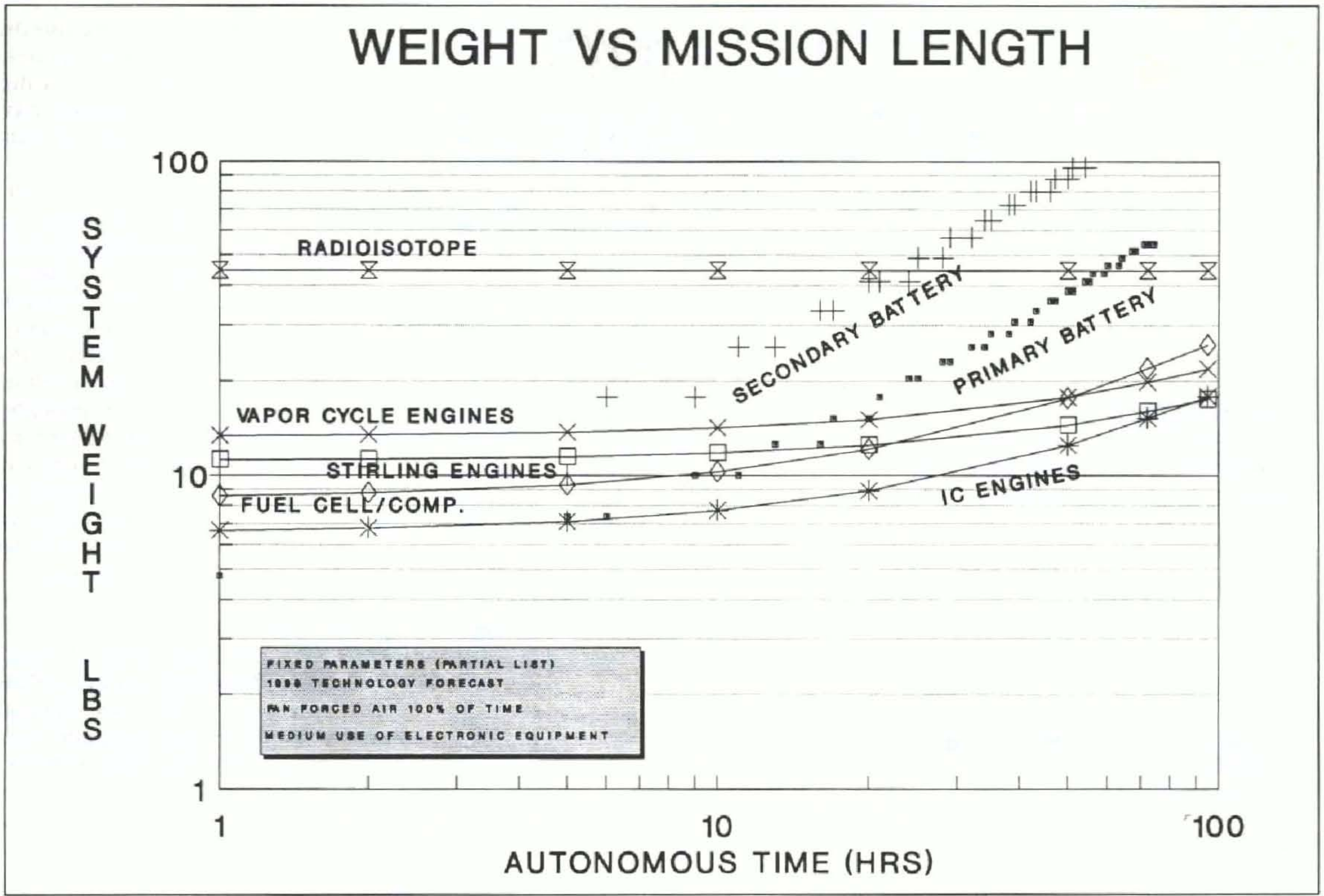

Figure 3.

cycle costs vs. the range of mission lengths can be graphed. The summary tables show only the results of the maximum mission length calculations. Weight vs. mission length for a 1 to 100 hour mission using projected 1998 technology is shown in Figure 3.

Summary

The Soldier Individual Power parametric model was essential to conducting parametric analyses as a part of the power source selection effort. The model provides an efficient means of calculating the results of many different scenarios instead of only a few scenarios. It enables the user to determine Soldier System power and energy requirements and to select the appropriate power source for a given mission or class of missions.

The evaluation found that for individual soldier missions that do not require cooling, battery-powered systems are the preferred approach. These systems are presently preferable for low-energy, short duration (less than eight hours) missions. For missions requiring more energy (cooling soldiers in hot climates), a fueled system, such as a small engine-driven system (engine-generator) or hydrogen-oxygen fuel cell, is the near term option.

The Soldier Individual Power parametric model has contributed greatly to ongoing efforts. It will continue to be valuable when new calculations are needed. This may be necessary as changing scenarios arise. Also, the 1994 and 1998 component weights are projections. The parametric model will be modified as these values are refined and additional analysis conducted to ensure the appropriate systems are developed to power the Soldier System.

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CONTINUOUS IMPROVEMENT

The End of the Rainbow

By Kenneth H. Rose

Introduction

Folklore has it that at the end of every rainbow lies a pot of gold. This makes a good story and—absent the intrusion of some basic physics—probably provides a source of optimism for many. Quality is a lot like this: it is a journey toward an elusive destination. But unlike rainbows and other amusing, though fruitless, diversions for the naively informed, quality rewards are *in the journey,* strewn copiously along the way for those wise enough to see them. Under the quality rainbow, the "gold" is found in the many incremental steps of continuous improvement.

The path of quality improvement is not easy. It is fraught with many difficult hurdles and not a few outright barriers. The first would seem to be the simple fact that improvement means doing something different. It means change, and that is generally not a welcome addition to anyone's agenda. Fortunately, this is not news. The resistance to change phenomenon is well recognized and pretty well understood. Techniques for implementing and managing change are on the shelf and readily available for just about any circumstance or domain. Resistance to change is not a barrier or even much of a hurdle; it's just something else that has to be addressed.

The real problems are a lot more subtle. They are buried deep within organizational culture and, when disclosed and confronted, seem to wear a badge that says, "I'm not a problem." They defy resolution by claiming presumptive acceptance as "the way things are." Three such issues provide examples.

First, it is sometimes difficult to agree that it's okay to improve. A suggestion of an improvement opportunity may be viewed as criticism of those responsible for the current conditions, usually the boss. The suggestion then becomes viewed as an act of aggression or disloyalty. Wounded pride and hurt feelings are milder responses of the same kind.

The common thread here is that improvement is a professional matter, not a personal matter. Suggestions should be welcomed, not shunned, and significantly successful suggesters should be celebrated as heroes, not condemned as traitors. The central truth about continuous improvement is that each successive level of achievement provides a better view, which makes more opportunities visible and more improvement possible. Continuous improvement does not mean that the present or the past is in someway deficient or otherwise deserving of criticism.

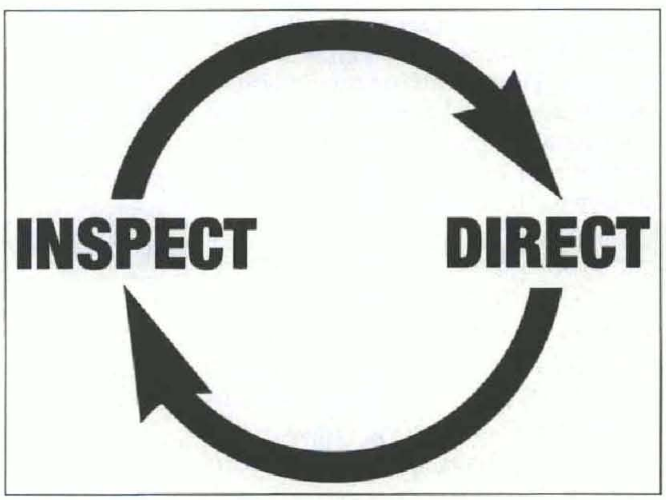

Figure 1.
Inspect-Direct Model.

Specifications

Specifications are another issue that can impede quality progress. This seems to fly in the face of conventional wisdom that dictates that specifications are the essential measure of performance. To meet specifications is to succeed; to fall short is to fail. Specifications are not a pass-fail yardstick; they are more like the optimist-pessimist view of the half-full or half-empty glass. While meeting specifications may define success, meeting specifications may also be viewed as doing just enough to escape punishment—nothing more. Any organization that considers such a view to be "quality" has embraced a fundamental misunderstanding of the word.

Specifications should be considered a starting point, not a goal. They should be considered a baseline for continuous improvement, not a one-shot target for fire-and-forget delivery of products and services. To this end, customer-prescribed *performance* specifications are probably a better approach than specifically quantified *technical* specifications. The former allow the latitude for interactive adjustment between customer and supplier as they both march toward delivery of a superior product or service. The latter are often little more than a guess by someone insufficiently informed to determine what is possible.

Defining Terms

The last potentially troublesome issue discussed here deals with language.

Up to this point, "continuous improvement" has been the term used. Yet, in the real world of organizations seeking quality improvement, the term often used is "continuous process improvement." There is only a one-word difference between the two, but it is a crucial difference.

"Continuous improvement" is a universally applicable term. Fundamentally, it addresses products and services—the ultimate things that customers receive and use. But it also applies to a network of related issues: customer satisfaction, processes, training, administration, management, leadership, maintenance support, design, supplier support, and so on.

The term "continuous process improvement" is not only incomplete and shortsighted, it is dangerous. It opens the door to the debilitating disease of process orientation—that management malady in which organizations that have precious little idea of where they are going are nevertheless obsessed with the details of how they are going to get there. Such organizations increasingly turn inward at the expense of their products and the customers who might use them.

Traditional methods for dealing with these and related issues reflect similar shortsightedness and danger. The errant wisdom codified in the contemporary adage, "If it ain't broke, don't fix it" provides one example. The message appears to be, "Don't meddle with things that work well." The first danger is that the message could be construed to mean "...things that *appear* to work well." Defining quality by appearances is not the recipe to survive, let alone prosper, in the coming decades. But suppose the focus is on things that really do work well, not just appearances. The message is now a charter for the *status quo,* not a better tomorrow. Organizations that follow this guide will never be all they can be; rather, they will be only what they are—only what they once were.

Problem Solving

This don't-rock-the-boat approach to quality might be expressed graphically by the Inspect-Direct Model shown in Figure 1. Organizations restrict their quality efforts to problem-solving, excluding continuous improvement. Ignoring things that "ain't broke," they seek things that are "broke" to be fixed. Problems are identified through some means of inspection: reports, visits, conferences, briefings, and so on. Once a problem has been identified, some kind of direction to do better usually follows. Then it is time for more inspection and additional direction, if the problem persists.

In *A Leader's Journey to Quality,* Dana Cound describes problem-solving as "non-elective." Problems present a compelling, immediate need for action—or, more accurately, *reaction.* Problems are easy to deal with because they stand right in front of you, demanding attention. Improvement, on the other hand, is elective: you don't have to do it. You can be satisfied with meeting specifications. The cost, though, is that you must also be satisfied with stagnation as the world advances around you. Given this, the most surprising—and disappointing—aspect of this "ain't broke-don't fix" approach is not its many adherents, but rather that in an informed, industrial society it even exists at all.

This is not to say that problems should be ignored in favor of let's-make-a-better-tomorrow improvements. Problems play an important role in the overall improvement scheme—they provide a sense of urgency. The formula for technological advancement includes availability, opportunity, and need. Nothing provides need like a screaming do-or-die problem. Consider the technical advances that occur during wartime and subsequently benefit civilian populations. Similar conditions exist during peacetime. Problems and their attendant urgencies prime the pump of improvement. The frequent misstep is that we get so involved with the urgent that we forget about the important. Cound sums it up best: "The improvement-driven organization doesn't make this mistake."

These issues and others combine to form a complex environment for those who would continuously improve. There are probably many tools and techniques available to deal with this complexity, as evidenced by the myriad offerings of publishers and consultants. One classic and powerful paradigm seems to stand out in its own right and as a base for others.

The PDCA Cycle

The Shewhart Cycle, so named by Dr. W. Edwards Deming in *Out of the Crisis,* is a time-proven paradigm for continuous improvement. Deming introduced this technique to Japanese engineers during a series of invited lectures beginning in the summer of 1950. As a result, in Japan, it has become known as the "Deming Cycle." It is also widely known in a variety of sources as the "PDCA Cycle"—an acronym for plan-do-check-act, which describes the four major functional steps of the technique. In their 1989 text, *Tools and Methods for the Improvement of Quality,* Gitlow and others summarize the cycle as follows:

> "A plan is developed (plan); the plan is tested in a trial basis (do); the effects of the test plan are monitored (check); and appropriate corrective actions are taken... (act). These corrective actions can lead to a new

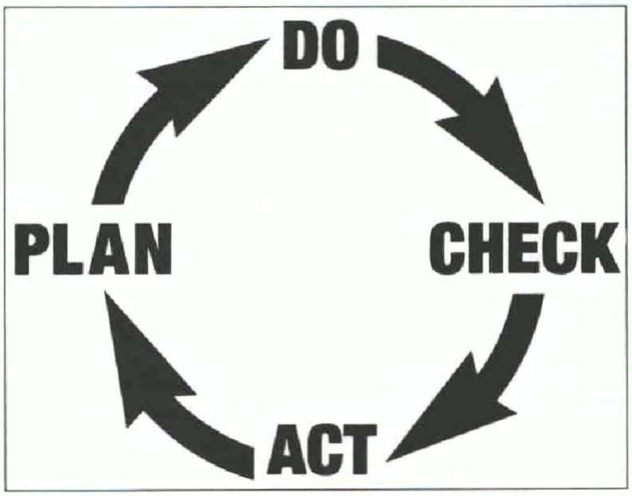

Figure 2.
The PDCA Cycle.

or modified plan, so the PDCA cycle continues forever in an uphill cycle of never-ending improvement."

This technique was not just adopted by Japanese manufacturers, it became a way of life, woven into the fabric of industrial culture, as described in *Kaizen: The Key to Japan's Competitive Success* by Masaaki Imai. *(Readers are encouraged to review this text in its entirety. It is an excellent one-stop service view of continuous improvement.)* The PDCA Cycle also enjoys some attention in the United States. William Scherkenbach discusses its American application within the context of Deming's Fourteen Points for Management in his brief but comprehensive book, *The Deming Route to Quality and Productivity: Road Maps and Roadblocks.*

A basic model of the PDCA Cycle is shown at Figure 2. In practice, the PDCA Cycle is much more than a four-word model. If it were just that, it would be little different from the Inspect-Direct model, described earlier. Instead, the four steps include a richness that is at once both singular and interactive, and which may, according to Imai, be applied in any situation.

Plan

The first step—planning—is the critical and defining difference. Thomas Berry, in *Managing the Total Quality Transformation,* breaks this step into eight substeps that address missions, activities, functions, outputs, priorities, and customers. Regardless of how the planning process is subdivided, the important issue is that it constitutes the first step. This is what sets PDCA apart from Inspect-Direct. Planning is the breakthrough that allows the necessary leap from reactive problem-solving to proactive continuous improvement.

Do

In this step, the plan is applied in the real world, usually on a test basis at first. A successful test will flush out any problems lurking in the corners and alleyways of the organization, and prevent knee-jerking the organization with every new bright idea—a not infrequent result in the Inspect-Direct model.

Imai describes an extension of this step in Japanese practice. The sequential application of the "Do-Check" steps often results in management checking on workers' performance rather than checking the effect of what was done. So, an additional PDCA Cycle is nested in the "Do" step as an internal control. This makes intuitional sense. When PDCA is implemented in an organization, it must extend throughout all levels, not remain isolated at the top while everyone else waits to be told what to do.

In other words: as part of the "Do" step, top-level management might issue instructions to all divisions, which will apply PDCA in complying; as part of their "Do" step, divisions may issue instructions to all branches, which will apply PDCA in complying; and so on down the line.

Check

As previewed above, this step involves checking, or more aptly *studying,* the effects of the "Do" step. It verifies and validates the plan and the improvement methods of the test. In *Excellence in Government: Total Quality Management in the 1990s,* Carr and Littman suggest that costs and benefits should be reviewed at this point, as well. Use of the term "check" does not imply cursory action here. Careful study of data is absolutely essential to successful improvement. Happily, this step often involves more than mere validation. The results to this point often indicate additional opportunities for further improvement.

Act

Depending upon the results of the previous step, leaders may decide to proceed, go back and modify plans, or terminate the cycle altogether as not worth the effort. Proceeding means applying the tested improvement in a more global environment, providing necessary training, and eventually instituting the change throughout the organization. Going back—usually a response to unexpected, disappointing results—means revisiting the "Plan-Do" steps and modifying them before starting again. Termination is just that: test results indicate that the improvement effort does not offer benefit sufficient to justify continuation.

Imai points out a rather unflattering aspect of Western management in discussing this step. As mentioned above, another PDCA Cycle is nested in the "Do" step in Japanese practice as an internal control measure for worker performance. Typically, this is not Western management practice. He implies that, instead, Western managers follow a PDCF cycle—"F" for "firing." If the results of the "Check" step are less than rosy, "...*firing* of workers or managers becomes a quick solution."

The last action in this step—and the single most important action of all—is to loop back to the "Plan" step and begin the next iteration of the cycle. This may mean planning wider implementation, planning modification of the test, or planning an alternate approach seeking different improvements. Whatever the goal, this essential loop is what makes PDCA a cycle—what makes it an effective tool for continuous improvement.

Conclusion

So in the end, improving quality is much like chasing rainbows. With each step forward, the goal seems to move ahead at a rate exactly equal to our own advance. But this really does not matter. We know there is no pot of gold waiting somewhere ahead. We know, instead, that pieces of gold lie easily within our reach along our path. The rainbow is there—in a better future. The gold is there, too—in the benefits of progressively better quality in products and services. And the path is there—if we choose to take it—in a deliberate and never-ending program of continuous improvement.

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RESIN TRANSFER MOLDING: TAILORABLE COMPOSITES MANUFACTURING

By Diane S. Kukich

Background

Broadly defined, composites are materials with two or more components (reinforcement in the form of fibers, fabric, whiskers, or particulates encapsulated in a matrix) that combine to yield characteristics superior to those of the individual constituents. The fibers and matrix may be combined using a variety of fabrication processes, depending on the desired alignment of fibers, the number of parts to be produced, the size and complexity of the parts, and a number of other considerations.

