30th Anniversary Issue

ARMY LOGISTICIAN

JANUARY-FEBRUARY 1999

The Revolution in Military Logistics

PB 700-99-1 Headquarters, Department of the Army

ARMY LOGISTICIAN

PROFESSIONAL BULLETIN OF UNITED STATES ARMY LOGISTICS

PB 700–99–1
VOLUME 31, ISSUE 1
JANUARY-FEBRUARY 1999

ARTICLES

Army Logistician (ISSN 0004-2528) is a bimonthly professional bulletin published by the Army Logistics Management College, 2401 Quarters Road, Fort Lee, Virginia 23801-1705. Periodicals postage paid at Petersburg, VA 23804-9998 and additional mailing offices.
Mission: ***Army Logistician*** is the Department of the Army's official professional bulletin on logistics. Its mission is to publish timely, authoritative information on Army and Defense logistics plans, programs, policies, operations, procedures, and doctrine for the benefit of all logistics personnel. Its purpose is to provide a forum for the exchange of information and expression of original, creative, innovative thought on logistics functions.
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Postmaster: Send address changes to: EDITOR ARMY LOGISTICIAN/ALMC/2401 QUARTERS RD/FT LEE VA 23801-1705.

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Acknowledgment

Army Logistician gratefully acknowledges the editorial, administrative, and financial support of the Army Logistics Integration Agency (LIA), Office of the Deputy Chief of Staff for Logistics, in the preparation of this special issue on the Revolution in Military Logistics. Under the direction of Mark J. O'Konski, LIA's support was vital in conceiving and compiling this issue and bringing it to publication. In particular, we would like to thank Mike Hendricks, LIA's liaison with ***Army Logistician*** on this project, for his unfailing cooperation and assistance.

–Editor

☆ U.S. GOVERNMENT PRINTING OFFICE: 1999 – 432-782-80002

A Revolution in Military Logistics:

"Changing logistics in support of a power projection Army by Reshaping the way we project and sustain… Right stuff, right place, right time…always at best value!"

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ISSN 0004-2528
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US ARMY LOGISTICS MANAGEMENT COLLEGE
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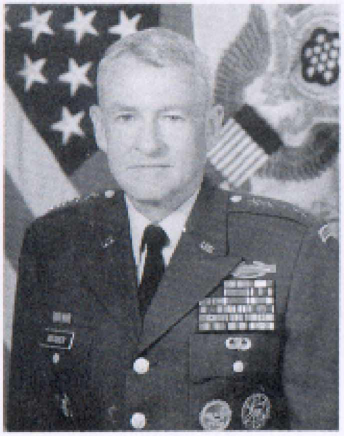

A Note From the Chief of Staff of the Army on

The Revolution in Military Logistics

Congratulations to *Army Logistician* as it celebrates its 30th anniversary of publication. Throughout its distinguished history, there can have been no more exciting time than today in the world of Army logistics. As I have said many times, there can be no revolution in military affairs (RMA) without first having a revolution in military logistics (RML). To provide the capabilities-based forces we need for the future, we must set the stage for transformation by changing the way we project and sustain those forces. We stand at the threshold of a new era in military logistics—a truly exciting time.

We are dramatically transforming the way we support forces. This revolution is about more than providing equipment and supplies better, cheaper, and faster, although these initiatives are crucial for readiness and modernization today. It is also about rethinking logistics functions and processes that will enable decisive victories well into the future. This revolution spans the depth and breadth of military logistics—from achieving an agile defense infrastructure to getting the right stuff at the right time to the soldier in the foxhole. It includes integrating logistics functions, replacing volume with velocity, reducing demand, and lightening the logistics load on the ultimate customer—the warfighter.

We have a clear vision of 21st century global military logistics and paths to achieve it. All of our efforts are focused by the six tenets of RML—a Seamless Logistics System, Distribution-Based Logistics, Agile Infrastructure, Total Asset Visibility, Rapid Force Projection, and an Adequate Logistics Footprint. Achieving this vision requires the best efforts of our entire logistics community, Army soldiers and civilians, active and reserve. It includes Department of Defense initiatives and support to our sister Services. It also demands strong and long-term partnerships with industry to develop and exploit the best ideas and practices.