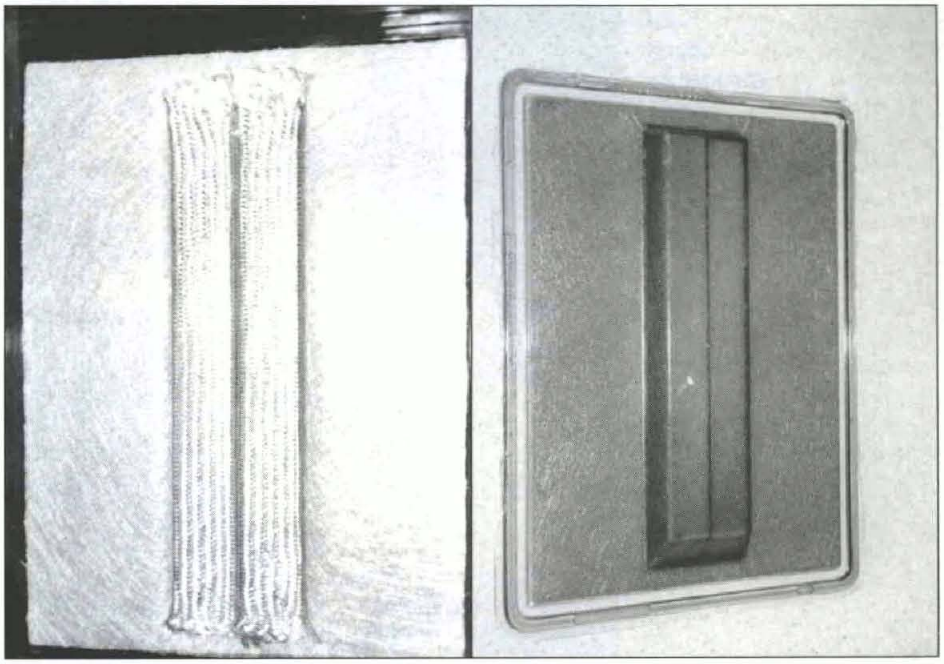
The term *liquid molding* refers to a set of processes wherein a network of fibers is first fabricated to form the "skeleton" of the part, called the preform. The preform is then placed into a tool, the tool is closed, resin is injected into it, and the part is cured and demolded, after which final finishing operations may be conducted. Resin transfer molding (RTM) is a common form of liquid molding used for automotive, aerospace, and commercial parts where low cost, high performance, and quality are required. Conceptually, the process is similar to the approach used in making reinforced concrete beams, the preform being analogous to the cement slurry.

Depending on the end application, the reinforcing preforms used in RTM can range from inexpensive chopped glass fiber mats to more sophisticated textile preforms made by braiding, weaving, or knitting fibers together in a specified two- or three-dimensional design. Preforms can be made in a wide variety of architectures (i.e., the orientation of the fibers), and several can be joined together during the RTM process itself to form a multi-element preform offering reinforcement in the specific areas and directions needed.

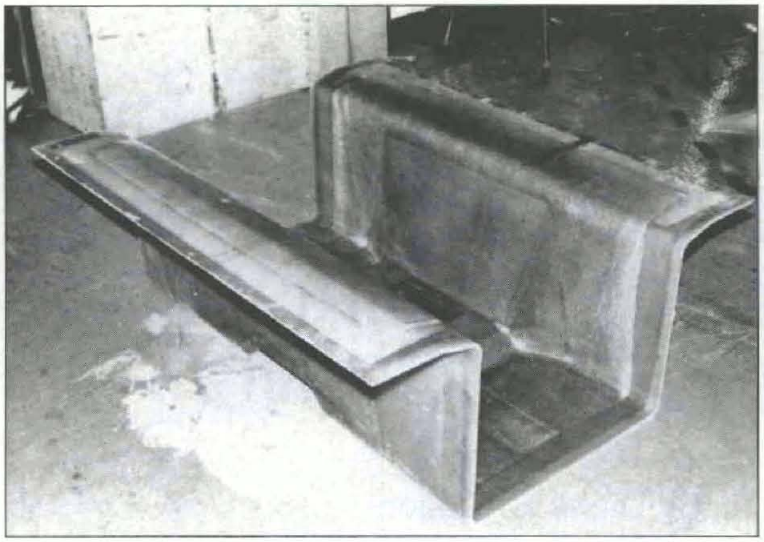
RTM has been used for about 30 years, primarily to produce non-structural parts. Recently, however, the technique has been applied more frequently to the production of structural composite parts, due largely to developments in textile preforming technology. RTM is receiving increased attention as efforts are made to find cost-effective substitutes for autoclave processing. Researchers at the University of Delaware's Center for Composite Materials—an Army Research Office/University Research Initiative Center of Excellence—are investigating several aspects of RTM, with the overall goal of making it a viable, cost-effective manufacturing method for medium- to high-volume applications. The following describes briefly several of the projects being conducted under the direction of Vistasp M. Karbhari, associate scientist at CCM and research assistant professor of civil engineering.

Automotive Structures

Among the many benefits of RTM, three are of particular interest for automotive applications: low cost, potential



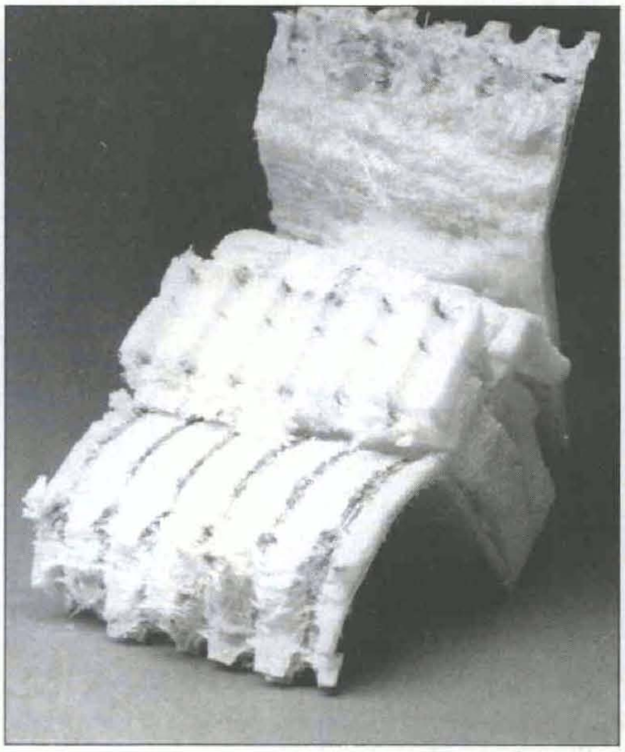
Assembly of multi-element preform structure, leading to stiffened RTM panel.



RTM Tree Harvester Bed.

for parts integration (i.e., replacing many small parts with one larger one), and the opportunity for placing reinforcing fibers in the desired directions and amounts to form an optimized preform. Automotive structures made by this process range from body panels, fenders, and hoods to entire automotive "shells." Such structures have been used by the automotive industry to make high-performance vehicles like the Lotus and formula race cars.

Due to the inherent weight reduction associated with the use of composites, RTM is also an attractive way to make automotive trailers. In a recent project conducted at CCM in collaboration with Neste Oy, a Finnish company, a lightweight trailer used in tree-harvesting operations was fabricated using RTM. The one-piece structure, comprising integrated foam cores and metal inserts, was not only lighter in weight than its aluminum predecessor but also more weather- and crash-resistant, as well as less damaging to the trees it inevitably came into contact with during use. Despite the reduction in weight, the load-carrying capacity was increased as a result of the optimized reinforcement.



Example of crush structure.

Processing/Microstructure/ Performance Relationships

To efficiently and economically construct large structures, it is essential to have information about how such factors as the fabric, or reinforcement, and the way the resin is infused, or injected, affect the final part quality and its performance under actual use conditions. To this end, both analytical and experimental research is being conducted at CCM to build a better understanding of the mold-filling process. Experimental investigations have been conducted to characterize the interrelationships among equipment and processing conditions. For example, the researchers have examined the effects of variables such as preform material type, equipment parameters, injection pressure, tool temperature, and resin formulation to assess the effects of one production variable on another and to understand how small variations in settings affect part quality and reliability.

In one investigation, it was found that the stroke length selected in the piston-type injection equipment routinely used by industry had a major effect on part quality. With the pumps used, the injection pressure increases at the outset of each stroke and then drops at the end of the stroke while the piston retracts to fill the cylinder again. With a long stroke (used to inject large amounts of resin in a single stroke), the pressure differential between the various stages is pronounced, whereas with short strokes, the pressure is more uniform. The results of such studies not only indicate the major effect that equipment can have on the overall performance of parts but also provide guidelines for improving the process and controlling each facet of it.

Impact and Blast Resistance

In RTM, the fabric is placed in the required orientation, shaped, and then filled with resin. As a result, RTM structures can be uniquely designed for resistance to damage from projectiles and various armor-penetrating treats. RTM composites present the opportunity to combine the rigid structure needed for structural performance with the flexibility required to "catch" projectiles—analogous to a baseball glove—rather than allowing them to penetrate and create damage.

In a project funded by TACOM, re-

Photo courtesy of General Dynamics Land Systems Division.

One piece RTM air intake system for the M1 Abrams Tank.

searchers are investigating the design of fabric architectures to create inexpensive yet impact-resistant structures for application to, for example, the composite armored vehicle (CAV) program. Tests are being conducted using glass fabric and vinyl ester resin with drop weight impact methods to create structures that are less expensive than traditional composites (e.g., the graphite/epoxy used on airplanes) yet still offer a high level of impact resistance. Such structures, built at thickness of half an inch and more, have been shown to withstand low- and medium-threat projectiles. Similar work is being conducted at GD Land Systems, a CCM industrial sponsor and leading U.S. Army subcontractor for armored vehicles, to create hulls resistant to blast and shock (i.e., land mines, explosions, etc.).

Such technology has a strong dual-use potential. Impact resistance, for example, is applicable to civilian automobiles, where damage due to accidents and road debris is an everyday threat. Similarly, the ability of RTM composites to withstand blast and shock would make them useful in the armored vehicles used to transport dignitaries or large sums of money and other valuables.

Marine Structures

Resin transfer molding is now being investigated as a way to fabricate low-cost, high-performance structures for hulls and decks capable of withstanding repeated wave impact. Research is being conducted on the use of foam- and balsa-filled and hollow sandwich-type structures for single and double hull construction. Such structures offer good stability during storms at sea.

The use of composites also offers corrosion resistance for both inner and outer structures. Outside, composite hulls require less maintenance than those made of metal, which have to be scraped frequently and are quickly degraded by salt water. Inside, cargo like grains and fluids can come into direct contact with composite containers because the materials are inert and do not react with the contents, as metals can. In pre-preg-type autoclaved composite sandwich structures, the core often fails to adhere to the face skins. Proper use of RTM can mitigate this potential problem.

Design, Damage, and Failure Modes

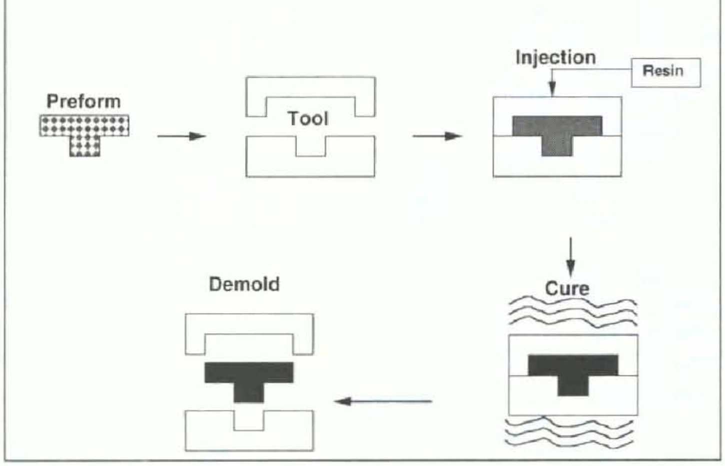
As with all high-performance materials, knowledge about, and control of, damage mechanisms and failure modes is critical to reliability in primary structural applications. A series of investigations is being conducted to assess the potential for inducing RTM structures—for example, compression boxes and crush panels—to fail in benign, repeatable, and predictable ways. In one study, stiffened-plat-type structures for use in automotive and marine applications were designed with the preform fabric to occur in a predetermined fashion, the advantage being that the user is warned before the structure actually fails. Those involved in maintenance and repair can readily determine the remaining life of a structure by assessing the current state of damage and identifying where it fits in the predetermined sequence of damage mechanisms and failure modes.

In another investigation, RTM structures are being tailored to optimize their use for "crush." In this application, the structure is designed to break catastrophically and thereby absorb as much energy as possible from impact through the use of specific trigger mechanisms (structural shapes) and tailored fiber architectures. This technology can be applied to automotive structures—front fenders and side panels, for example, which, when hit, absorb the energy of impact and prevent it from passing through to the passenger compartment.

Interfacial Investigations and Tailoring

Because the resin is infused into the fabric preform during the RTM process, it is critical that the fiber and resin form a good bond. The formation of this

SCHEMATIC OF RTM PROCESS



bond is dependent on a number of factors, the most important of which is "wet-out." Wet-out is enhanced by fiber surface preparation, or treatment of the fibers with a chemical that induces them to bond with the resin. As the preform is made of yarn bundles rather than single fibers, the resin must flow not only *along* the bundles (macro-flow, which is rather quick) but also *into* the bundles (micro-flow, which is comparatively slow). A series of experiments has been conducted to create a fundamental understanding of resin flow behavior through different architectures (i.e., various types of weaves, knits, braids, etc.). The researchers are also interested in identifying the effect of various sizings and binders on flow and performance and in the relationship between micro-flow and macro-flow.

Fabrication of Multi-Element Preforms and the Use of Inserts

With RTM, various types of fabric can be placed in different local areas of the preform in order to achieve specific properties (i.e., strength, flexibility, etc.) that may differ from one of these areas to another. This benefit brings with it the problem of how to join these various elements either along or through the thickness of the composite. A series of investigations is being conducted to assess various means of joining preform elements in an optimized way from the viewpoints of both structure and resin infusion. One of the problems to be solved is that at the point where the two fabrics meet, there is a zone of weakness which is likely to consist of just resin and therefore to have low performance levels. Analytical and experimental means are being used not only to develop a scientific knowledge base but also to establish guidelines in terms of tradeoffs among design flexibility, processing, placement ease, and final performance of such jointed structures. This is critical information because the structure is only as strong as its weakest internal joint.

Although it is conceivable that an entire tank, car or airplane could be made using RTM, this would be neither efficient nor sensible. Thus, it is important to consider means of joining or attaching RTM composite components to components made of, for example, metals or other composites. Since the preform can be designed and placed before the composite is formed, metal inserts can be placed within the preform and co-cured (i.e., molded as an integral unit within the composite). Thus, a leaf spring can be joined into an automotive structure, or two composites can be attached to each other by bolting without drilling holes that could damage the materials.

Conclusion

Although RTM presents the opportunity for creating a "material by design" (i.e., a material that has properties varying from one point to another to meet the requirements of the intended application), the method is not appropriate for all structures and cannot replace other composites fabrication processes—including filament winding, thermoforming, tape laying, pultrusion, injection molding, and fiber placement—for all applications. RTM does provide an economical means for making both complex and simple parts, and it opens new doors for the use of composites in DOD-related and civilian applications.

DIANE S. KUKICH is an editor at the Center for Composite Materials at the University of Delaware. For more information about the RTM work described in this article, contact Dr. Vistasp M. Karnhari on (302)831-6808 or fax (302)831-8525. Computer simulations of flow behavior are being developed by two other CCM-affiliated faculty, Suresh G. Advani, associate professor of mechanical engineering, and Antony N. Beris, associate professor of chemical engineering.

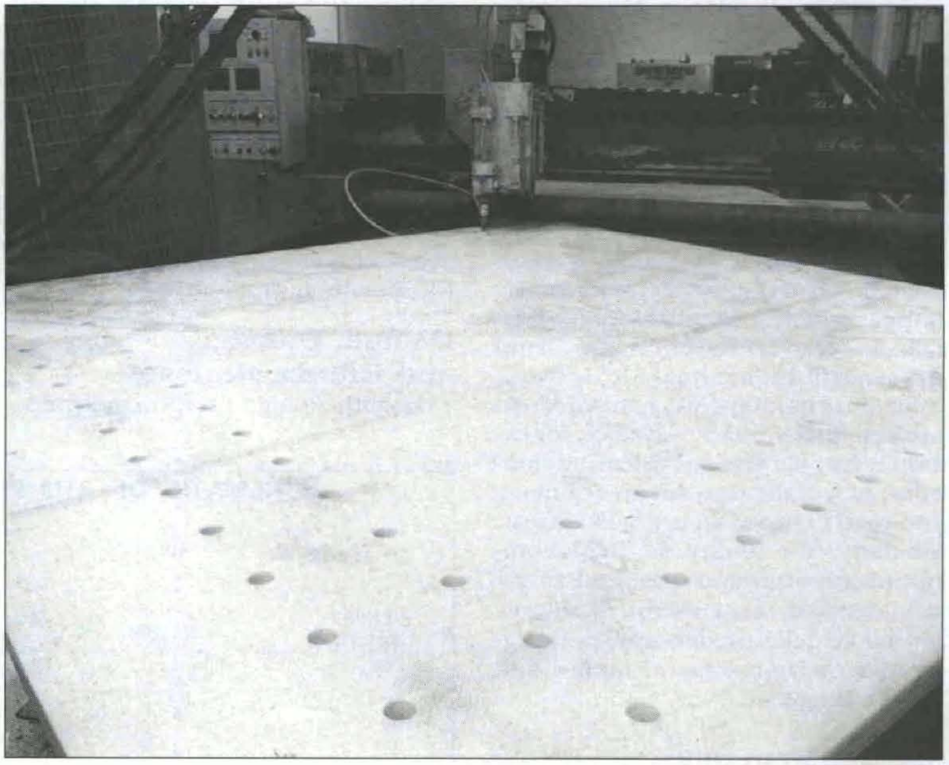


Photo courtesy of General Dynamics Land Systems Division

RTM composite hull floor specimen.

TRAINING WITH INDUSTRY

A Walk In the Other Guy's Shoes

By MAJ John N. Lawless Jr.

Introduction

During the past year, I was privileged to be a participant in the Training With Industry (TWI) Program, one of the Army's most exciting and rewarding learning experiences. Unlike traditional courses of instruction, my classroom consisted of the sprawling manufacturing facilities of the Sikorsky Aircraft Division of United Technologies Corporation, one of the world's largest defense contractors. My instructors were many of the more than 11,000 employees who work there.

Last year, a total of 31 officers in functional areas 51 (research and development) and 97 (contracting and industrial management) trained at some 22 companies, among them such industry leaders as General Electric, Raytheon, and Martin Marietta. While my experiences at Sikorsky were uniquely my own, they are in many ways typical of those encountered by my fellow TWI officers.

Background

The TWI Program was established to give selected Army officers the opportunity to learn firsthand how the private sector operates. Initiated during the 1970s, the program took on added emphasis when the Packard Commission, the Defense Management Review, and similar studies concluded that much of the expense of major weapon systems could be attributed to a lack of knowledge and experience among government personnel. To correct these deficiencies, the Defense Acquisition Workforce Improvement Act (DAWIA) of 1990 mandated that each service establish a corps of highly trained, educated, and experienced acquisition professionals.

TWI supports DAWIA in a unique and valuable way. The objectives of the TWI Program are to learn how private industry conducts business, obtain training in industrial procedures and practices which is not available in service schools, provide a nucleus of officers trained in higher-level managerial techniques, and serve as a source of information concerning innovations in industrial management practices and techniques. Once the TWI officer is integrated back into an Army organization, he can then apply this knowledge and experience to better interact and conduct business with industry.

Of particular significance is the tremendous amount of support given the TWI Program by industry participants. Defense contractors recognize the importance of having knowledgeable government counterparts, and work diligently to help officers gain insight, understanding, and knowledge of how the private sector functions. Without such enthusiastic support, the TWI Program would be mediocre at best.

Nomination and Selection

The U.S. Army Personnel Command (PERSCOM) solicits applications each year between October and December. Interested officers submit an application, consisting of a resume and a completed DA Form 1618-R, in accordance with Army Regulation 621-1. Professional development officers screen the applications and nominate those officers judged to be competitive for continued military service and demonstrating the potential to meet the

Defense contractors recognize the importance of having knowledgeable government counterparts, and work diligently to help officers gain insight, understanding, and knowledge of how the private sector functions.

desired learning objectives. PERSCOM then convenes a board to select those officers who clearly appear best suited to meet the program objectives.

During February and March, PERSCOM sends the resumes of selected officers to the appropriate functional area program manager. To the extent possible, officers are paired with industries according to their background and experience (aviators with aerospace companies, for example). Following the program manager's review, the resumes are forwarded to the appropriate companies for approval. Once an officer is accepted by the company, the program manager directs PERSCOM to place the officer on orders for training. Officers are usually notified of their selection during the month of April.

Getting Started

In the summer, a conference is held to introduce officers selected for TWI to their industry coordinators, who serve as the principal points of contact within each company. In addition, PERSCOM and the proponency offices present information briefings and answer questions concerning the program. Representatives of the U.S. Army Student Detachment (USASD), to which officers are assigned for the duration of the program, conduct inprocessing and provide information on personnel, finance, travel, and other administrative matters.

Since many of the companies are located hours from the nearest military facility, the support provided by USASD is particularly important. Still, arranging for rental housing and utilities, setting up delivery of household goods, and finding local physicians and dentists can be daunting tasks for families accustomed to living on large Army installations. Trying to cash an out-of-state check with an out-of-state driver's license, while routine at any post exchange, can be a frustrating experience, and military identification cards carry little weight away from military communities. Life "on the outside," like life in the Army, can take a little getting used to.

My first week at Sikorsky consisted of company inprocessing and a new employee orientation. I was issued a security badge identical to those worn by company personnel which, together with my civilian coat and tie, rendered me indistinguishable from regular Sikorsky employees. (One of the objectives of TWI is to fully integrate participants into the company's day-to-day operations, and maintaining an inconspicuous appearance helps to accomplish this). In addition, the markings on my badge allowed me unescorted and virtually unrestricted access to all of the company's manufacturing and design facilities, a privilege which would be unheard of under ordinary circumstances. I spent the balance of my first week meeting with my industry coordinator, with whom I completed my training schedule and refined my training plan.

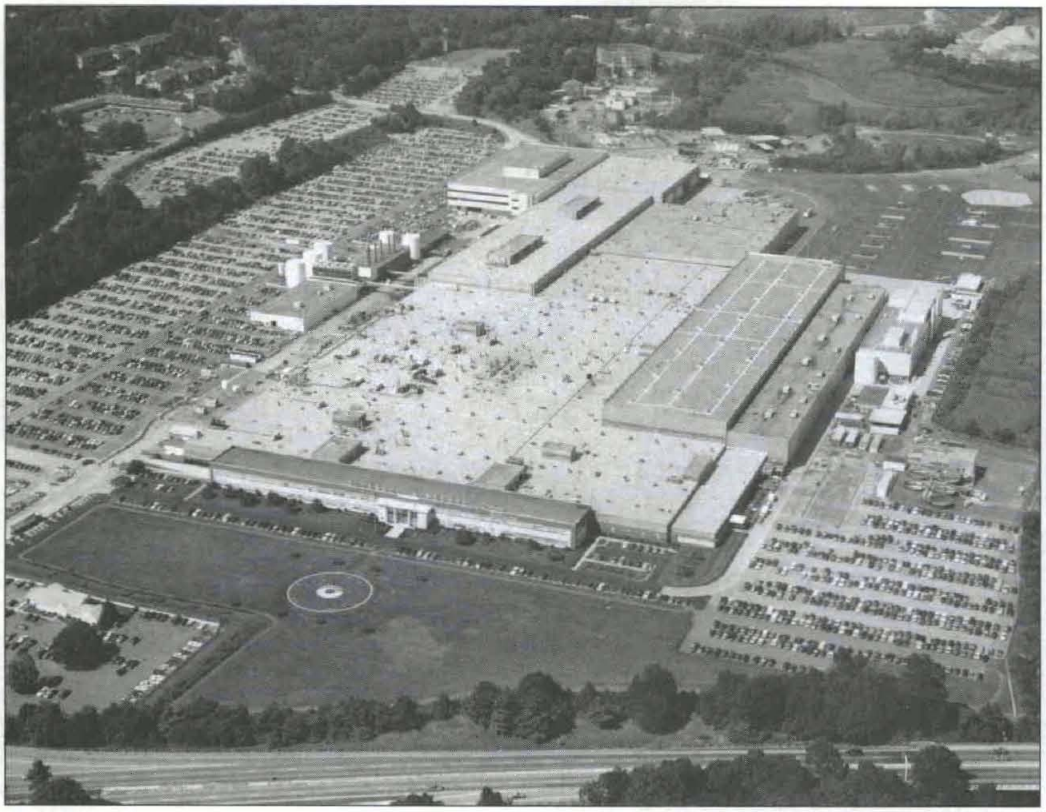
The UH-60L BLACK HAWK, the Army's primary utility helicopter, is manufactured by the Sikorsky Aircraft Division of United Technologies Corporation.

Company Overview

The on-site training plan, which serves as a blueprint for the program, is initially prepared by the industry coordinator, who discusses it with the TWI officer upon his arrival and makes changes as appropriate. Although specific learning objectives have been established for TWI, the organization and conduct of the program are left to the individual companies. Some tend to be rather formal, while others are less structured. At Sikorsky, I was given a great deal of flexibility in modifying the training plan to build on my previous experience and to incorporate my personal training goals.

My training plan was organized into two distinct phases. The initial phase, an in-depth overview of the company, included meetings with scores of Sikorsky managers, from foremen and line supervisors to directors and vice presidents. Our discussions focused on how each manager's duties and responsibilities were integrated into the overall organization, as well as their functional relationships with other managers. I had the opportunity during this phase to become familiar with each of the operations centers by which the company is organized, including such activities as manufacturing operations, industrial engineering, finance, design engineering, production control, purchasing, manufacturing engineering, product integrity, and worldwide customer service. Finally, I toured each of Sikorsky's manufacturing facilities to observe the entire process in detail, from the receipt of raw forgings and sheet metal to delivery of a completed aircraft.

Sikorsky Aircraft is a world leader in the design and manufacture of advanced helicopters for military and commercial uses, and they occupy a



United Technologies' Sikorsky Aircraft facilities based in Stratford, Connecticut.

dominant international position in the intermediate to heavy range (9,900-pound to 70,400-pound gross weight). Sikorsky helicopters are currently used by every branch of the U.S. armed forces, the military services of more than 30 countries, numerous state and local governments, and commercial operators around the globe. Core aircraft programs are the H-60 series (including the U.S. Army BLACK HAWK, U.S. Navy SEAHAWK, and their derivatives), the CH-53E/MH-53E heavy-lift helicopters, and the S-76 commercial transport.

Sikorsky is based in Stratford, CT, with additional manufacturing facilities elsewhere in Connecticut, as well as in Florida and Alabama. The total area of buildings owned or leased by Sikorsky comprises about four million square feet, and 1992 revenues exceeded $2 billion. Sikorsky is established in the international market with licensing agreements with Westland in the United Kingdom, Mitsubishi Heavy Industries in Japan, and Korean Air. In addition, Sikorsky and Korean Air are co-producing BLACK HAWK helicopters for the Republic of Korea.

Work Assignments

During my company overview, which spanned some nine weeks, I developed an appreciation for the tremendous complexity not only of the product itself but of the process by which it is designed, manufactured, and supported. Even more impressive is the dynamic nature of the organization, which enables the company to respond rapidly and effectively to changes or problems as they occur. The second phase of my training gave me the opportunity to become an active participant in this elaborate enterprise.

Perhaps the most rewarding (and challenging) feature of the TWI experience is the chance to become a productive member of the company. After being saturated with the structure and operation of the firm, officers are given specific work assignments in which they can make an active contribution.

While the number and duration of work assignments may vary from company to company, most TWI participants agree that they had a significant amount of input into the departments they would visit and the functions they would perform. Logically, these duties should be related to the officer's specialty, so a research and development officer might arrange for a stint in design engineering while a contracting officer could spend time with manufacturing or purchasing. Still, since each function in the organization affects both the product being manufactured and the company's bottom line, there are valuable lessons to be learned in every department.

At Sikorsky, I had three work assignments of 10 weeks each, the first of which was in the supplier quality section of product integrity. This office has responsibility for ensuring that parts and supplies purchased from subcontractors conform to Sikorsky's, and ultimately the customer's, quality standards. During this assignment, I visited several suppliers in the local area with a Sikorsky source manager, whose primary duty is to perform acceptance inspections at points of manufacture. Later, I was assigned to an audit team to perform on-site evaluations of suppliers' quality programs. In addition to developing a working knowledge of quality systems, my assignment in product integrity allowed me to see and compare a variety of different vendors, both large and small, outstanding and average.

Next, I joined the assembly and flight operations center, which is responsible for the final assembly, inspection, flight test, and ultimately the delivery of chasing system. During a previous assignment as a contracting officer, I was often frustrated by the tremendous amounts of time and paperwork consumed in executing simple, routine contracts and purchase orders. Much of this inefficiency could be attributed to a lack of adequate automation, so I was anxious to learn the capabilities and limitations of Sikorsky's system and any possible applications for the government.

Investment in the Future

It would be difficult to overstate the tremendous value that TWI has had for me both personally and professionally. I am grateful to the many Sikorsky employees who gave freely of their time and expertise to make my program so worthwhile. No classroom instruction could ever capture the depth and breadth of experience I enjoyed there.

Both the Army and the companies selected to participate have demonstrated tremendous support for the TWI Program. They recognize the inestimable advantages of having an acquisition workforce that is both knowledgeable of and empathetic with the private sector. As government and industry leaders prepare for an uncertain future with diminished resources, it is reassuring to know that such a valuable program continues to flourish.

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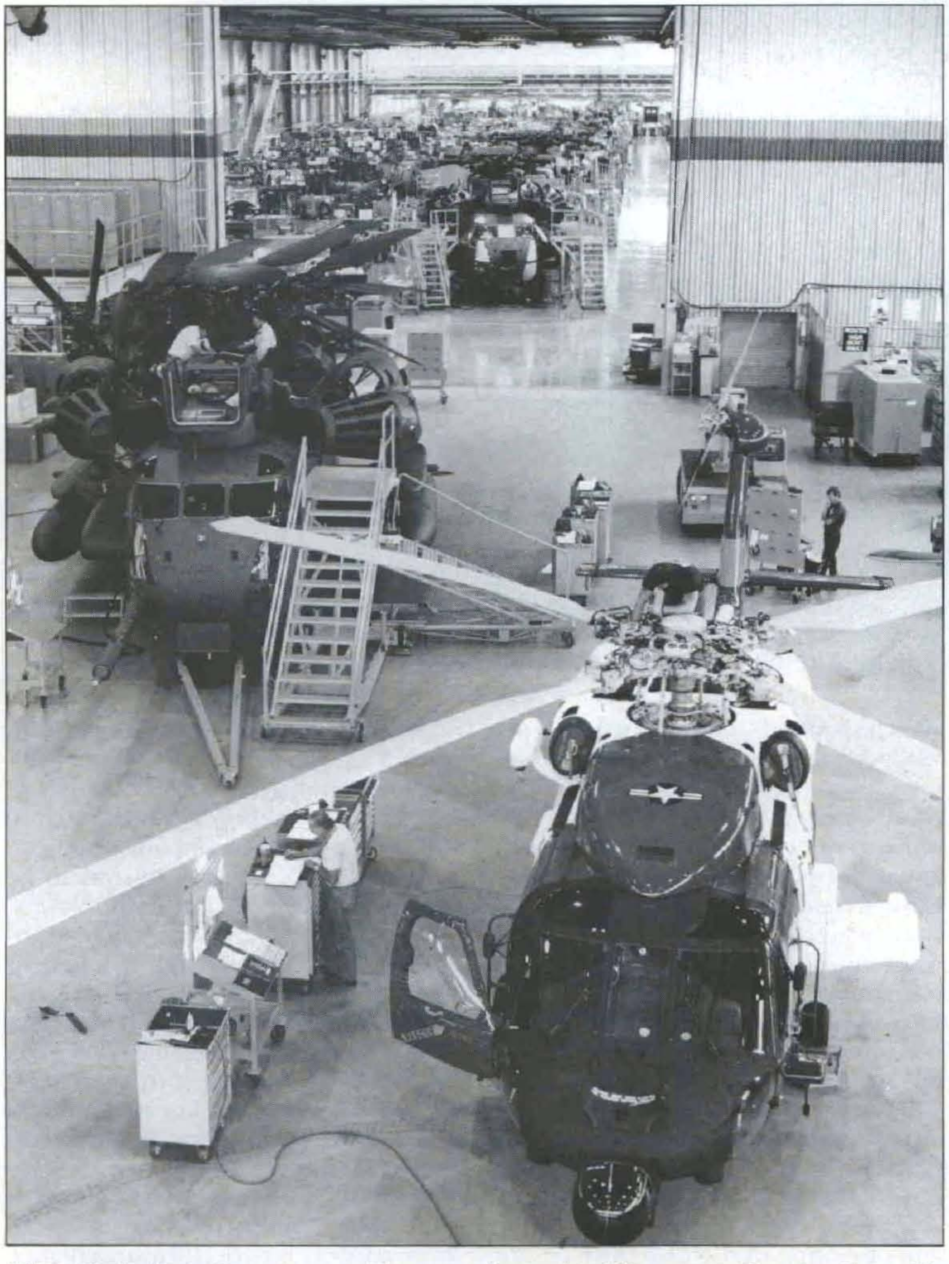

Sikorsky helicopters are used by every branch of the armed forces, the military services of more than 30 countries, numerous state and local governments, and commercial operators around the globe.

production aircraft. I became involved in a problem concerning the interior acoustic panels used on several SEAHAWK models. Solving this seemingly innocuous problem required extensive coordination among various entities in the company, each with its own concerns and perspectives. Here I was able to observe firsthand the manner in which a complex organization addresses a deficiency and works together not only to resolve it, but to prevent its recurrence. I was particularly impressed with the application of total quality management techniques in reaching an effective solution.

My final rotation was in the purchasing department, where I concentrated my efforts on becoming familiar with their automated pur-

SELF-HEATING INDIVIDUAL RATIONS

A New Concept for Military Feeding

By Lauren Oleksyk
and CPT(P) Kenneth Anderson

Background

The U.S. Army Natick Research, Development and Engineering Center is involved in an intensive Continuous Product Improvement Program for the standard individual combat ration, the Meal, Ready-to-Eat (MRE). In addition to the new entrees, and snacks, desserts, beverages and candies that have been added to the MRE, a Flameless Ration Heater (FRH) has also been included in the MRE meal bag beginning with MRE XIII. The FRH is a lightweight, water-activated heating device which provides every individual soldier who receives the MRE XIII a quick and easy way to heat the entree.

To continue to enhance the individual combat ration for use on the future battlefield, the Quartermaster Center and School (QMC&S) has identified a need for a lightweight, self-heating, shelf stable, nutritionally complete, individual ration packaged in a form familiar to the soldier. The ration must be conveniently handled by the individual soldier in diverse scenarios, particularly in a stationary defense situation.

The new self-heating ration will contain an entree packaged in an alternative primary package such as a formed, plastic tray as opposed to the flexible pouch used in the MRE. Developers envision that the self-heating individual ration will be issued during periods of high intensity conflict or when a tactical and/or logistical situation will not support group feeding systems.

In response to the QMC&S requirement, the initial effort by Natick involved the rapid development of the Meal, Ordered Ready-to-Eat (MORE), which consisted entirely of commercially available, individual shelf stable foods packaged in a plastic menu bag (Figure 1). The MORE addressed the potential production shortfalls and lag time between start-up and full scale production of fielded operational rations.

Subsequent to the MORE, Natick developed the Self-Heating Meal, Ordered Ready-to-Eat (SMORE). The SMORE incorporates the commercial aspects of the MORE. However, components are contained in a biodegradable tray with a preplaced, commercially available heat source to add a self-heating capability (Figure 2). The biodegradable tray incorporates two water-activated, exothermic chemical heating pads identical in composition to the FRH.

Figure 1.

The operational concept of the MORE and SMORE is to use recognizable commercial shelf stable items including entrees packaged in semi-rigid polymeric trays, fruit and pudding cups, beverages and desserts. The availability of these commercial items aids in the management of this system by expediting procurement of the ration components by avoiding lengthy lead times required by some contractors.

Although the MORE and SMORE would serve as a contingency ration during the early stages of mobilization and provide added variety, they do not meet the full spectrum of the Military Service Requirements for Operational Rations. Therefore, they are designed to augment the "family of operational rations" and not directly replace operational rations.

Research and Development

To satisfy the future needs of the combat services support force structure, Natick is developing a variety of Self-Heating Individual Ration (SHIR) concepts that exploit the latest advances in packaging, food and heating technologies and industry trends.

The SHIR will provide a variety of high quality meals in all tactical operations and climatic conditions, and will meet the needs of the integrated, non-linear, highly mobile and dispersed future battlefield. The SHIR concept utilizes commercial components whenever possible to provide foods familiar to the user and to ensure a viable production base for wartime surge production. Since the future battlefield scenario dictates the development of an individual "heat-and-eat" ration, the SHIR provides an individual soldier in a forward or remote area with a self-heating, ready-to-eat meal in a convenient packaging configuration.

Several SHIR concepts are being developed under the Family of Operational Rations program for a series of technology demonstrations scheduled to occur between 1993 through 1995. The Self-Heating Individual Meal Module (SHIMM) is one of the SHIR concepts successfully demonstrated to Army mechanized units in FY92. The original prototype SHIMM developed by Natick consisted of two modules: a self-heating entree module and an eat-out-of-hand module (Figure 3).