You will read about many ongoing initiatives in this issue. You will see many other efforts in the field as you implement streamlined procedures to request and receive support. We are well along the path to the 21st century, and we must continue to aggressively pursue the transformation of logistics processes and products. The opportunities and benefits before us are enormous. Again, I want to thank *Army Logistician* for showcasing the Revolution in Military Logistics with this important 30th anniversary edition. I also want to express my deep appreciation to all soldiers, civilians, and industry partners who are working so diligently to realize the vision. In our movement to contact with the future, Army logistics will lead the way!

Dennis J. Reimer
General, United States Army
Chief of Staff

GEN Wilson

LTG Coburn

MG Brown

Our Revolution In Military Logistics—Supporting the 21st Century Soldier

by General Johnnie E. Wilson, Lieutenant General John G. Coburn, and Major General Daniel G. Brown

"Logistics is the lifeblood of armies"—our Chief of Staff, General Dennis J. Reimer, believes this . . . and we believe this. As we move into the 21st century, that will not change. However, changing how we fight influences changes in how we support. Army XXI will require changes in doctrine, organizations, business practices, and training, and an increased reliance on advanced technologies. It is a challenge we are meeting while simultaneously balancing near-term readiness and force modernization in an environment of increased missions and fewer resources. It will take visionary leaders—people who can think "outside the box"—to make it a reality. The future of Army logistics remains tied to its fundamental tenet— responsiveness to the warfighter and to the national military strategy. We have to field future logistics systems that support both ends of the spectrum simultaneously. Logistics is not just a combat multiplier; rather, it is a warstopper!

The operational and intellectual underpinning of Army XXI and Army After Next (AAN) is based on knowledge and speed, but the Achilles heel in AAN is not operational speed or killing power. It is logistics. The logistics pipeline must be shrunk, the load lightened, and the closing time cut. Just as German operational maneuver groups in World War II were able to break away from the logistics railhead, we must provide the same kind of capability to similar concepts envisioned for AAN forces. At the joint level, change started with *Joint Vision 2010* and *Focused Logistics*; at the Army level, change starts with a *Revolution in Military Logistics* (RML), which already is underway. The RML is not only central to preparing for future military operations; it is the fulcrum of the Army's effort to balance readiness and modernization.

The first wave of our revolution (from now until 2010) will focus on exploiting improvements in automation, communications, and business practices; reshaping command and control relationships to provide better unity of command; and purchasing distribution technologies that facilitate rapid throughput and follow-on sustainment as we build for Army XXI. We want to know what our customer, the warfighter, needs before he requests it. We must anticipate battlefield requirements. The single combat service support (CSS) operator at each level of command will capitalize on technologies such as smart diagnostics, prognostics, and the latest information technology to help reshape our products and practices. With these improvements, we can gain and maintain information dominance by knowing and acting on what our force requires.

The second wave of the revolution (2010 and beyond) will focus on maximizing emerging technologies to lighten support requirements (particularly in classes III and V and water), project them faster, and reduce the overall demand for logistics. Technological breakthroughs in propulsion, lightweight armor, power supplies, information distribution, and other disciplines will feed this wave. Through this era, we will continue to exploit information dominance and use new technologies that provide real-time logistics control and support at all echelons. As a force, we must beat a potential adversary to the punch. This second revolution will focus on just that.

The Revolution in Military Logistics is still in its infancy. We know that logistics results achieved by world-class U.S. companies did not come easily or overnight. They had to transform their support structures or risk going out of business. They reengineered their processes, contracted out where it provided better performance at lower cost, applied information technology solutions, and overcame cultural opponents who insisted on business as usual. RML is the counterpart to what industry did to remain competitive. As it matures, the logistics system will become predictive, anticipatory, and responsive—a system that uses sensors to anticipate equipment problems, monitor consumption, and automatically generate replenishment to a predetermined level based on OPTEMPO and projected battle requirements. We will think in terms of hours, or even minutes, rather than days. We need to use the RML to bolster our ability to act decisively, with knowledge and assurance of providing support on time, in the right place, and in the right quantity.