The self-heating entree module consists of 10 ounces of food packaged and thermally processed in a high-barrier plastic food tray. The food tray is attached to a bottom plastic tray that contains a chemical heater positioned under the entree, and an activator pouch containing a liquid positioned adjacent to the heater. The chemical heater is activated by pulling a tear strip to release 50 milliliters of water from the integrated pouch. The resulting safe chemical reaction increases the initial temperature of the entree (unfrozen) by approximately 100 degrees Fahrenheit in 12 to 15 minutes.

The eat-out-of-hand module contains snacks, bread and accessories similar to those in the MRE. Natick conducted initial demonstrations with field soldiers who indicated the self-heating concept was highly acceptable. However, the two module packaging configuration was considered to be bulky, generated excessive packaging waste and required further ruggedization. Therefore, a new SHIMM prototype was designed and consisted of the self-heating entree and a full assortment of components and accessories available in the commercial and military supply system packaged in a meal bag similar to the MRE.

New Concepts

Several new SHIR concepts are being developed by Natick for FY93 and

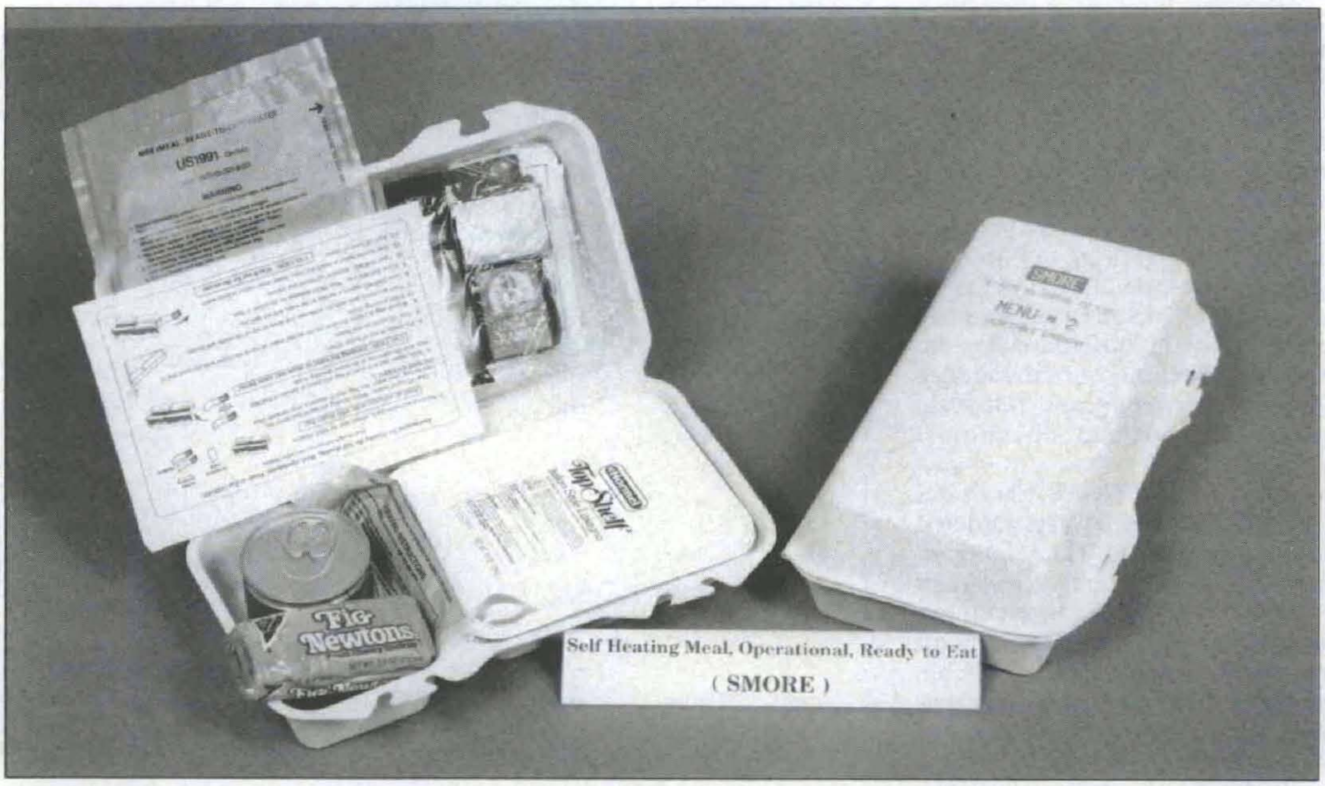

Figure 2.

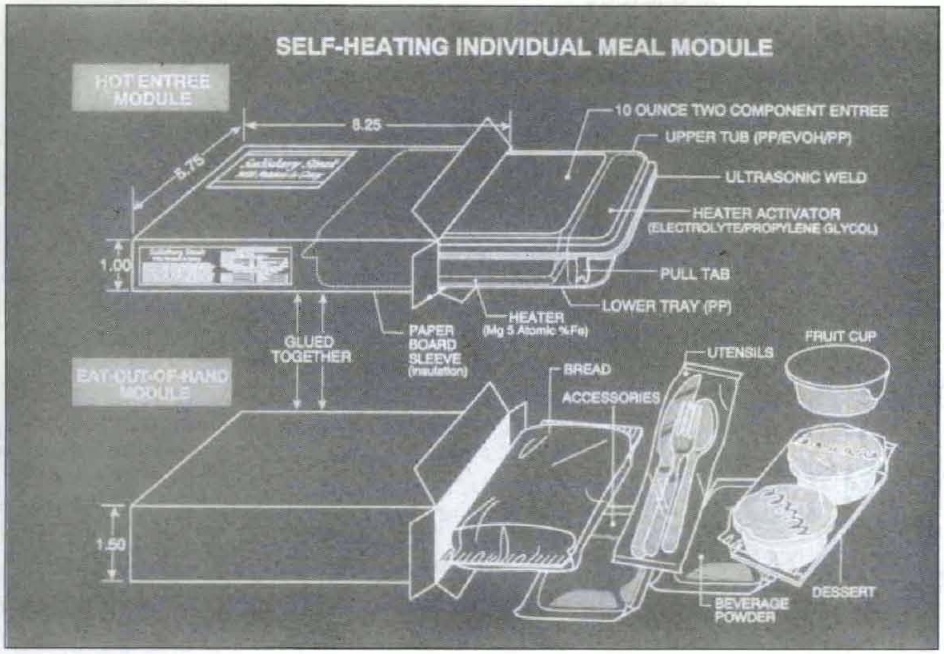

Figure 3.

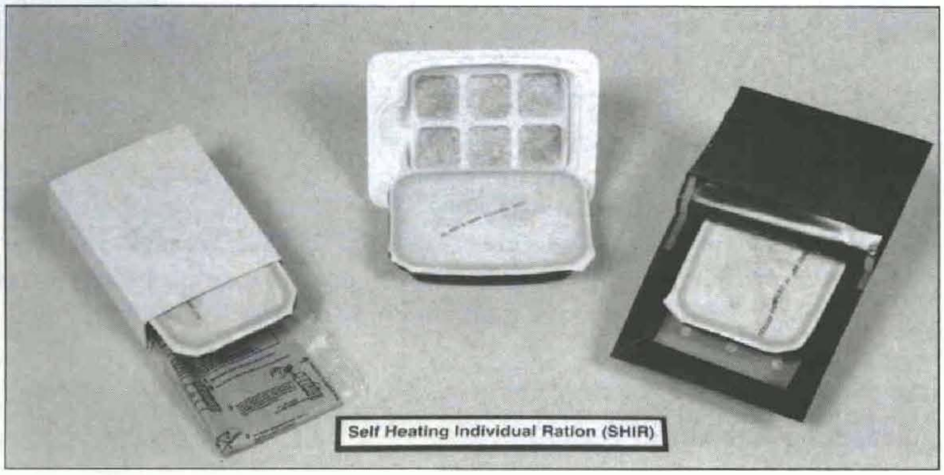

Figure 4.

FY94 technology demonstrations (Figure 4). Unlike the SHIMM, in which the food, heater and activating water are all integrated into the same package, these new concepts represent partially integrated self-heating meals.

The new SHIR concepts consist of commercially available shelf stable meals with integrated chemical heaters, but do not contain the activating water pouch. Instead, the user adds approximately 50 milliliters of water to the package to initiate the heating reaction at his or her own convenience. The elimination of an activating water pouch was thought to be more readily producible by the commercial sector.

In keeping with the demand to utilize nondevelopmental items whenever possible, the newer SHIR concepts contain a commercially available 10 ounce shelf stable meal tray currently produced by several food manufacturers. One concept integrates the meal tray and chemical heater in a plastic heating bag on which pictorial instructions are printed. The bag directs the user to add water up to the fill lines on the bag, similar to the FRH.

A second SHIR concept consists of the same meal tray and chemical heater, but the heater is formed into a molded plastic tray that "snaps" onto the bottom of the meal tray. The user is instructed to fill the bottom tray with water to activate the chemical heater. A third concept integrates the meal tray and chemical heater inside a flexible tray produced on form-fill-sealing equipment. Water is added to the level of the fill lines preprinted on the flexible tray.

Prior to demonstrating the SHIR concepts with soldiers, prototypes will be subjected to heating performance, rough handling, preliminary acceptance tests and initial cost and producibility assessments. In addition, prototypes will undergo a complete Manpower and Personnel Integration review to ensure that all human factor and safety issues are addressed.

After the preliminary reviews, a three to five day small scale technology demonstration of several SHIR concepts will be conducted by Natick in 4th Quarter FY93. Objectives of the technology demonstration include soldier evaluations on the overall effectiveness of the various heating concepts, adequacy of operational instructions, ease of utilizing the self-heating devices, packaging configuration and durability, time required to heat the entrees, temperature and acceptability of the entree after heating, overall food component acceptability and user safety.

All SHIR concepts will be demonstrated to potential item users as the entree component of MRE XIII during normal lunch periods. Natick's successful development of a self-heating individual ration will ensure that every soldier can enjoy a hot operational meal anytime, anyplace.

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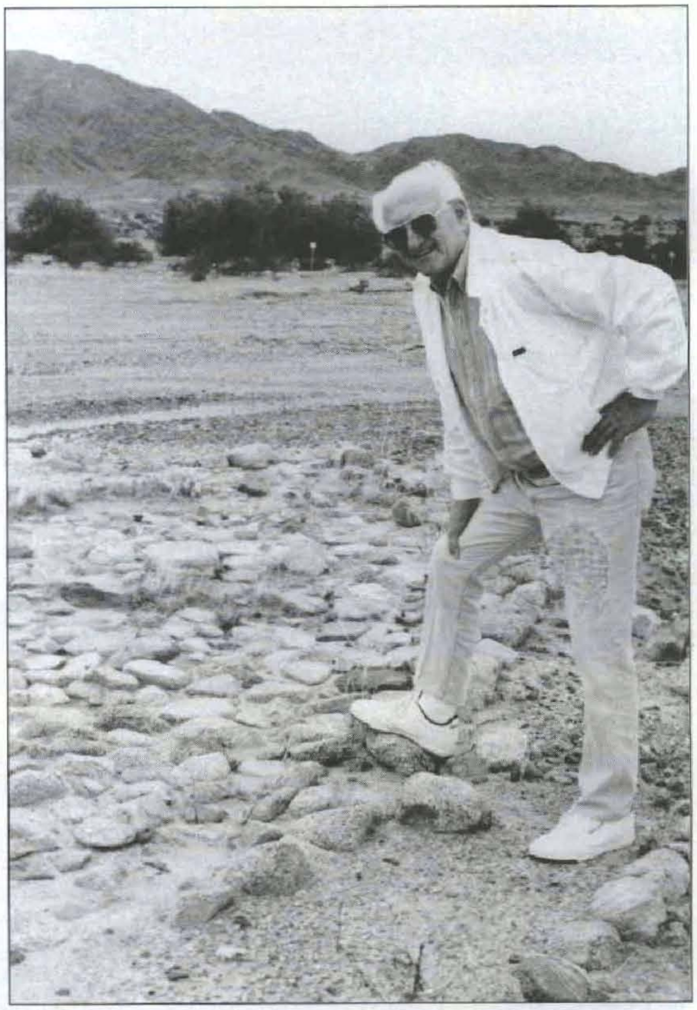
CPT(P) KENNETH E. ANDERSON is assigned to the U.S. Army Natick Research, Development and Engineering Center as the research and development coordinator and military assistant to the director, Food Engineering Directorate. He holds a bachelor's degree in food technology from Pennsylvania State University and is currently working on his master's degree from Penn State.

Looking Back 50 Years...

VETERAN VISITS WORLD WAR II TRAINING SITE



Howard Hardrath views the desert training site where he spent many memorable World War II months.

By Chuck Wullenjohn

Camp Laguna, an important part of World War II's Desert Training Center, was once the temporary home of tens of thousands of American soldiers. Living in primitive conditions in the midst of the harsh Arizona desert in what is now U.S. Army Yuma Proving Ground, Camp Laguna's soldiers resided in canvas tents and trudged many miles in forced marches under the hot sun. The purpose of the challenging training was to prepare soldiers for a severe life of combat in the deserts of North Africa or one of the other fighting fronts.

Typically arriving in Yuma aboard special passenger trains operated by the Southern Pacific Railroad, the mostly-drafted soldiers were loaded aboard trucks for the bumpy 25-mile drive to the desert camp. Many were experiencing the rigors of the desert for the first time.

Howard Hardrath was one of these men. A platoon sergeant in Company C, 313th Infantry Regiment, of the 79th Infantry Division, Hardrath was a young man in the prime of his life. His unit was made up of a combination of draftees and soldiers who had volunteered for duty and had recently participated in maneuvers in Tennessee. He arrived July 14, 1943, and departed on Dec. 5 of the same year.

"The officers showed unusual regard for us when we arrived," said Hardrath as he recently toured the World War II campsite. "They barely let us out of our tents for the first 10 days we were here. Their intention was to let us acclimatize to what was a new experience for nearly everyone."

After 10 days, the men were taken on an evening march through the desert. According to Hardrath the uniform-of-the-day featured helmet liners, boots and socks, and "GI shorts." "Even in the evening it was hot," he emphasized.

Later, the soldiers began to wear full field gear and to go on forced marches any time of the day or night. One time Hardrath's division was absent from Camp Laguna for a full month while taking part in maneuvers which took them dozens of miles north.

Hardrath particularly remembers the "water training" that the men of his unit underwent. "For a long time, they tried to limit us to one quart of water per day," he said. "This was the equivalent of a single canteen-full and it too often just

World War II cargo bound for Camp Laguna is unloaded from box cars. The vast majority of supplies moved to Yuma by rail during the war years.

An unidentified soldier stands in front of his company street at Camp Laguna.

wasn't enough. I can remember people keeling over and fainting due to the heat and lack of fluids."

Hardrath doesn't remember much about the town of Yuma during those years, saying that bus service between Camp Laguna and the town was nonexistent and he was able to hitch a ride on an Army truck only twice.

"Yuma was a small town then," he said, "but I remember the Native Americans selling jewelry and crafts at the train station and the watering holes that filled the town. Those joints were really popular among the soldiers and they really guzzled the beer."

As for life at Camp Laguna, Hardrath says it was primitive and tough. "We lived in canvas tents the entire time we were there," he said. "The only wooden structures I remember were the cook shacks, which were made of mesh screen and wood. We ate from our mess kits and used the forks, knives and spoons the Army issued. We didn't eat off decent plates once."

Aside from the obstacles and inconveniences, Hardrath recalls many good things resulting from the experience. "This desert training didn't necessarily teach us all about combat, but it sure made us tough. The people who couldn't take the punishment dropped out of the unit and were sent someplace else. Those who made it were transformed from boys into men—men ready for the rigors of active combat."

"To my knowledge, nearly everyone who went into the field with my company, aside from the support people, was hit by enemy fire," said Hardrath. "This included both officers and men. Even I was hit in the leg after fighting the Germans in France for 31 days. I spent a year in the hospital after that."

Hardrath's experience at Camp Laguna was harsh and demanding, and it remains etched in his memory, though 50 years have passed. Currently a resident of Atlanta, GA, he well remembers his "sojourn in the desert" as a time when maturity blossomed and difficult obstacles were overcome.

Today, 50 years later, U.S. Army Yuma Proving Ground is the Army's desert environmental test center, working with a wide variety of weapon systems—from M-1 Abrams tanks to Apache helicopters. The 1,800 military and civilian Yuma Proving Ground community—and the entire Department of Defense—truly salute those who came before.

CHUCK WULLENJOHN is chief of the Public Affairs Office at the U.S. Army Yuma Proving Ground. He is a graduate of Humboldt State University in California.

THREE CASE STUDIES ON TECHNOLOGY PARTNERSHIPS

By Dana L. Finney and Jeffrey J. Walaszek

For the past decade the U.S. Army Construction Engineering Research Laboratories (USACERL) has been extremely active in technology transfer. The main thrust of USACERL's technology transfer efforts has been to deliver products into the hands of its military customers. Establishing a partnership with the private sector and university community has been a critical part of USACERL's ability to deliver quality products to its customers. USACERL and other Corps of Engineers laboratories recently expanded their efforts to form partnerships through the Construction Productivity Advancement Research (CPAR) program and other initiatives.

One of the first successful partnerships for USACERL was with APS Materials, Inc. Under an exclusive licensing agreement in 1984, APS received rights to USACERL's ceramic anode. The ceramic anode is an innovative component of cathodic protection systems that prevent corrosion of steel structures.

The agreement with APS Materials benefitted the Army and non-military users by providing a commercial source for purchasing the ceramic-coated anodes. In addition, APS has developed several other versions of the anode for use on water towers, lock gates, hot water heaters, and underground storage tanks. The USACERL and APS Materials partnership continues to thrive almost 10 years after it began.

USACERL's efforts took a new direction when the program was authorized under the 1988 Water Resources Development Act. CPAR is a cost-shared partnership between the U.S. Army Corps of Engineers laboratories and the U.S. construction industry, universities, state and local governments, and private groups. The objective of CPAR is to facilitate research, development, and application of construction related technologies through cooperative research and development (R&D), field demonstrations, licensing agreements, and other forms of technology transfer. CPAR was initiated by then Assistant Secretary of the Army for Civil Works Robert Page and supported by Congress.

CPAR is different from other government research programs in that:

- research ideas and proposals are generated by industry, not the government;
- CPAR projects are fully cost-shared partnerships between the Corps and industry—the federal share can be up to 50 percent of the cost; and
- rapid transfer and application of R&D results are facilitated by the commercial partner who already has a vested interest in the technology.

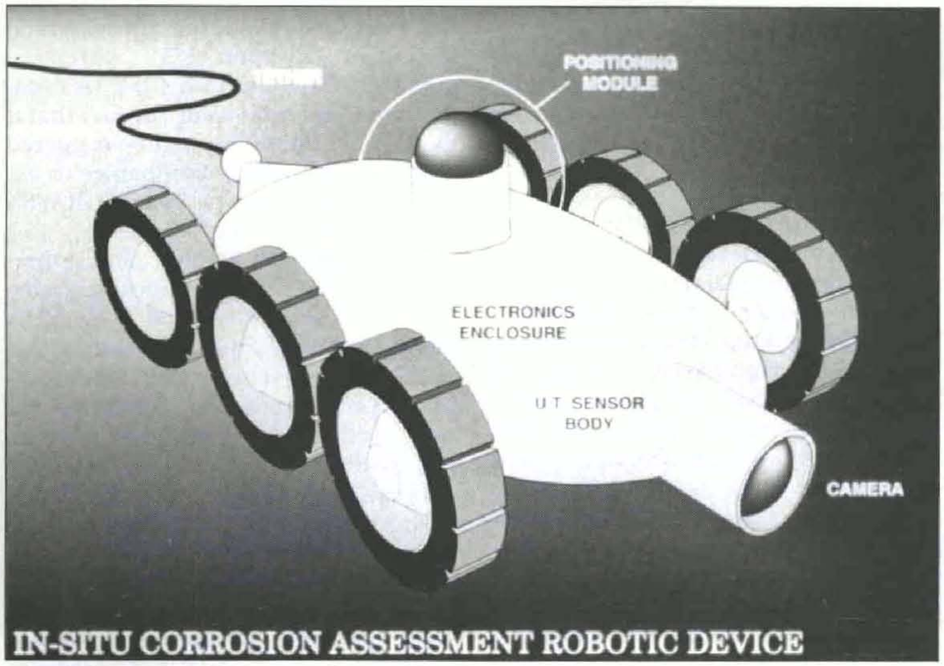
This article contains two case studies describing the types of partnerships established under the CPAR program. The third case study describes another interesting partnership which has emerged from the fielding of USACERL's Geographic Resources Analysis Support System (GRASS).

GRASS is a geographic information system (GIS) and image processing tool designed to assist Army personnel responsible for land management. Intense interest in this public domain software from public and private agencies resulted in a network of formal and informal partnerships. These partnerships provide for both coordination of research and support to the many public and private sector users of GRASS.

Recycled Plastics for Construction

In one CPAR project at USACERL, research is being funded jointly by the Corps, Rutgers University at Piscataway, NJ, and several other partners to develop construction materials from commingled waste plastics. Included in the partnership are 20 plastic lumber manufacturers and the New Jersey Department of Environmental Protection. They will contribute funds, products and services to support the project. For example, the plastic lumber companies will donate various products for testing and provide consultants during construction.

The plastic lumber is not anticipated to replace all of the wood in construction. It is of primary interest for replacing products now made of treated wood. With plastic's natural resistance to rot as well as chemical and insect attack, plastic lumber is ideally suited for use in soil, high humidity environments, water immersion, and other corrosive environments. Plastic



Design concept for robotic inspection system.

lumber has been used in making park benches, picnic tables, and similar items; outdoor decks, and a variety of marine structures such as small boat docks and pilings.

Several U.S. manufacturers are making plastic lumber and timber products from commingled waste plastics. However, these materials have seen low acceptance in the construction industry, primarily due to incomplete information on their mechanical properties and long-term performance, and to the lack of standards for their manufacture and use. The CPAR project will seek to develop standards and specifications for these plastic lumber and timber products after completing tests on the mechanical and other performance properties. An activity focusing on plastic lumber has been organized within the American Society for Testing and Materials (ASTM) under Committee D-20, Plastics.

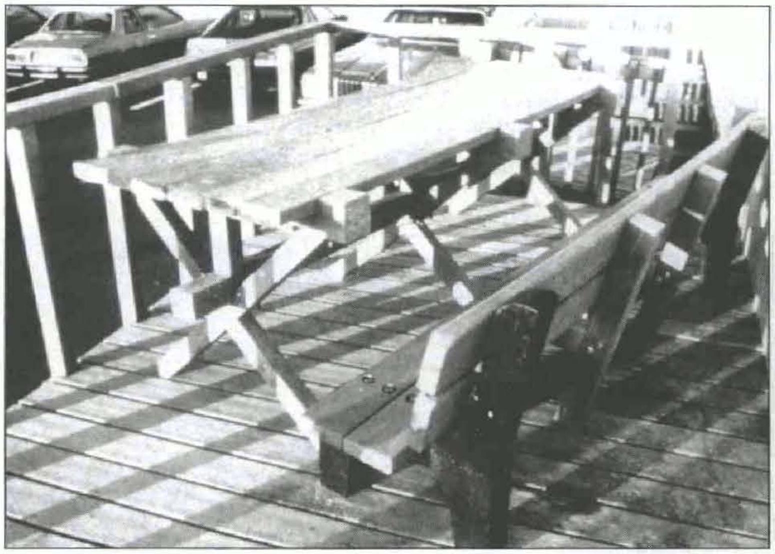
This project leverages the human, financial, and equipment resources between USACERL and the Center for Plastics Recycling Research at Rutgers. Under the cost-sharing agreement, the Corps will invest $350K while the partners will contribute $519K. The willing participation by the plastic lumber industry will provide both valuable insight and ownership for the project's outcome.

The CPAR agreement for the recycled plastic lumber project was deliberately left "open." That is, the partnership is not limited to those organizations listed above. In fact, the current partners are actively seeking companies and agencies to join in the project. With more participants and funding, the research effort could be expanded, standards development would gain more support, and technology transfer would be facilitated. For more information, contact Richard Lampo at USACERL, (217)373-6765.

Robotic Tank Inspection

In another CPAR project, USACERL is sharing the cost of robotics research with a private company, Ebasco, headquartered in New York City. The prestigious Robotics Institute at Carnegie-Mellon University is also taking part in the research, working with USACERL.

In this project, USACERL and its partners will develop a robotic system called Neptune. The goal is to build a robotic inspection system that can



Picnic table and deck constructed of plastic lumber from commingled waste plastics.

deploy various sensors and other analytical equipment to complete different tasks. Potential applications for this technology are inspections and other tasks that are difficult, dangerous, expensive, repetitive or labor-intensive for humans.

One of the first tests for Neptune will be in above-ground bulk fuel storage tank inspections. The robotic system will deploy a video camera and an ultrasonic sensor to take thickness readings. It will crawl along the tank's bottom surface collecting data to ascertain the plate thickness of the tank bottom. This system is being designed for tanks containing light crude, jet fuel, and gasoline.

This partnership could have a profound impact on Army installations by providing a robotic system to complete expensive and/or dangerous tasks. Ultimately, it may create expanded business opportunities for Ebasco, which provides tank inspection services. The CPAR experience will further enhance Carnegie-Mellon's technical base and reputation as a robotics center.

In this CPAR project, the Corps of Engineers and Ebasco will share the cost, contributing $550K and $900K, respectively. Currently, USACERL is actively seeking a manufacturer for the system, who would become a partner in the project. For more information, contact LTC Tom Kelly, (217)352-6511, Ext. 369.

GRASS and the Open GRASS Foundation

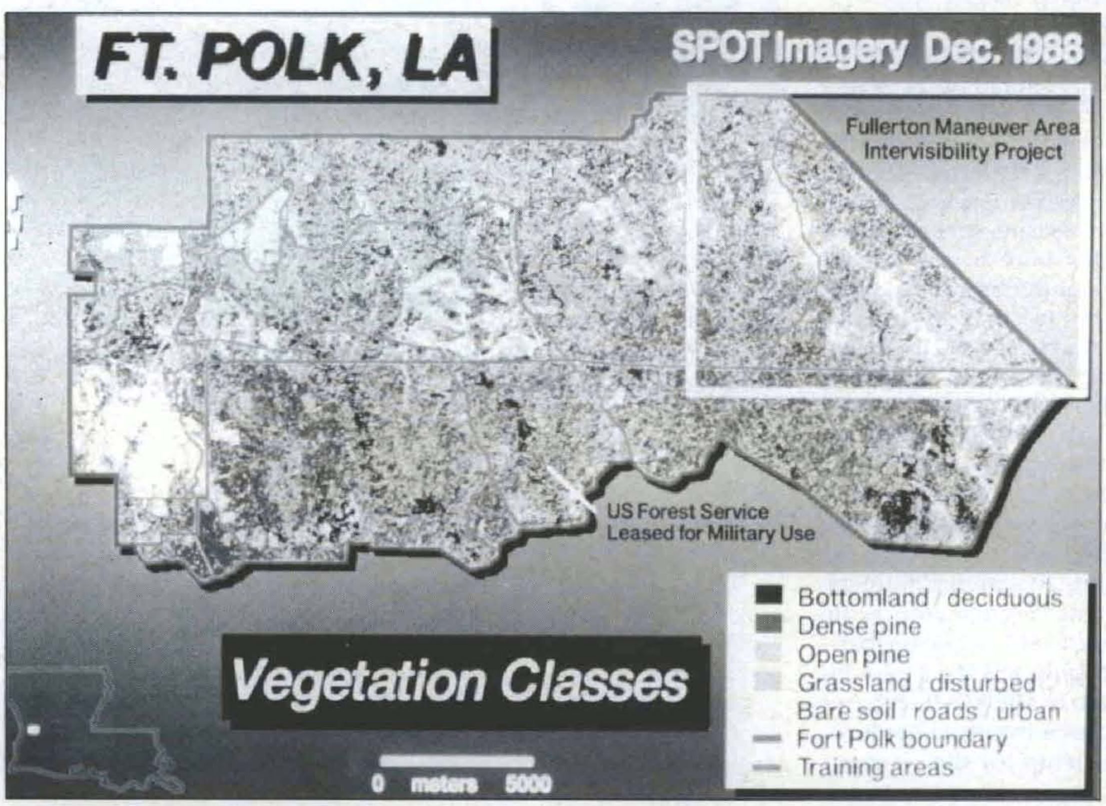
The international transfer of GRASS technology offers a classic case study in leveraging Army research efforts to benefit a broad-based user group within and outside the government.

USACERL began developing the GRASS geographic information system (GIS) in the 1980s as a tool for Army land managers. Soon, many other federal agencies saw the potential for this system to serve their unique needs and became cosponsors in the R&D. Each agency with an interest in the technology joined the GRASS Inter-Agency Steering Committee, which provided strategic planning for GRASS R&D. The academic community was also well represented on this committee.

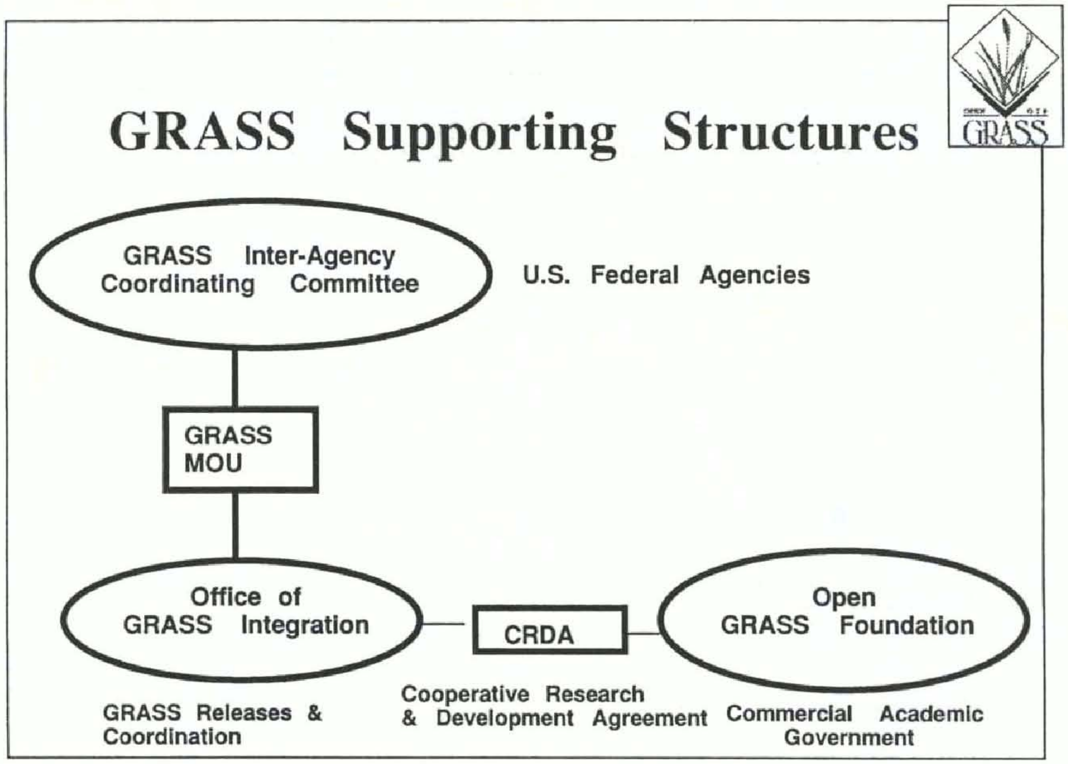
GRASS's development has been guided along a path of standards. This approach has afforded flexibility for the system to be adapted to almost limitless applications, including those which integrate commercial software products (GIS and non-GIS). Its compatible standards—plus the fact that it is in the public domain—triggered hundreds of private companies to exploit this technology. Today, GRASS's users number in the thousands.

By the early 1990s, it became apparent that the scope of technology transfer for GRASS surpassed USACERL's R&D mission. At the same time, there was a growing sense within the federal GRASS community that a commitment was needed for a continuous product improvement process. As witnessed for 10 years under the GRASS "open" GIS development environment, coordinated development and integrated products ultimately benefit all users. The user community determined that new mechanisms were needed for preserving the open GRASS environment to ensure a future ability to respond to wide-ranging GIS needs.

To resolve these issues, USACERL and the Inter-Agency Steering Committee reorganized the GRASS tech transfer machine. A new organization called the Open Grass Foundation (OGF) became an outgrowth of the



GRASS helps land managers analyze natural resources to make informed decisions in siting activities.



Steering Committee. As a separate, nonprofit group, the OGF's job is to:

- stimulate open GIS development in the private and public sectors;
- sustain a standards-based, open GIS environment; and
- coordinate user group functions.

It cooperates with a newly formed federal group, the GRASS Inter-Agency Coordinating Committee (GIACC). GIACC governs the development and distribution of GRASS within participating federal agencies.

USACERL's continuing GIS R&D is centered in the Office of GRASS Integration (OGI). The GIACC serves as a liaison between its federal members, the OGF, and USACERL's OGI (see accompanying figure). GIACC's relationship with USACERL is formalized through a memorandum of understanding.

The OGF, located in Boston University's Center for Remote Sensing, operates under a cooperative R&D Agreement (CRDA) with USACERL. The CRDA is the instrument that authorizes partnerships between the government and the private sector in the continued development of GRASS. It also clearly defines the roles of each organization in this new technology transfer environment.

OGF receives additional support through a corporate membership program. Sponsoring members make tax-deductible contributions and gain numerous opportunities for exposure to the GRASS community. This program also positions member companies to benefit from the OGF's support and product developments. Members are able to cultivate working relationships with other members to extend open GIS resources for commercial ventures.

OGF now handles most of the major technology transfer initiatives formerly done at USACERL. These include:

- publishing and distributing *GRASS-Clippings,* the journal of open geographical information systems;
- sponsoring the annual GRASS user's conference and exhibition;
- organizing seminars for GRASS users; and
- developing various promotional materials.

Meanwhile, USACERL's OGI continues to develop GRASS applications based on its federal customers' needs as identified by the GIACC. Having GIACC as an interface between the OGF and OGI ensures the optimal use of resources while avoiding duplication of effort.

The technology transfer mechanism involving OGF, the GIACC, USACERL, and the GRASS user community breaks new ground in federal/private partnerships. It maximizes GRASS's continued responsiveness to all users—federal and non-federal—while stimulating private industry.

Conclusion

The nation's future ability to manage its natural resources will depend on the availability of appropriate data, tools, skills, and models. The open GIS approach used in transferring GRASS technology is a major step forward in achieving this national capability. For more information contact Marjorie Larson, (217)352-6511, Ext. 504.

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TOTAL SYSTEM ACQUISITION MANAGEMENT METHODOLOGY

"Thinking is the hardest work there is,
which is probably the reason why so few engage in it."
—*Henry Ford, 1929*

By Dan A. Carey, Mark A. Layton and Paul F. Skalny

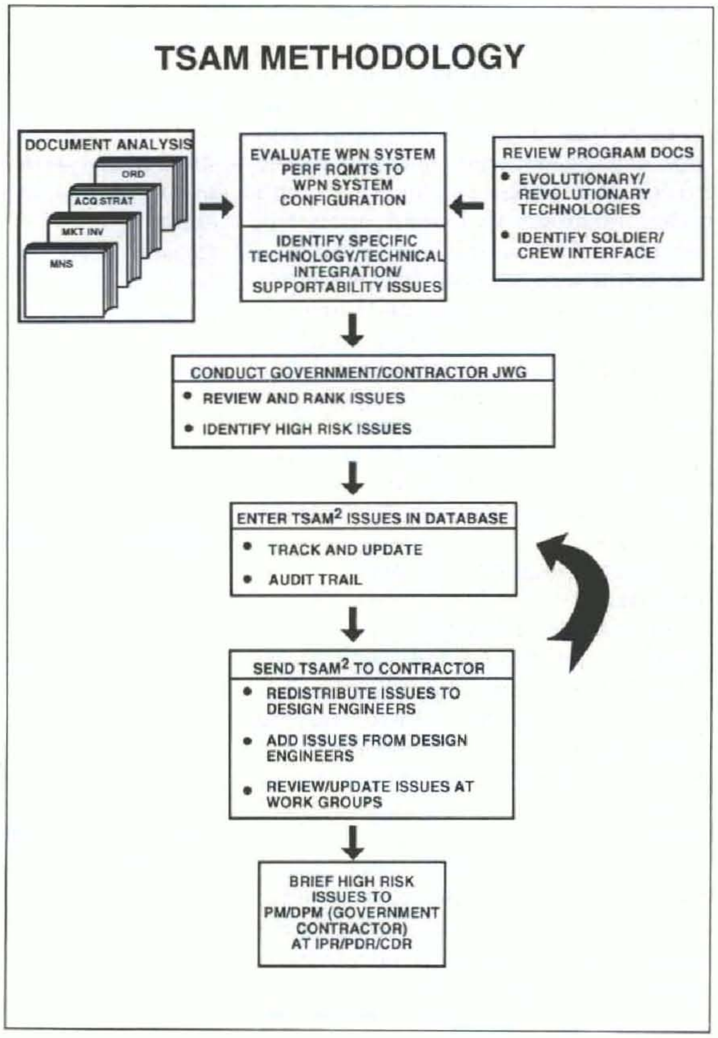
Introduction

Two years ago we authored an article in the March-April issue of the Defense System Management College *Program Manager*. The article, titled "The Logistics Interface Control System" (LICS), described LICS as a systematic, structured approach that enabled logistics engineers to make a valuable contribution to the design of the Defense Advanced Research Projects Agency (DARPA) Advanced Land Combat Systems (ALCOS) Programs.