We have a roadmap to guide us through this transformation. It is structured along six tenets that frame how logistics will be performed and what it must do in the 21st century. It is a plan that will exploit not only the potential of the soldiers and civilian employees of our Army but also the potential of our partners in industry. These six key tenets capture the essence of future logistics: a seamless logistics system, distribution-based logistics, total asset visibility, agile infrastructure, rapid force projection, and maintaining an adequate logistics footprint. Thanks to *Army Logistician*, we have a means to showcase how our Army is changing to meet the challenges of the 21st century. The articles you will see in this special edition help to set an azimuth that guides how we are changing our doctrine, organizations, training, business processes, command, control, communication, computer, and intelligence (C4I) architecture, and hardware enablers to support the force.

The digitized, force projection Army of the future requires efficient logistics organizations that are quickly adaptable to the warfighter's needs. Our Army has moved from a threat-based force to a capabilities-based force able to dominate across the spectrum of conflict. Leading this will be the digitized Army XXI division—the backbone of the Army's capabilities-based force. It eventually will be supported by a hybrid of forces (special operations, strike, contingency light, and contingency heavy forces). Our logistics organization must be capability-based, modular for flexibility, able to anticipate and predict logistics requirements sooner, have pipeline visibility, focus limited logistics resources at the point of need, and able to react faster than ever before. The recent creation of forward support companies in the digitized Army XXI division will employ many of these attributes. Our overarching objective is to achieve a single CSS operator at each echelon to facilitate maximum throughput and follow-on sustainment.

We know that the predominately continental United States (CONUS)-based infrastructure must incorporate flexible organizational designs, world-class facilities, modern systems and platforms, and soldiers equipped with the latest equipment and supplies. The RML relies heavily on the Army Materiel Command (AMC) as the Army's provider of power projection, sustainment, weapon system management, and technology generation. Even as we transition into the 21st century, its core competencies will still remain logistics power projection, acquisition excellence, and technology generation and application. Yet, something fundamental now is taking place; in light of reductions and changing processes, a shift is occurring from a position of "owning" core competencies to that of "integration."

New ways of providing support for major weapon systems are being explored—methods that achieve significant savings over the life of a major weapon system. Modernization Through Spares will help reduce operating and support costs by using performance-based requirements permitting technology insertion and use of commercial processes, products, and practices. Prime vendor support of the Apache and Fleet Management of the M109 family of vehicles are being evaluated. These processes, combined with a movement to competitive sourcing of non-core work that does not jeopardize support to the warfighter, along with previous base realignment and closure (BRAC) reductions, Quadrennial Defense Review (QDR)-mandated cuts, and changing support concepts, have had a tremendous impact on AMC's current organizational structure. A general officer-led Overarching Integrated Product Team has been formed to develop options, associated cost savings, and recommendations for reengineering AMC while ensuring that the end-state organization is capable of accomplishing the mission of equipping and sustaining soldiers.

Balancing readiness and modernization while supporting our Nation's largest business necessitates improving our logistics processes. RML calls for a logistics system that focuses on managing information and distribution, not inventory. The implementation of multiple business practices that enhance the six RML tenets will leverage the advantages technology and automation provide. One such business process is the movement toward a single stock fund (SSF). This initiative will eliminate the current horizontal layering of sustainment supply, maintenance, and financial practices and create a vertical view of our Army working capital fund, supply management Army inventories, and financial actions. Commanders on the ground will see better supply availability with reduced logistics and financial management burdens. We are accelerating the implementation of SSF in fiscal year (FY) 1999 by establishing a new national management process that realigns the roles and responsibilities of the Army Deputy Chief of Staff for Logistics and the Army's major commands. Before implementing new SSF business processes, we will validate new SSF business processes in laboratory and field environments to ensure that there will be no adverse consequences on peacetime readiness or wartime sustainment. Change translated to field support means soldiers will have equal confidence in providers and sustainers wearing "suits," BDU's [battledress uniforms], or "purple" crests.