The article also revealed how LICS promotes communication between logistics and system design engineers early in a system's acquisition life, serves as a catalyst to improve the quality of the concurrent engineering disciplines, reinforces the Logistics Support Analysis process, and helps to control design and life-cycle costs of a weapon system.

As the DARPA ALCOS Programs evolved, the scope of LICS was expanded to incorporate both programmatic and functional technology/technical integration area issues; thereby providing managers in different functional disciplines a method of identifying and tracking critical high risk issues. With the additional capabilities incorporated into the methodology, LICS was renamed the Total System Acquisition Management Methodology (TSAM²) (See Figure 1).

Figure 1.



The purpose of this article is to describe the utility of TSAM² to a program manager (PM) and to share lessons learned from implementing our methodology on two Advanced Technology Demonstration (ATD) projects.

Discussion

In the past year we have briefed and demonstrated TSAM² to Army Integrated Logistics Support (ILS) representatives at a conference, a seminar and to a senior executive committee. At these presentations, two basic topics were discussed and are worth sharing, especially in the reality of declining defense budgets.

First, some participants expected the TSAM² software to contain a data base of generic issues for each programmatic and functional area. Providing generic issues would defeat the purpose of the TSAM² methodology—to provide PMs oversight of their system specific critical high risk issues "up-front" in the research and development phase.

It is also important to understand that the software for TSAM² supports the methodology, which is the central focus. The software is provided simply to organize, record, and speed the TSAM² process, not to represent yet another PM system. We are convinced

Performance

Hit/Kill Probability	Maintainability (Design and Mission)
Rate of Fire	Transportability
Accuracy	Crew Size
Lethality	Availability (Design and Mission)
Survivability	Reliability (Design and Mission)
Resistance to Detection	
Speed	
Altitude	
Range	
Payload	
Mission Time/Radius	
Loiter Time	
Communications Connectivity	
Resistance of Jamming	
Electromagnetic Compatibility	

Notes: (1) Parameters critical to the weapon system - e.g. aircraft weight, missile range, reliability, accessibility.

(2) Parameters must be extracted from the ORD or Mission Need Statement

Schedule

Preliminary Design Review

Developmental Test and Evaluation

Cost and Operational Effectiveness Analysis (COEA)

Operational Requirements Document (ORD) Approval

Test & Evaluation Master Plan (TEMP)

Live Fire Test & Evaluation

Integrated Program Summary

Defense Acquisition Board (DAB) Milestone I Review

Prototype Contract Awards (Contractors)

First Prototype Delivery

Dem/Val Development Test (Start & Complete)

Early Operational Assessment (Start & Complete)

Milestone II DAB Review

Critical Design Review

Long Lead LRIP Release

Final Development Test (Start & Complete)

LRIP Decision

Cost

Cost Analysis Requirements Description (CARD)

- Known Resources
- Specification of Resources
- Operational and Logistic Support

Then Year and Base Year

- Total RDT&E
- Total Procurement
- Total MILCON
- Average Unit Procurement Cost (FY88$ & FY91$)
- Total Procurement Quantities

Program Life-Cycle Cost Estimate Summary

- Cost Profile for each Concept Alternative (Base Year $ & Then Year $)

Current 6-year Defense Program Rates/Ground Rules

For preferred alternative, two additional cost profiles must be provided for accelerated quantity streams: (1) Optimum peacetime surge production rates, and (2) Mobilization production rates.

Notes: (1) Cost estimates must be consistent with estimates used in the Cost and Operational Effectiveness Analysis (COEA).

(2) Manpower estimates supporting Operational & Support (O&S) cost estimates should be consistent with the Manpower Estimate Report (MER).

Supportability

ILS Considerations

- Maintenance Plan
- Manpower and Personnel
- Supply Support
- Support Equipment and Test, Measurement, and Diagnostic Equipment (TMDE)
- Training and Training Devices
- Technical Data
- Computer Resources Support
- Packaging, Handling, and Storage
- Transportation and Transportability
- Standardization and Interoperability
- Facilities

MANPRINT Domains

Manpower	Human Factors Engineering
Personnel	Health Hazards
Training	System Safety

Note: These domains relate directly to the ultimate system(s) - "soldier/crew"

Accessibility

Figure 2.

Criticality and Risk Weighting Criteria

Criticality*		
Score	**Numerical Value**	**Definition**
High	3	Significantly impacts operational mission
Moderate	2	Moderately impacts operational mission
Low	1	Minimal impact on operational mission
Risk**		
Score	**Numerical Value**	**Definition**
High	5	Significant impact with no solution identified
Moderate	3	Significant/Minor impact with solution or workaround identified
Low	1	Minimal/No impact identified
Total Score = Criticality x Risk		

* Criticality score is established by the TSAM² team.

** Risk score is dependent on the design engineer's response.

Figure 3.

that TSAM² promotes aggressive risk management simply because the risks are system specific and quantified; thereby enabling the PM to focus on the critical high risk issues.

The second topic of discussion related to when and what duration should the TSAM² team of hands-on experienced professionals be committed to a program. TSAM² is very elastic. For a large weapon system program, we recommend a three member team; however for a small program two people will suffice. As we found with the ALCOS Programs, there is no substitute for a diverse team willing to roll up their sleeves and provide thoughtful issues based on individual expertise.

The outcome of our early pick and shovel effort resulted in a number of issues that have stayed relevant and critical throughout the ALCOS Programs. The amount of time spent by the team to identify and develop issues should reflect a direct relationship to the acquisition phase of the project (Phase O, Concept Exploration and Definition or after contract award).

Obviously, the team will spend less time reviewing and identifying technology, technical integration complexity and supportability risks from program source documents such as, trade-off determination, trade-off analysis, best technical approach and, if available, the cost and operational effectiveness analysis, rather than starting after a contract has been awarded.

Regardless of when the team is committed, system specific program issues will be developed using our set of guidelines depicted in Figure 2 and quantitatively scored using the criticality and high risk weighing criteria shown in Figure 3. The guidelines are intended to serve as a basis for generating issues, they are not intended to be all inclusive.

Ideally, TSAM² will provide PMs the high risks associated with their programs that can be used as "Exit Criteria" (program-specific results to be required in the next phase) at each milestone. For example, TSAM² can be used for scoring the criticality of each question (high-moderate-low) of the detailed marketing investigation questionnaire. The questions are recorded on the TSAM² Worksheet (Figure 4), the centerpiece of the process, and then entered into the software for tracking, updating and providing an audit trail. The contractors' responses to the questions are entered in the appropriate resolution section on the TSAM² worksheet. The "Risk" (high-medium-low) is then assigned to each issue according to the contractor's answer.

Results

The results will be used to identify the most promising potential solution(s) to validate user needs. If an ATD contract is proposed, the TSAM² data base can become the primary source for developing an acquisition strategy and tailoring the program (i.e. an objective assessment of the number of phases and decision points or exit criteria to meet the specific needs of the program). Of course, the request for proposal will then require the contractors, who submit proposals, to address the TSAM² high risk issues.

In addition to providing the PMs with risks that are quantitatively scored, the TSAM² Worksheet crosswalks each issue to the appropriate program source document, such as the Operational Requirements Document, Test and Evaluation Master Plan, Integrated Program Summary, Integrated Logistic Support Plan, etc. This allows the PMs (government and contractor) to be cognizant of the interrelationship of the issues to other documents and generates communication between responsible government organizations. For example, with the ALCOS Programs, logistics issues were extracted from the TSAM² data base and reformatted as operational and technical test issues for the detailed test plan. The human factors engineering, safety and health hazard issues were also extracted from the data base and used to verify the contractor's resolutions described on the TSAM² worksheet. Our verification and validation of the test issues was performed on a non-interference basis at the contractor's facility, or at the test site. For risks (high, moderate) that remain open, the explanation from the TSAM² worksheet can be used to satisfy the risk assessment annex of the integrated program summary.

Lessons Learned

Clearly, one of the most significant lessons learned from our experience in implementing TSAM² relates to the flow of information between the contractor and government program representatives. This open exchange: generates more interaction between other government commands, activities and agencies; thereby, enhancing teamwork; improves the efficiency of matrix management; and improves the ability of the senior leadership to focus management attention, monitor corrective action and allocate and reallocate resources. Other notable lessons learned from our TSAM² experience were:

- TSAM² data base transitions with the program and not the resources.
- TSAM² tracks issues/risks and provides an audit trail.
- TSAM² isolates functional areas requiring further assessment.
- Government organizations are kept abreast of high risks without additional work.
- Contractor and subcontractors are kept informed and must focus on resolving high Risks.
- TSAM² is productive—a value added—not a paper exercise.

Conclusion

Why implement TSAM²? First, it follows the KISS principle—"Keep It Simple Stupid." What we have accomplished with TSAM² is to isolate, for the PM, specific design discrepancies in technology/technical integrated functional areas that represent high risks to the total system. This in turn provides managers at all levels visibility over critical high risk issues, thereby promoting aggressive risk management. Finally, we are not telling the contractor how to design the system, but our issues definitely influence design.

TSAM² REPORT/WORKSHEET 1/4/93

ISSUE NO.:

PROGRAM/FUNCTIONAL AREA:

ELEMENT:

CRITICALITY: RISK: TOTAL (Latest) SCORE: ORIGINAL SCORE:

ISSUE IDENTIFIED: DATE IDENTIFIED:

ACTION:

THIS ISSUE WILL BE CONSIDERED DURING TESTING (Y OR N):

RESPONSIBLE ORGANIZATION/POC:

PHONE:

SUSPENSE:

RESOLUTION: DATE RESOLVED:

DOCUMENT CROSSWALK: MNS: ( ) MKT INV: ( ) ORD: ( ) COEA: ( ) AS: ( )
BCE: ( ) ILSP: ( ) SMMP: ( ) TEMP: ( ) HHA: ( ) HFEA: ( ) CRLCMP: ( )
IPS - (7) ANNEXES: ( ) ICE: ( ) APB: ( ) SSA: ( ) MER: ( )
EXIT CRITERIA: ( )

Figure 4.

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MARK A. LAYTON is a research scientist with Battelle Memorial Institute. He has more than five years experience in research, engineering and logistics/systems analysis in support of DOD programs. Layton holds a B.S. degree in materials engineering from Virginia Polytechnical Institution and is currently enrolled in the M.S. materials science program at the University of Virginia.

PAUL F. SKALNY is a logistics management specialist in the U.S. Army Tank-Automotive Command Research, Development and Engineering Center. He is the chief of logistics and systems engineering for the Advanced Technology Program. He has more than 13 years experience in Army acquisition and logistics management. Skalny holds a B.A. degree in economics from Wayne State University and is currently enrolled in the M.S. industrial engineering program at Wayne State University.

How Would You Assess Your Experience as a Participant in the Training With Industry Program?

MAJ Ralph Hernandez
DynCorp
Reston, VA

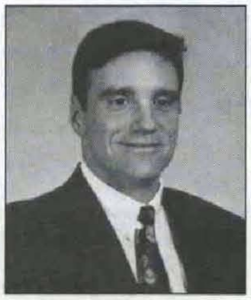
The Army's Training With Industry Program is designed to provide active duty officers experience in industry procedures and practices not available through the military service school system. The officer also learns how major defense contractors and other firms do business. The knowledge gained by the officer in the TWI Program will be utilized to the Army's benefit upon completion of this program. The industry experience serves as a source of information concerning innovations in industrial management practices and/or techniques.

Training With Industry experience has shown me that there is more to business than meets the eye. My training experience at DynCorp, Reston, VA, has been very rewarding. The company is a technical services organization with operations worldwide, providing services at government installations, research facilities, commercial airports, company facilities and many other locations. It is also employee owned.

The training received has been outstanding. As a result of this training, I am convinced that the money spent to send officers through the Training With Industry Program is worth it. The Army benefits greatly from having such a program available for its officers. Many of the things I have learned from industry will stay with me for a long time to come. I can honestly say that I will no longer be able to view industry as a foreign entity. If the question was—"How has the Training With Industry experience changed you?"—I would say that my view of industry is now one of partnership. We must look at industry, the contractor, as our partner in business. The impact that this experience has made upon me is that we, the Army, must recognize that the contractor wants to work with us and has a desire to learn from us. Training With Industry is an invaluable opportunity to see how industry conducts business, why they do things, and what strategic decisions the company makes now and for the future. The industry experience should be viewed by all officers as an opportunity to see where industry practices can be applied to government business practices. It is also an opportunity for industry to get a better idea of how government conducts business.

My experience and what I have seen of industry has changed the way I view business as a whole. I think I have grown professionally because of it and the business effectiveness of the Army is enhanced by the officers who have been through the program.

MAJ Bill Lake
Bell Helicopter Textron Inc.
Fort Worth, TX



I do not think I can give a stronger endorsement to the TWI Program than to say that all prospective acquisition managers should attempt to learn its lessons in some forum or other. There are issues, constraints, systems and cultures which can be most efficiently understood by prolonged exposure to the contractor's environment. The high percentage of TWI-trained people who are selected for PM positions indicates to me that selection boards agree with this point of view, and I applaud them for their insight.

At Bell Helicopter Textron Inc., located in Fort Worth, TX, the program is enthusiastically supported by company leadership. The yearlong program initially consists of a three-to-four month familiarization with the company. During this time, the candidate visits extensively with various departments such as finance (pricing and proposals), engineering, materiel management, planning and tooling, manufacturing and human resources. The remainder of the TWI experience at Bell allows the candidate to actually work for the company in an area that he or she would like to further explore. I selected program management, and Bell has given me current programs to manage on their behalf. As a program manager, I am learning how the departments at Bell integrate with each other and how they interface with government agencies. If spare time exists, I can pursue additional knowledge by setting up my own appointments in areas that interest me. For example, I recently spent a day with the Bell manager who establishes forward pricing rates.

Many of the world's problems are, in part, due to misunderstanding of others and lack of knowledge of the other parties' problems and constraints. The acquisition business is certainly no exception. The more you know about the contractor, the more effective you will be as a manager. Misunderstanding and mistrust between the government and the contractor can be minimized. TWI at Bell Helicopter has dramatically improved my knowledge as well as my understanding of the contractors' world. It has actually given me the experience of *working for* Bell Helicopter. This unique opportunity cannot fail to make me a more well-rounded and potentially effective PM, acquisition manager or member of the DOD acquisition community.

TWI is an experience which cannot easily be replicated. However, many of the potential benefits depend upon the openness and willingness of the company to expose the candidate to all of its operations and procedures. Bell, through the years, has been exemplary in this regard. Much also depends on the willingness of the candidate to maximize the opportunity in a self-managed environment. I hope I have.

MAJ Don Huff
Hughes Missile Systems Company
Canoga Park, CA

I arrived at my Training With Industry (TWI) assignment with two distinct areas of interest. The first was to receive an in-depth look at how Army requirements are translated into a weapon system design and the second was to observe the civilian leadership of a large, technically oriented organization. I expected TWI to provide insights into those areas as well as the hands-on experience in program management that can't be taught in the classroom. In that regard I was not disappointed. To say the very least, it has been an invaluable "reality check."

The U.S. Army Logistic Management College does an excellent job of focusing the acquisition process on the needs of the ultimate customer, the soldier in the field. For those of us in uniform, that seems pretty straightforward. However, from industry's point of view we often speak with many customer voices, and those voices usually have competing and conflicting points of view. Those voices can belong to the government program manager and the various Army schools and laboratories. Add to that list the possibility of a congressional agenda, as well as the company's internal workings and you have a typical acquisition environment.

It was refreshing to find my co-workers to be earnest, hard working professionals, genuinely concerned about the needs of the soldier in the field. They are also, first and foremost, concerned about winning contracts. And if the soldier's requirements are diminished to satisfy one of the influential "voices" *and* improve their chances of winning, so be it. The soldier will then get the best compromise weapon system that the industry can field.

My observation of leadership within the industry gave me a new appreciation for our senior officers and NCO's (Now there's a line I never thought I'd write). Compared to the military, skills like mentoring and situational leadership are not emphasized at the senior levels of management. This is not to say that industry doesn't care; it just seems they are uncomfortable with the process. This may be a reflection of the civilian career path where success may come by way of technical achievements compared to the military where success is measured by mission, vision, and the environment created to attain both.

So, all of that said, how would I assess my TWI experience? Without a doubt, it is a tremendous opportunity to view the realities of the acquisition process. I can think of no other program that offers such a broad exposure in so short a time. If an education program exists that links formal training with real world problems, it is TWI.

MAJ Mark Meaders
Oshkosh Truck Corporation
Oshkosh, WI

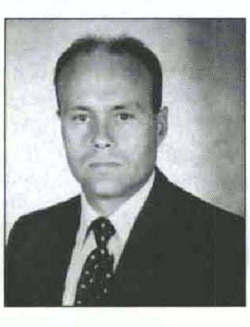
Well-rounded business education and experience are hard to come by within the United States Army. The opportunity to hire an Army major or lieutenant colonel from the private sector simply does not exist. To overcome the void, the Army has developed training with industry. The program allows the officer a chance to meld civilian education and military experience with the realities of the business world. This process allows each party involved to reap both direct and indirect benefits that can be extensive. I would be hard pressed to choose who benefits the most. In this program all are winners.

My direct benefits began with an opportunity to fine tune the skills acquired through my civilian education. I have learned new techniques with which to apply those skills in a real world environment. Additionally, my industry assigned several projects providing a catalyst for learning. They allowed me direct access to their vendor base to conduct actual price negotiation, scheduling, quality control and packaging decisions. In doing so, my industry mentors allowed me to call the shots providing insight and guidance as required. I could see first hand the issues and concerns of a vendor base associated with both commercial and military applications. Additionally, I achieved an appreciation for the impact of government contracts at the subcontractor level. This was perhaps my biggest eye opener. I was unprepared for the depth and complexity that producing a truck can have on the economies of communities in the region.

It will take many years to reap all possible benefits of the TWI program. A deeper understanding of a large corporation will cause me to look at problems from a different perspective. This will only help foster a mutually beneficial relationship between government and its defense contractor base as I continue my acquisition career.

Other benefits have an intangible effect which are difficult to measure. Exposure to new management techniques will enhance those learned during past Army assignments. Association with the diversity of personnel and talents of a large corporation has helped me grow individually as a person.

Overall TWI is an excellent conduit for learning. Active duty military members could not otherwise obtain experience of this caliber. In only a few short months I have been able to place many things in perspective and hone skills that will benefit both the Army and industry in the years to come.



CPT Jay Hilliard
Loral Vought Corporation
Dallas, TX

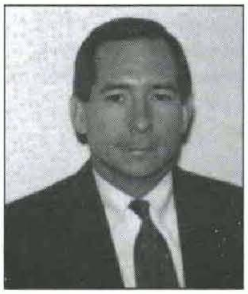
My experience as a participant in the Training With Industry Program has been totally positive. This assignment has done more to prepare me for a future in the Acquisition Corps than any of my past assignments.

Training With Industry is a program that all officers should participate in. It challenges you from the very first day. During my stay with Loral Vought Corporation I have worked within the Army Tactical Missile Systems Program (ATACMS) in the areas of financial management, quality assurance, configuration management, scheduling, program controls, and manufacturing engineering. The program director monitored my progress during the program and guided me through the maze.

I learned in every area that I was exposed to and actively participated in the program. Prior to my arrival I thought that industry would be a very secretive place and my exposure to different facets of the program would be limited. This was not the right impression. I could not have been more "off base." The Army TACMS Program Director opened everything up to me and made me part of the TACMS team. The knowledge that I gained will be of direct benefit to me and to the Army during my years of future service in the Acquisition Corps.

The pace that industry operates at is very intense and profit oriented. Their bottom line is to put forth a quality product that is profitable. They are totally customer oriented and definitely know where their "bread is buttered." I have learned that industry wants to please government and wants very much to work as a team because their future is totally dependent upon it.

The experience was worth it. I cannot wait to use it. I look forward to applying what I have learned.



MAJ Luis D. Sans
Rockwell International Corporation
Duluth, GA

This has been a great opportunity for me. The Training With Industry (TWI) Program has proven to be all that I expected when I first requested to participate about a year ago. In fact, this program offers more to the student than can be realized until becoming involved.

The key to a successful tour in TWI, I believe, is the individual participant. As is the case with most training programs, you can only get out of TWI what you dedicate yourself to accomplish and then only if those who provide the training environment and resources are willing to support your goals and objectives.

My experience here at Rockwell's Tactical Systems Division has been professionally rewarding and everyone, without exception, with whom I've had the opportunity to work has done more than I anticipated to make this a valuable career milestone for me. TSD is fully committed to a Total Quality System and its approach to TWI falls in line with that philosophy. This corporation lets the student experience, hands on, the many and varied challenges of Defense Contracting.

My Training Coordinator here developed a plan, based on my objectives, which ensures exposure to all the major functions which primarily impact government business. Throughout the year, I have been given the latitude to revise my schedule to take full advantage of learning opportunities as they arise. The result has been a training program which supported my established goals but also allowed for flexibility in meeting my personal needs as well as those of the company.

Training With Industry has also proven to be an "eye opening" experience. Having had only limited time as a contracting officer previously, I was not fully aware of the significant impact which government contracts requirements have on industry. I have found out, by being now on "the other side" that it really is quite complicated and costly for contractors to meet all the requirements which the government must impose through its acquisition process.

In my time here, I have become somewhat more sensitive to industry's challenges in doing business with the U.S. government. That is not to say that I now believe that the government mistreats or abuses contractors. I am simply saying that, as a result of nine months of working at TSD, I have a different perspective and a much better understanding of the roles played by both parties. I will keep that in mind once I put on my uniform again very soon.

Overall, I value this experience and consider it essential in making me a competent Army Acquisition official. I hope that I have not only improved myself professionally, but that I have also made a contribution to the Army and to Rockwell International. TWI is a worthwhile program and I recommend it fully for all Army Acquisition Corps officers.

BOOK REVIEWS

Moving Mountains: Lessons in Leadership and Logistics from the Gulf War

By LTG William G. Pagonis, with Jeffrey L. Cruickshank Harvard Business School Press (248 pages; photographs; index, $24.95).

Reviewed by CPT Thomas D. Coffman, an Acquisition Corps officer assigned to the Project Manager's Office for Medium Tactical Vehicles, Program Executive Office—Combat Support in Warren, MI.

Moving Mountains is a firsthand account of one of the largest and most successful logistical operations in military history. LTG William (Gus) Pagonis, who commanded this outstanding logistical effort in the Persian Gulf, threads the flow of his book in sensational fashion.

The book's first chapter provides the reader with a basis of understanding for the magnitude of the planning and execution required to logistically support the Gulf War. He cleverly uses comparative examples such as the 52 million miles driven in the theater being equivalent to 10,000 round trips from Los Angeles to New York, giving the reader a benchmark of understanding.

Pagonis uses chapters two and three to provide insight into value-shaping events from his childhood in Pennsylvania to leadership skills honed throughout his 28-year career in key military positions. Understanding Pagonis' foundation of attributes provides the reader a clear and personal insight into the discussions throughout the remainder of the book.

Clearly, *Moving Mountains* is a book focused on logistics. However, the book covers many key aspects relevant to the defense acquisition community—both military and civilian—as well as government and commercial industry. Pagonis has commanded at various levels and has held positions such as director of plans and operations in the Office of the Deputy Chief of Staff for Logistics (ODCSLOG); director for transportation, energy, and troop support in ODCSLOG; and FORSCOM J4 (director of logistics). In these positions, his responsibilities touch acquisition-related areas like research and development, new product procurement, modernization planning, contracting, budgets, time management, future doctrine and the private sector. He discusses several examples throughout the book on these various subjects.

In the initial stages of the Gulf deployment, contracting support through host nation vendors is critical to the success of the operation. It also proves challenging in overcoming the many intricacies like customs, language barriers, monetary systems, etc. Pagonis states, "In fact, one of the more interesting challenges we faced in the Middle East grew out of the limitations of our own financing and budgeting structure." He further explains how the military divides expenditures into various categories, or the "colors of money," and how each category is governed by different rules and regulations. In the early stages of the deployment, his staff only has access to Operations and Maintenance funds. Pagonis cites his previous experiences in dealing with Capitol Hill and how he overcomes the rules and regulations through threshold waivers. Additionally, his office does not operate with a "blank check" and has to stick to a budget, reporting all expenditures to the Pentagon.

As mentioned, Pagonis builds a strong foundation of understanding in the book's initial chapters. He then devotes the main portion to events relating to the Gulf deployment, Operations Desert Shield and Storm and finally, redeployment. Pagonis draws his book to a close with the final two chapters devoted to leadership techniques and lessons learned. These two chapters could be extracted and stand alone as a pocket guide of "How to be Successful in the Acquisition Business." He is an expert in time management, with "simplicity" and "bottom-line" his watchwords. His discussion of centralized planning with decentralized execution parallels the concept of matrix team support; the way we organize for acquisition in today's drawn down defense base.

Drawing upon lessons learned from the Gulf War, there is specific mention of areas that need fixes and those that don't. The areas he mentions as needing fixes are transportation, material handling equipment and doctrine. To the acquisition-minded professional, these lessons learned are the beginnings that lead to research and development studies and future requirement documents for weapon systems.

In detailing his techniques of time management and leadership, he discusses management tools useful to the military and commercial industry. He writes on simplicity, training, flexibility, communications, how to run meetings, being personable and motivating subordinates. Pagonis' business background includes an MBA and he clarifies many of his points by citing examples from such industry leaders as Goodyear, UPS, Shell Oil Company, 3M and Wal-Mart.

Moving Mountains is a valuable reference for leaders in the acquisition business. It is not your typical dry text book; rather, it provides food for thought in interesting fashion. It combines military and business concepts and is a must read for those acquisition professionals wanting to stay in step with our evolving Army.

COL Grube Becomes Acquisition Career Management Deputy

COL Richard A. Grube, former project manager for Soldier Systems, has assumed new duties as deputy director for acquisition career management in the Office of the Assistant Secretary of the Army for Research, Development and Acquisition.

Backed by more than 26 years of active military service, COL Grube served from January 1990 until March 1992 as project manager for clothing and individual equipment. From 1986 to 1988 he commanded the 266th Quartermaster Battalion at Fort Lee, VA.

A 1967 graduate of the U.S. Military Academy, he holds an M.S. degree from Georgia Institute of Technology and has completed the Ranger School, Armor Officer Basic Course, Quartermaster Officer Advanced Course, Command and General Staff College, Defense Systems Management College Program Management Course, and the Industrial College of the Armed Forces.

COL Greenhouse Retires

COL Al Greenhouse, deputy director for acquisition career management in the Office of the Assistant Secretary of the Army (RDA) since 1990, retired in late April following more than 28 years of active military service.

Noted for his expertise in procurement and acquisition career management, Greenhouse began his commissioned service in 1965 following graduation from the Army ROTC Program at Southern University in Baton Rouge, LA. His key career assignments included two tours of duty in Vietnam with the 101st Airborne Division; procurement staff officer, Policy Division, Office of the ASA (RDA); and chief of the Procurement Management Division, Contracting Support Agency; In addition, he served a tour of duty at the U.S. Military Academy and commanded the 2nd Battalion, 13th Infantry and 4th Battalion, 8th Infantry in the Federal Republic of Germany.

FY 94 Colonel Command Selectees

Congratulations to the following officers who were selected for project manager or acquisition command positions.

Name	FA	Project
ACQUISITION CORPS 97 COMMANDS		
Adams, Charles J.	97	
Chrisco, Larry D.	97	
Clagett, David C. Jr.	97	
Davis, Frank C. III	97	
Fortin, Robert A.	97	
Harrington, Edward M.	97	
Hatton, Sam E.	97	
Lheureux, Roy W.	97	
Pulscher, William R.	97	
Stewart, Lawrence J.	97	
Westrip, Charles W.	97	
ACQUISITION CORPS 51 COMMANDS		
Fuzy, Eugene A.	51	
Oliver, Randall G.	51	
Price, Morris E. Jr.	51	
Sittler, Wayne L.	51	
Thomas, William G.	51	
ACQUISITION CORPS 53 COMMANDS		
Blake, James T.	51/53	
PROJECT MANAGERS		
Armbruster, Robert E.	51	TOW Weapon System
Bubb, Ernest E.	51	Line of Sight Antitank
Cross, James B.	51	Mobile Electric Power
Haller, Thomas L.	51	Corps Surface-to-Air Missile
Mitchell, Clarence B.	53	Common Hardware/Software
Nelson, John D.	51	NBC Defense
Oler, Roy P.	51	Aviation Combat
Powell, Frank L. III	51	Extended Range Interceptor
Rees, Chester L. Jr.	51	Utility Helicopter
Sheaves, William B.	51	Advanced Field Artillery System
Wolfgramm, Paul E.	51	Defense Communications and Army Transmission Systems
Yakovac, Joseph L. Jr.	51	Bradley Fighting Vehicle Systems

AAC Senior Service College List

Congratulations to the following Army Acquisition Corps officers on their selection for Senior Service College.

NAME	RANK	FA	BRANCH
Arnold, Albert Edward III	LTC	53	SC
Brown, Robert Patrick	LTC	97	QM
Cardine, Christopher Vandyke	LTC(P)	51	AR
Cerutti, Edward Andrew	LTC	51	FA
Cooper, Winthrop Herr	LTC	53	AG
Duckworth, Roger Lee	LTC(P)	51	AV
Ertwine, Dean Robert	LTC	51	CM
Fornecker, Christopher	LTC	51	SC
Hamilton, Philip Edward	LTC	51	IN
Jeong, John Charles	LTC	97	QM
Johnson, Noble Truitt	LTC	51	AR
Kuffner, Stephen John	LTC	51	AD
Pulscher, William Robert	LTC(P)	97	OD
Russell, Mark Warren	LTC	51	AV
Sorenson, Jeffrey Alan	LTC	51	MI
Verity, James Edward	COL	51	AV
Wilson, Joseph Keith Jr.	LTC(P)	97	SF

MAJ Chandler Chosen As FA 51 Proponent Officer

MAJ Robert L. Chandler has been assigned as the FA 51 proponency officer in the Office of the Deputy Director for Acquisition Career Management, Office of the Assistant Secretary of the Army (Research, Development and Acquisition). His served formerly with the National Guard Bureau where he was responsible for functional and budgetary management of the Army National Guard's $53 million food service program.

A 1978 distinguished military graduate of the Virginia State College ROTC Program, Chandler has a B.S. degree in business administration from Virginia Union University, and an M.S. degree in personnel management from Troy State University. He is also a graduate of the Command and General Staff College.

Senior Service College Fellows Program

The U.S. Army has designated the University of Texas (UT) at Austin as a host university for the Army's Senior Service College Fellows

Program. The Fellows Program is designed for Acquisition Corps field grade Army officers and their civilian counterparts—all having technical specialties—to study in an academic environment compatible with their background and career needs.

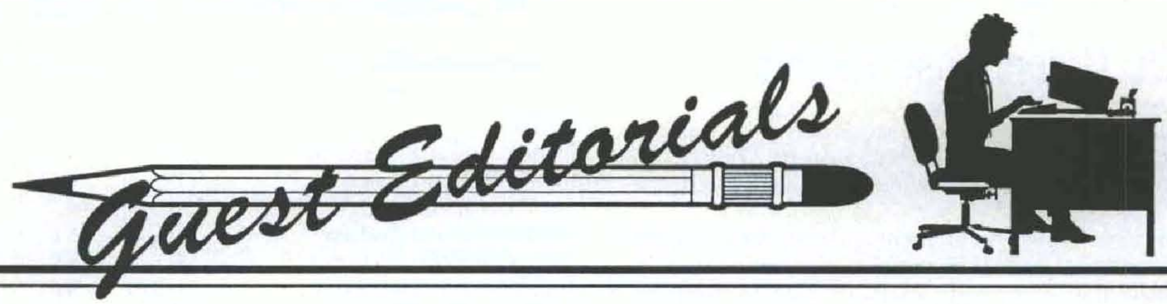
Participants will be in residence at UT for one academic year, in lieu of Senior Service College (War College) and will receive the award of Military Education Level One (the highest level of formal military education).

The program, including national security/policy process, critical technologies and their application on the future battlefield and defense industrial base issues, has been approved by Department of the Army and began with five fellows in August 1992.

The fellowship has a trilateral focus in which fellows study the relationships between national security policy and process, critical technologies and national industrial policy and base. The industrial base module exposes the fellows to the relationship between government and the defense industry. Industrial base issues are significantly enhanced through fellow linkage with Austin-based corporations such as Lockheed, Sematech, Texas Instruments and Tracor.

Each course module is enhanced through a series of distinguished speakers from the government and the Army. Scheduled speakers include the chief of staff, Army and the military deputy to the assistant secretary of the Army (research, development and acquisition).

Fellows are sponsored and supported by the Institute for Advanced Technology, the Army's Federally Funded Research and Development Center at UT. For additional information on the Fellowship Program refer to an article beginning on page 15 of the May-June 1993 issue of *Army RD&A Bulletin* or call Dr. Jerry Davis or Jim Pollard on (512) 471-9060.



DON'T TEASE LARGE DOGS

Ralph A. Evans
Quality and Reliability Consultant

When I take my large dog for a walk, children will occasionally tease it. I explain to them that teasing dogs is not nice, but teasing large dogs is stupid. In managing a reliability and/or quality program some things are not good and they are reasonably well known. But many companies persist in teasing large dogs—doing things that are stupid. Some of these stupid things are—

Management by sloganeering, fads, and buzz-words. As everyone knows before they get to be in upper management, engineers and middle managers treat such approaches with the contempt they deserve. Yet as managers rise through the ranks, they use the approaches more and more. Doing nothing is often preferable to preaching slogans and buzz words. When a new fad is introduced, middle managers and engineers properly believe: ***And this too shall pass.***

Negative incentives. People respond reasonably well to incentives (penalties and rewards) that affect them. Much of the poor response to reliability and quality programs by everyone from workers to higher management is due to the existence of incentives that run counter to such programs. Example 1—Many companies still provide a reward to production managers that is based on the number of units shipped, not on the number of good units shipped. What is a reasonably intelligent production manager to do? Example 2—Few if any project managers, on the military or commercial side, have been hung out to dry for not meeting a reliability requirement. Since most people who rise to such positions can at least observe which side of the bread the butter is on, why is anyone surprised that such managers trade-off against reliability? Example 3—Engineers often have no incentive to make tolerances as broad as feasible. Their only real incentive (to avoid penalties) is to make the tolerances assuredly narrow enough so that they are never too broad.

Play Numbers Games. The results of reliability tasks must be applied by designers, not filed in a dark place never to be seen again; that is, the product must *know* that the reliability task was done. Otherwise the task was worse than a waste of resources: It let people deceive themselves that reliability was being managed. Example— Reliability budgeting is often looked on as a numbers game wherein the reliability engineers get any desired number. But getting that number merely means that the task is finished. The real meat of the task is the list of assumptions that had to be made in order to get those numbers.

No High-Level Corrective Action. Low-level corrective action ("Band Aid" & engineering levels) is necessary, but does not contribute substantially to economic reliability. Corrective action is needed at the administrative levels too.

TARDEC Eyes Electron Beam Curing for Composite Materials

Researchers at the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC) are evaluating a revolutionary manufacturing process for curing polymer composite material structures that is faster than traditional curing methods.

A standard practice for curing composites is to heat the parts in an autoclave or under an external heater. Curing time ranges from several minutes to a day or more, depending on the size and complexity of a given part and the type and thickness of the material.

The alternative approach is to cure parts with electron beam radiation. In this procedure, parts are molded using resins that are specially formulated to react chemically with the radiation. A conveyer belt then moves the parts into a shielded room, where they are exposed briefly to low-level radiation, and the reaction takes place at room temperature. Once the process starts, it continues on its own until it is done and leaves no trace of radiation in the finished parts.

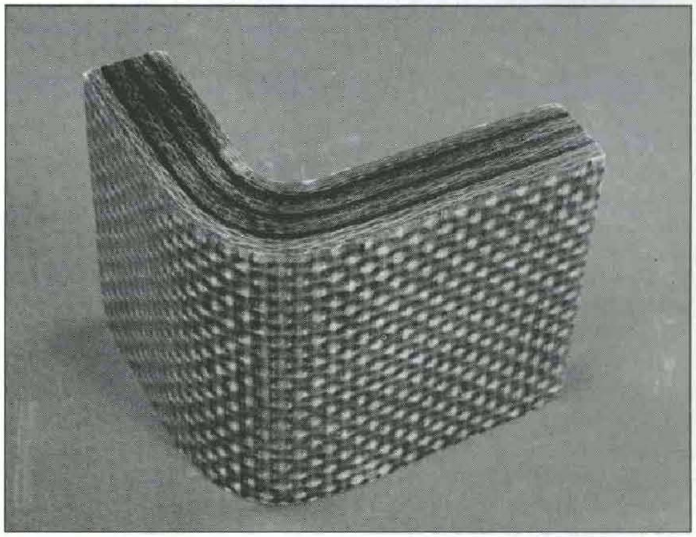
"It's all done very quickly," explained TARDEC project engineer Luis Hinojosa. "The amount of time that can be saved compared to thermal curing is substantial. In France, for example, a company started using it to cure eight-foot-diameter, filament-wound rocket tubes, and the processing time went from four days to eight hours."