Another process improvement, which is taking place through two policies recently signed by the Army Vice Chief of Staff and the Army Acquisition Executive, involves formalizing better diagnostics and prognostics. The policies basically direct program executive officers and combat and materiel developers to coordinate their embedded diagnostics plan for new and retrofitted equipment with the Program Manager-Test, Measurement, and Diagnostic Equipment (TMDE). A third business process, Subsistence Prime Vendor, already in operation, provides food distribution to all CONUS military installations (outside of CONUS to be completed in FY 1999).

Maintaining an adequate logistics footprint focuses on putting the right logistics organization at the right location with the appropriate resources anywhere in the world. Increasingly, the force structure will consist of a mix of soldiers and our partners in industry. No longer will it seem unusual to see contractors near the battlefield. The recent publication of the Contractor Deployment Guide, DA Pamphlet 715-16, and ongoing initiatives by the Assistant Secretary of the Army for Research, Development, and Acquisition and the Army Combined Arms Support Command to publish doctrine on both contracting and contractors on the battlefield will help solidify this concept.

RML equates to strong partnership with industry, as well as with the joint community and with the other Services. Through this process, we will learn from industry and our other Services—but they also will learn from the Army. This revolution also means establishing and fostering an active, enhanced partnership with the reserve components. The Army, for example, trains 40,000 Marines each year in logistics. We are "partnering" with industry through research, production, facility use, and partners on the battlefield. This "partnering" spirit applies to the programs we are forging between the active and reserve components. The Office, Chief of Army Reserve (OCAR), programs for upgrading D7F bulldozers and rough-terrain container handlers, plus the National Guard Bureau's ¾-ton trailer repair program, enhance our maintenance as well as our supply posture—all while giving great training opportunities to reservists. Component repair performed at our installations is fully integrated on a regional basis, to include Army National Guard and Army Reserve units through the Army's integrated sustainment maintenance (ISM) program. OCAR is providing transportation support to ISM on a test basis. The unit training benefits, coupled with the maintenance and supply efficiencies gained by ISM, make this a win-win program for all players.

It is the integration of these changed business processes that provides the revolutionary aspect of synergistic results. When we combine changes in tactical, operational, and strategic sustainment simultaneously with changes in the way we obtain technology, acquire systems, and get them to the digitized force, we get at the revolution. When we put ISM, SSF, and wholesale logistics modernization together with Global Combat Support System–Army (GCSS-Army), revolutionary things will happen for the soldier and sustainment.

Initiatives like GCSS-Army will turn the seamless logistics system tenet into a reality. GCSS-Army will transform segmented, "stovepipe" standard Army management information systems (STAMIS) into a single logistics (retail, wholesale, and joint) automated system that will replace the current STAMIS and interface with existing battlefield automation systems. GCSS–Army will cut across all CSS disciplines, to include manning and sustaining the soldier and the soldier's systems. It consists of a series of functional modules, such as supply, property, maintenance, ammunition, and management, all of which use an integrated relational data base. Each module will run at the level or organization where soldiers perform that mission. Tier I, which includes the functionality of existing logistics retail

STAMIS and the first of a three-stage development plan, is scheduled to begin fielding in late FY 1999 or early FY 2000.

Building stovepipe systems is a "prerevolutionary" business practice none of us can afford again. The full success of the single seamless logistics system will be measured by how well GCSS–Army ties into other critical automation tools such as the Combat Service Support Control System (CSSCS) and the Transportation Coordinator's Automated Information for Movements System–II (TC AIMS–II). The ability to pass the logistics STAMIS-type information through GCSS–Army, and then share a portion of it with CSSCS, will start giving future logisticians a "common logistics picture" across all echelons. The same concept applies to getting critical transportation movement information through the TC AIMS–II and into CSSCS, thereby giving the future logistician information dominance (ID). ID means knowing where the supplies are, in what quantity, and when they will arrive. The challenge of seamlessly connecting these systems is being worked by a host of teamed logisticians: joint and Army policy and resourcing analysts, combat and materiel developers, and experts from industry and academia. Seamlessly connecting these systems and making them work is a challenge that must be overcome. Through integration, we can only enhance how battlefield distribution is performed.

We know that distribution-based logistics works. We estimated that the time it takes to move containerized ammunition from the depot to the unit will drop from 74 to 34 days in Europe. Since June 1995, order and ship times (OST's) for areas as diverse as Korea and Fort Hood, Texas, have fallen from 34 to 14 days and from 23 to 8 days, respectively. In Bosnia, strategic packaging, radio frequency (RF) tags, movement tracking systems, and automated manifest system cards are being used to speed the flow of supplies. The use of the TC AIMS–II, in conjunction with two-dimensional bar code scanning, has enhanced deployment activities significantly in Tuzla, Bosnia. Use of RF tags and fixed or hand-held interrogators is making a difference in tracking stocks. Last year alone, more than 6,900 RF tags clipped to air line of communication (ALOC) shipments were processed through New Cumberland Army Depot, Pennsylvania—and that number is expected to grow to 8,400 for 1998.

It is important to note that the Army has completed, and makes continually increased use of, its Army total asset visibility (ATAV) capability. We know, in real time, the location, quantity, and condition of about 99 percent of all Army materiel, from wholesale through and including retail-level stocks; in other words, the authorized stockage lists (ASL's). Indeed, much of the data in joint TAV (JTAV) that is available to the warfighting commanders in chief (CINC's) has its origin in ATAV. Exploiting this knowledge, and applying "control" to the various supply chains (TAV+C), will be a critical mission of a "revolutionized" AMC if we are to realize the RML vision of global, strategic, and tactical logistics management.

Getting the right technological enablers into our soldiers' hands is paramount in building an agile infrastructure. Fielding critical logistics enablers, such as GCSS-Army, TC-AIMS-II, TMDE, movement tracking systems, CSSCS, improved diagnostics, palletized loading systems, and materiel handling equipment, is one of our top priorities; getting the dollars to support these programs remains one of our toughest challenges. Rapid force projection (normally thought of as enhanced strategic lift) is actually much more than lift. Being able to move sustainment stocks throughout any contingency, buying new lift technologies and systems, and investing in research and development technologies that lighten force infrastructure and provide the support needed to sustain it are parts of this tenet. Eighteen of the 19 large medium-speed roll-on-roll-off ships are now under contract, and 42 of an eventual 120 C-17 aircraft have been delivered. The Army also is investing $682 million (FY 1999 to 2003) in upgrades and improvements to our CONUS deployment infrastructure.

The programs, processes, and initiatives described are linking today with the force of the 21st century. The RML points us in the right direction. Ensuring that our logistics systems are efficient in peace and reliable in war is our goal. Transforming our logistics organizations and processes to this improved efficiency and reliability will be a tremendous challenge, but we are confident that our logisticians around the world are equal to the task. Fundamental values and a steady focus on quality soldiers, world-class equipment, and relevant doctrine and policy continue to be our bedrock as we push for change. Supporting soldiers remains our mission, now and into the 21st century. **ALOG**

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Lieutenant General John G. Coburn is the Deputy Chief of Staff for Logistics, Department of the Army.

Major General Daniel G. Brown is the Commanding General, Army Combined Arms Support Command and Fort Lee.

Joint Vision 2010 and Focused Logistics

by Lieutenant General John M. McDuffie, USA

Joint Vision 2010 is the conceptual template for how America's Armed Forces will channel the vitality and innovation of our people and leverage technological opportunities to achieve new levels of effectiveness in joint warfighting. Inherent in this is the development of four new operational concepts—

- Dominant Maneuver.
- Precision Engagement.
- Full Dimensional Protection.
- Focused Logistics.

As the Department of Defense (DOD) moves closer to the year 2010, we must be able to capitalize on information superiority and its associated technological advances. Information superiority is the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same. It is also the common band that ties the four new operational concepts together.