According to Hinojosa, curing with radiation offers other advantages over thermal curing besides saving time. For one thing, he said the absence of external heating means reduced emissions of volatile substances from the curing material, which in thermal curing produces bubbles that weaken the composite. Moreover, it eliminates the problem of thermal mismatching between tooling and finished parts that sometimes occurs when molds and parts expand and contract at different rates during the thermal curing process.

In April 1992, TARDEC awarded a Phase I Small-Business Innovation Research (SBIR) contract to Damilic, Inc., of Bethesda, MD, and the University of Maryland, a radiation research leader, to investigate radiation-cured composite materials for combat vehicles. The contract called for Damilic to find sources of radiation-curable resins, establish processing protocols, make recommendations concerning application of radiation curing to land vehicle application, and make two prototype composite panels for TARDEC.

The panels arrived in January. One is a one-square-foot flat panel containing 69 plies of fiberglass. The other is a 69-ply 90-degree-curve section consisting of alternating layers of fiberglass and carbon. It also includes a copper mesh on one surface to simulate electromagnetic shielding. "The curved panel was particularly impressive for two reasons," said Hinojosa. "First, it validated the fact that we could irradiate complex geometry. Also, it demonstrated that we were able to cure fiberglass and carbon together without incurring voids in the bend region—which tend to occur in thermally cured composites because of different rates of thermal expansion in these materials."

The results of the Phase I effort were presented in January to engineers from General Dynamics Land Systems, FMC Corporation, the Army Research Laboratory, the Defense Advanced Research Projects Agency and TARDEC. Commenting on the overall quality of the radiation-cured composites, Hinojosa said tests showed the material density to be greater than that achieved with thermal curing. He conceded, however, that other physical properties, such as tensile strength, were somewhat below expected levels. "We are not sure why this happened," said Hinojosa, "because there are just too many variables involved. For example, it was the first time that the company laid up a composite panel, and they could have made many mistakes in laying up the material. But I consider these first composite panels to be a good initial effort. More research is needed to further characterize the technology."



Prototype of radiation-cured composite laminate.

Hinojosa said Damilic is preparing a Phase II proposal which, if approved, could lead to radiation-cured composite vehicle components for use in tests.

The preceding article was written by George Taylor, a technical writer in the Marketing Office of the U.S. Army Tank-Automotive Research, Development and Engineering Center.

New Hand-Held Mine Detector Used in Somalia

More than 200 units of the new Army hand-held metallic mine detector—the AN/PSS-12—were recently diverted from ongoing fielding for use by our troops deployed in Somalia.

According to Irving Kintish of the Project Management Office for Mines, Countermines and Demolitions (PM-MCD), Picatinny Arsenal, NJ, "These items were purposely diverted to assist our soldiers locate land mines. Our troops knew of the mine threat they were going to encounter in Somalia resulting from the many years of armed conflict there. Before their deployment, we (PM-MCD) acted quickly to provide them with the mine detectors they needed."

According to Phil Purdy of the Belvoir PM-MCD Office, "We also recognized the possible requirement of non-metallic mine probes and bonnets (mine markers) for Somalia. We wanted to have them in the Army inventory, in case they were needed. Mine probes are non-metallic to prevent the activation of magnetic-influenced fuzed mines."

"The probes and the bonnets were somewhat of a challenge. Prototypes of these two items were designed and fielded in limited numbers by the Belvoir RD&E Center (BRDEC) during Operation Desert Storm, but were never adopted as standard issue items," said Kintish.

"I'm pleased to say that we (PM-MCD) quickly solved the challenge. First, we obtained a statement of need from the Engineer School. Then, working aggressively with BRDEC and the Aviation and Troop Command (ATCOM), initiated activity to place bonnets and probes into the inventory in quantity," said Kintish.

According to PM-MCD officials, contracts were promptly processed and the first deliveries of bonnets and probes were made in February of this year. "We have them now in stock, in case they are needed in Somalia or any other part of the world," said Purdy.

"The cooperative actions by the ATCOM, BRDEC and PM-MCD team were key to the success of this expedited project. We're glad to have had the opportunity to provide our soldiers with the equipment they need to address the continuing worldwide proliferation of landmines," concluded Kintish.

The preceding article was written by Joe Morales, public affairs officer at the Belvoir RD&E Center, Fort Belvoir, VA.

ASA Owen Dedicates New Mobile Research Facility

The Honorable Michael W. Owen, acting assistant secretary of the Army for installations, logistics and the environment, visited Fort Detrick, MD, earlier this year to dedicate a new mobile research facility.

Consisting of three 48-foot modules in mobile trailers, the new laboratory is a platform for refining and implementing new methods and techniques for determining the hazards of complex environmental contamination. It was developed through a unique collaboration between the Army Medical Department, the Army Corps of Engineers and the U.S. Environmental Protection Agency (EPA).

The research facility's three components are a fully equipped biomonitoring research laboratory, analytical chemistry research laboratory, and research support facility.

The U.S. Army Biomedical Research and Development Laboratory (USABRDL) conducts basic and applied research to assess and help mitigate the environmental effects of military training and industrial operations. The laboratory has conducted basic and applied research for more than 10 years to develop rapid, cost effective, biological methods for monitoring the hazards from exposure to chemicals in the environment. The most promising of these methods will now be field tested and validated in the new biomonitoring research laboratory.

The biomonitoring research laboratory is a self-contained aquatic toxicology facility patterned after the unique and sophisticated fixed laboratory facilities at USABRDL. Aquatic organisms (fish, frog embryos, water fleas, and algae) which are cultured in the USABRDL labs at Fort Detrick will be shipped to the mobile laboratory in the field. The laboratory will expose the test organisms to varying concentrations of surface and ground waters at the cleanup site, and will monitor the test plants and animals for signs of acute and chronic toxicity.

By using aquatic plants and animals, both vertebrates and invertebrates, the researchers will potentially save time and money on cleanup costs by providing data on the potential hazards measured at the site. Toxicity can be detected earlier and less expensively through the use of these aquatic models.

A second benefit of the program will be the development of new data on contamination. In many cases, the effects of chemical contamination can only be estimated by extrapolating from known toxicological effects of single chemicals, or the presence of unidentified chemicals. On-site monitoring of the biological effects of ground-water and surface water samples will supplement existing toxicological data. This new information will support decision making regarding the priority of site cleanup, and can monitor the effectiveness of cleanup actions on-site.

The analytical instrumentation in the mobile chemistry laboratory, modelled after fixed USABRDL facilities, includes liquid and gas chromatography and mass spectrometry. This will assist in quickly identifying and quantifying chemical contaminants in air, soil, sediment, water, and in residues in the tissues of organisms exposed on-site.

The support facility contains office space, computers, printers, a small library and conference room, voice and data communications capability, and a rest room, shower and sleeping area for long-term remote operations. The support trailer's transformer will distribute electrical power to the research trailers when electrical power is provided at the cleanup site.

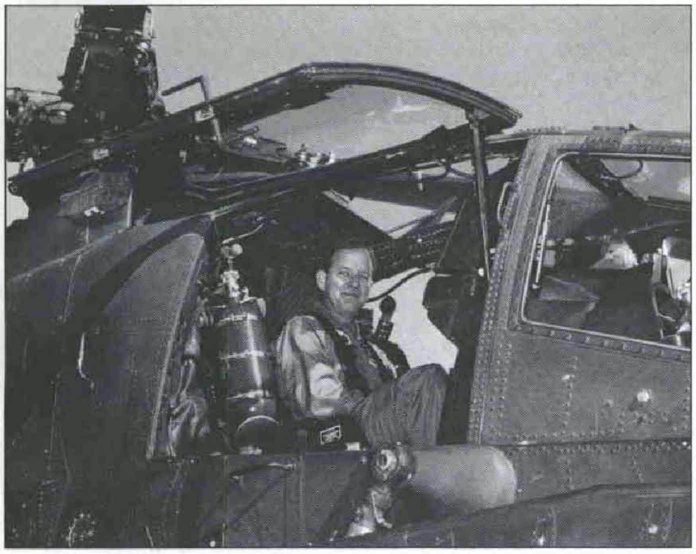
The mobile research laboratory's first field deployment was at Aberdeen Proving Ground this summer. A second field site is being negotiated for further validation efforts at the Rocky Mountain Arsenal in Colorado.

Under a new Memorandum of Agreement between the Departments of Defense and Interior, a collaborative research team of USABRDL and U.S. Fish and Wildlife Service scientists will use the new mobile laboratory to conduct joint research projects to advance the scientific understanding of the hazards posed by chemical contamination in the environment. The possibilities for collaboration with research scientists from EPA, the Army Corps of Engineers, and the Department of Energy are being pursued to enhance this federal interagency initiative.

ADPA Names Metzger Tester of the Year

CW4 Mark E. Metzger was recently awarded the American Defense Preparedness Association's Tester of the Year award for his service as an experimental test pilot with the Airworthiness Qualification Test Directorate (AQTD) at Edwards AFB, CA. AQTD is part of the U.S. Army Aviation Technical Test Center, headquartered at Fort Rucker, AL. Metzger was selected from all personnel involved in test and evaluation in all the service branches of the Department of Defense. The award was presented last spring at the Test and Evaluation Symposium IX in Las Cruces, NM.

Metzger was the test director/test pilot for the integration of a new engine (T700-GS-701C) on the Apache helicopter. Over the past year, he conducted tests on a series of six design iterations of the engine controls. Development problems which occurred during this integration resulted in major fielding and combat readiness implications. Metzger became the Army expert



CW4 Mark E. Metzger

on this integration. Because of his outstanding engineering knowledge and analytical skills along with his ability to clearly articulate his conclusions, the program executive officer, aviation, requested that Metzger present briefings to decision makers in the Pentagon and the user community. Metzger has traveled extensively to train pilots and ensure the Apache-701C is a safe and responsive aircraft for the Army.

He also served as the lead project test pilot for the Aeronautical Design Standard (ADS-33C) evaluation using the AH-64A Apache. This test resulted in improved Army specifications for helicopter handling qualities. Metzger developed many new test techniques and improvements to the requirements of the specification.

Throughout his career, Metzger has been involved in numerous simulation evaluations to research advanced flight control systems, current and prototype symbology, and night vision systems. Metzger retired from active duty this past spring as a master aviator and master parachutist with almost 6,000 flight hours.

How Are We Doing?

Although the *Army RD&A Bulletin* staff sincerely tries to stay attuned to its readers' interests, we admittedly may sometimes miss the mark. If that's the case, we want to hear from you. Your preferences are important to us. We're here to keep you informed, so please let us know what types of articles you prefer—and don't prefer. Although we can't promise to respond to all of your requests, we do promise to give them all fair consideration.

Your comments should be mailed to: *Army RD&A Bulletin*, Building 201, Stop 889, Fort Belvoir, VA 22060-5889, or faxed to: DSN 655-4044 or commercial (703) 805-4044.

LETTERS

Dear Sir:

As a drilling IMA (DIMA) with DLA's Defense Contract Management Command I must respond to COL Carney's article with a resounding Yes! All of the services are wrestling with whether or not to have a Reserve Acquisition Corps. However, as IMAs to a DOD agency, we are obligated to follow the DOD regulations. Is there any other choice?

While individual service IMAs would probably be on the buying command side of acquisition, we are attached to the DCMAOs and DPROs. These have changed dramatically since the contract administration days and now involve much more program management.

I would venture to say that potential USAR Acquisition Corps members are IMAs rather than in TPUs. This creates its own problems: namely accession, training and promotions.

The USAR manages officers as they would upon mobilization: on a branch basis. Functional areas are managed only to the extent necessary, dual tracking is seldom heard of. RD&A IMAs are handled by the Ordnance Branch Team at ARPERCEN, and as with other functional areas, the positions are not mentioned too often. I personally heard of my position from a blind mailing by DLA. The fill of the available positions is very low; reducing the IMA force is made easy by eliminating unfilled positions. While the civilian education and skills required for Acquisition Corps positions are widespread in the USAR officer corps (after all, these officers have civilian industrial jobs), acquiring these officers is difficult as the officers must look outside of their normal branch.

Training is the most serious problem. This is paid for by the reserve components, not the gaining agencies. The agencies must define the training requirements for each IMA position so that funding and school quotas are found. As reservists must coordinate with their employers, short notice training opportunities are painful for everyone.

The duration of required training courses plus the need to be qualified before assuming a position needs to be evaluated. The reservist does not have the option of taking a course TDY en route to a new position. More has to be offered by correspondence courses, and then after assuming a position. To make the situation worse, many DLA positions are classified joint duty, with training requirements also defined by public law.

I would strongly advise USAR Acquisition Corps positions be DIMA. Otherwise, the only time an agency sees or hears from an IMA is for the two weeks AT. The typical DIMA receives 24 paid drills plus AT. The drills do not have to be performed at the mobilization unit. DIMA policies vary among the services; USNR 48 drills, USAFR 24 drills, USAR sometimes 24 drills. This makes IMA training at DLA difficult to coordinate.

Promotions are a sore point. In 1992 not one 97 and but one 51 made the USAR COL APL. The 1992 results were biased towards the combat arms and the National Guard. How do we interest officers in the Acquisition Corps, with the stiff training requirements, if there is no future? As an aside, the USAR ignores promotion requirements for joint officers similar to those of DAWIA.

The USAR does have unit vacancy promotions that are analogous to the secondary zone in the AC. However, these are only for TPUs, not IMAs, even though both are Select Reserve.

I have enjoyed my DLA positions, the assignments have been outstanding. For one AT I was made a DPRO commander on short notice during a gap in coverage between old and new USAF COs. I have always been treated as a peer. I believe the Army would benefit from a Reserve Acquisition Corps.

Theodore J. Bassman, Jr.
LTC, USAR
21/97

Response from: COL James L. Carney Director for Reserve Affairs OASA(RDA)

COL Bassman states that all of the military services are trying to decide whether to include their Reserve Components in their Acquisition Corps. This is surprising to me because the OSD regulations state specifically that the reserves ARE to be included, except for the National Guard which has been largely excused from participation. Unfortunately, this decision by the Secretary of Defense forecloses the discussion that should be taking place; i.e., to what extent, if any, should Reservists be included in their Service's Acquisition Corps and what training requirements make sense for them. What OSD should do, in my opinion, is tell the Services that their Reservists must be Acquisition Corps qualified to fill acquisition positions upon mobilization or activation for other than training. Then let the Services decide for themselves how to prepare for that.

Approximately 20 percent of the identified USAR positions in acquisition are in Troop Program Units (TPUs), mostly contracting jobs. This is much less than the 514 positions in the IMA program but still a significant number. In any event, because there is no systemic process for cross-walking between the two Selected Reserve categories, particularly in a niche field like acquisition, designing a coherent career path for Reservists in acquisition is nigh impossible, and probably counter in many cases to the best interests of both the Reserve officer and the nation. This is because the higher the level of activity, the better trained and the more valuable a Reserve officer is to national defense. He or she should be encouraged, therefore, to leave an IMA position for a TPU position, even if that means changing career fields and even requalifying in a different branch. Promotion to colonel also becomes much more likely as one's level of participation rises.

Training is, as COL Bassman points out, the most serious problem. The OSD regulations establish specific training requirements for the various acquisition career fields. In a few cases, the course does not exist at all, much less in a correspondence mode. Time to attend courses is a critical problem for most Reserve officers. Money to pay for that extra training is a critical problem for the Army in the face of a declining defense budget. Since a Reserve officer usually acquires his (or her) acquisition expertise primarily in his civilian job, it seems reasonable to waive or at least extend the training requirements for Reserve officers in an Acquisition Corps.

It is not clear why acquisition positions should have a higher claim on drilling IMA (DIMA) funding than non-acquisition IMA positions. In fact, I do not believe such a case can be made. Further, drills need to be under the control and management of the IMA agency, which, in my experience, generally limits DIMA participants to those within commuting distance of the assigned agency.

AWARDS

Award Recipients Named

The following Army Acquisition Corps and acquisition support personnel are recent recipients of key awards. **Army Acquisition Executive Support Agency (AAESA):** MG Peter M. McVey, Program Executive Officer—Armored Systems Modernization (ASM), Distinguished Service Medal; SFC(P) Steven P. Anderson, Program Executive Office (PEO)—ASM, Meritorious Service Medal (MSM); MAJ Peter A. Grant, PEO-ASM, MSM; LTC Joseph W. Kitchell, PEO—Intelligence and Electronic Warfare (PEO-IEW), Army Achievement Medal (AAM); LTC(P) Dennis McGaugh, PEO-IEW, Legion of Merit (LOM); SFC Dale Cotner, PEO—Aviation, AAM; SSG Gregory A. Smith, PEO—Aviation, AAM; MAJ Kenneth A. Vinning, PEO—Aviation, MSM; COL Ronald N. Williams, PEO—Aviation, LOM; LTC Mark C. Drouillard, PEO—Combat Support, Army Commendation Medal (ARCOM); COL Gerard P. Barrett, PEO—Global Protection Against Limited Strikes (GPALS), LOM; LTC Gary G. Swenson, PEO-GPALS, MSM; CPT Raymond J. Nulk, PEO—Tactical Missiles, MSM; and CPT Fred J. Wilson, PEO—Tactical Missiles, ARCOM.

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BULLETIN

Professional Bulletin of the RD&A Community

WRITER'S GUIDELINES

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PURPOSE: To instruct members of the RD&A community relative to RD&A processes, procedures, techniques and management philosophy and to disseminate other information pertinent to the professional development of the RD&A community.

SUBJECT MATTER: Subjects of articles may include, but may not be necessarily limited to, policy guidance, program accomplishments, state-of-the-art technology/systems developments, career management information, and management philosophy/techniques. Acronyms should be kept to an absolute minimum and when used, must be written out and explained.

LENGTH OF ARTICLES: Articles should be approximately 1,500 to 1,800 words in length. This equates to 8-9 double-spaced typed pages, using a 20-line page.

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

BIOGRAPHICAL SKETCH: Include a short biographical sketch of the author/s. This should include the author's educational background and current position.

CLEARANCE: All articles must be cleared by the author's security/OPSEC office and public affairs office prior to submission. The cover letter accompanying the article must state that these clearances have been obtained and that the article has command approval for open publication.

Authors should include their address and office phone number (DSN/autovon and commercial) when articles are submitted.

In addition to printed copy, authors should submit articles on a 5 1/4-inch floppy disk in ASCII format.

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