The Joint Staff recognizes the importance of achieving a Revolution in Military Logistics (RML) and the value of RML in successfully maintaining force readiness. While the Global Combat Support System (GCSS) is the warfighter's strategy to achieve logistics information superiority, Focused Logistics is the game plan.

Joint Vision 2010 describes Focused Logistics as the fusion of logistics information and transportation technologies for achieving rapid crisis response; deployment and sustainment; the ability to track and shift units, equipment, and supplies even while they are en route; and the delivery of tailored logistics packages and sustainment directly to the warfighter. To support the other operational concepts, Focused Logistics must be responsive, flexible, and precise. Logistics systems envisioned by Focused Logistics will include refined techniques for ensuring combat readiness and sustainment while attaining increased efficiencies. The goal is *full spectrum support,* from deployment to redeployment, reconstitution, or forward deployment, while at the same time enhancing both our combat effectiveness and the quality of life of our forces. The vision calls for improved support to the warfighter through the increased responsiveness, visibility, and accessibility of logistics resources.

When the Directorate of Logistics for the Joint Staff published *Focused Logistics, the Joint Logistics Roadmap to Joint Vision 2010,* we charted the course for gaining full spectrum support across the range of possible missions envisioned in Joint Vision 2010. Based on the concept of leveraging key enablers of technology innovation and information superiority, we presented an integrated approach on how to support the other operational concepts to achieve full spectrum dominance in joint warfighting. Focused Logistics maximizes the benefits to be gained from information superiority and technological innovation. By providing full spectrum coverage, the joint warfighter receives comprehensive support from the source of supply to the point of need, whether that is a foxhole, cockpit, ship, or base.

This joint logistics roadmap outlined several key joint initiatives that will lead to the desired future logistics capability. Inherent in this process was the development of six key tenets, which will emphasize a systematic, relational approach to developing full spectrum supportability. These tenets are the framework for designing the logistics template in joint warfighting—

- Joint Theater Logistics Management.
- Joint Deployment/Rapid Distribution.
- Information Fusion.
- Multinational Logistics.
- Force Medical Protection.
- Agile Infrastructure.

Information Fusion is key, and GCSS is the "lens" through which we will see this strategy. The end state for GCSS is a secure, network environment allowing DOD users to access shared data, applications, and administration, regardless of location, and supported by a robust infrastructure. This will result in near-real-time command and control of the logistics pipeline, one fused picture of combat support to the warfighter, and a closed link between command and control and combat support during the execution of any operation or mission in support of the joint warfighter. As Joint Vision 2010 guides America's Armed Forces into the 21st century, GCSS provides the combat support component through Focused Logistics, providing the joint warfighter with the support needed to achieve information superiority and full-spectrum dominance. **ALOG**

Lieutenant General John M. McDuffie, USA, is the Director for Logistics, the Joint Staff. Special thanks to Captain Dave Shanahan, USN, of the J4 Readiness and Requirements Division, for his contribution to this article.

Revolution in Military Logistics—Improving Support to the Warfighter

by Lieutenant General Henry T. Glisson, USA

There will be no Revolution in Military Affairs unless there is a complementary Revolution in Military Logistics. As modern warfare increases in technological sophistication, speed, and complexity, there will be dramatic changes to the way we fight. These changes in how we fight will require a change in the way we provide support. Logistics and acquisition organizations and systems must change to keep pace. What we do will not change, but how we do it will change radically.

The Defense Logistics Agency (DLA) has embarked on an aggressive effort to improve our support to the warfighter. DLA is reengineering its business practices to provide products to our customers "better, faster, and cheaper." Our philosophy is simple: capture and adapt best-value commercial business practices and supercharge them by applying emerging technologies.

Compare our current methods of buying, stocking, and issuing material to yesterday's methods to see how far DLA has come. In the past, we achieved our mission by buying products that were made to strict military specifications, and we bought them one at a time as the need arose. Then, we maintained vast inventories of stock at both the wholesale and retail levels, double-handling stock as it arrived from the vendor for reshipping to customers, all with a vast paper trail in tow. Today our practices substantially reduce inventory through long-term partnerships with industry, direct vendor deliveries to customers from commercial distribution systems, on-demand manufacturing arrangements, and electronic commerce.

Logistics has changed from a supply-based system relying on large stockpiles to a quickly developing Web-enabled distribution system that exloits advances in commercial information systems to gain total asset visibility and to improve management of the entire supply chain. DLA's focus is shifting from managing inventories to managing information across the supply chain; from managing supplies to managing suppliers; and from buying inventory to buying response time.

All of this reengineering is designed to provide the best combat support to the warfighter. Embedded in that goal is our commitment to lower costs so that more funds will be available for force modernization.

Let me illustrate the success of our reengineering efforts with some concrete examples.

Prime vendor business arrangements enable us to contract with one full-service distributor of commercial products rather than with hundreds of individual vendors. The prime vendor, under a long-term contract, provides all material in a product line or commodity to a major customer or regional customers on a just-in-time basis. Prime vendor contracting is a win-win situation because it eliminates the middle bureaucracy and puts customers directly in touch with vendors.

As an example, our Subsistence Prime Vendor program provides food for military garrison feeding. Taking advantage of the infrastructure of industry has allowed DLA to achieve direct shipment from vendor to customers within 24 to 48 hours, and our customers receive fresher, brand name products. From fiscal year (FY) 1995 to FY 1998, we estimate that we reduced commercial warehouse costs from $17.5 million to $9.0 million and subsistence inventory from $90 million to $25 million.

The Virtual Prime Vendor (VPV) program represents the next-generation prime vendor. It requires the prime vendor to furnish total logistics support to depot maintenance customers. The contractor uses any appropriate combination of DLA corporate contracts, DLA depot stocks, other long-term contracts, agreements, or prime vendor procurement. Currently, we have an operational VPV structure established for C-130 propeller system hubs and blades.

DLA's electronic mall (Emall) enables customers to shop via the Internet and browse electronic catalogs, compare prices, and order items they choose from preestablished contracts via personal computers. It blends the best of Internet-based shopping with the benefits provided by the International Merchants Purchase Authorization Card (IMPAC) and the Prime Vendor program. Preliminary estimates of net savings to the Government are in the tens of millions of dollars annually.

Single Process Initiative (SPI) is a key acquisition reform initiative that eliminates multiple processes in both manufacturing and management on all existing contracts within a facility. Government-unique processes are replaced with common, facility-wide processes that adopt best practices drawn from both commercial and Government experience. Everybody wins—Government oversight is reduced, the contractor is able to operate more efficiently, and cost, schedule and performance benefits are achieved for both the Government and the contractor. More than 600 contractors have proposed 3,152 process changes, and we already have modified about 1,859 processes. As a result, savings and cost avoidance to Department of Defense programs now exceed $472 million.

Early contract administration services can ensure upfront involvement in the acquisition cycle. By bringing contract management professionals into the acquisition process early, before costs are incurred, post-award complications are significantly reduced. We have a lot of knowledge about contractors and their past performance that should be considered early on in making decisions. Our goal is to share that knowledge to help our customers develop better acquisition strategies, craft more easily executed and administered contracts, select more capable contractors, and streamline their acquisitions.

Another significant initiative at DLA is our transition to paperless contracting. Anybody working around Government contracting knows the job is paper intensive. On behalf of the entire Defense Department, we are working on converting a number of projects to paperless contracting, with a January 2000 target date for full implementation.

We are paying more than 40 percent of all progress payment dollars electronically now. Since October 1997, we have paid $3.2 billion in progress payments electronically. In addition, we now are modifying contracts electronically. Last year, the Defense Contract Management Command (DCMC) alone issued about 97,000 modifications. DCMC already is posting over 90 percent of its modifications on the Internet. We currently are reengineering the process of receiving and accepting products for the Government. Now, our people execute a DD Form 250, Material Inspection and Receiving Report, which occurs almost 1.2 million times a year. That is a lot of paper that won't be needed in the future.

These are just a few of the many initiatives that make up the Revolution in Military Logistics at DLA. But they are just the beginning. Our success is essential for the warfighter's success, and we will not let the warfighter down. We will continue to improve as long as the customer demands it. **ALOG**

Lieutenant General Henry T. Glisson, USA, is the Director of the Defense Logistics Agency, Fort Belvoir, Virginia.

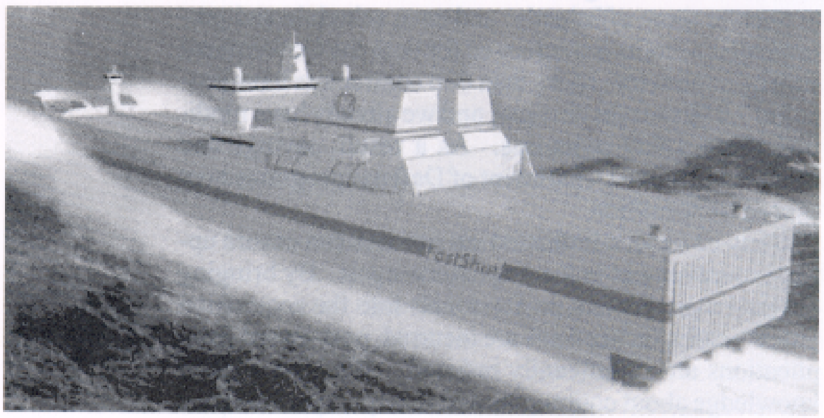
Revolution in Military Logistics: An Overview

by Mark J. O'Konski

The Army is leveraging technology to develop new concepts and reshape the way we project and sustain the force.

General Dennis J. Reimer, the Chief of Staff of the Army, often has stated that there cannot be a revolution in military affairs without there first being a revolution in military logistics. So, just what is this Revolution in Military Logistics (RML)? The Army's top logisticians have sponsored an effort over the past 2 years to define the RML and map a definitive path that guides the Army through it. The vision of the RML that has emerged is of a truly revolutionary logistics system that marries the power of information with modern transportation and electronic commerce systems.

The heart of the vision is the change to distribution-based logistics. To manage this new, dynamic approach to logistics, the Army will evolve a seamless logistics system that ties all parts of the logistics community into one network of shared situational awareness and unified action. These changes in turn will help the Army modernize its equipment, not only to continue dominating the battlefields of the future but also to be more deployable, supportable, and efficient. Organizations will evolve and new organizations created that will be tailored to managing distribution-based logistics. The result will be a power-projection and sustainment capability unlike anything the world has seen to date—a Revolution in Military Logistics!



The RML spans three domains: technology application and acquisition agility, force projection, and force sustainment. More importantly, it also integrates these three domains to produce a truly revolutionary result.

For example, as the program managers, scientists, and engineers in the technology and acquisition domain strive to develop the systems and components for Army XXI and the Army After Next, they also seek to reduce the physical size and the consumption rates of those new systems. They find new materials that are lighter, stronger, and more reliable, and they use new technologies to produce systems that are more powerful but consume less fuel.

At the same time, these new, fewer, lighter, but more powerful land-power systems are easier to deploy globally, at lower cost and with greater speed. Technology and acquisition efforts also support the development and fielding of improved projection platforms, such as the large, medium-speed, roll-on-roll-off (LMSR) ships now entering our strategic mobility fleet. Combined with world-beating systems such as the Air Force's C-17 transport and emerging commercial technologies such as the Fast Ship, RML force projection will put U.S.

new information system—it's really a new way of doing business. It has a crucial role in making Focused Logistics and distribution-based logistics a reality. The key processes of the seamless logistics system are—

• Readiness management, which requires skilled logisticians to track and fuse the plans of the warfighters and the prognostic feeds from systems in the field to forecast the status of units and judge whether they can support the mission.

• Logistics interventions, which are packages of materiel, labor, equipment, and skills that produce a specific improvement in readiness for a specific unit. They are bundled and linked to a specific readiness improvement goal to allow efficient use and reuse of both supplies and platforms in the distribution-based logistics network.

• Distribution management, which uses the seamless logistics system to task the distribution system to move assets to the point of need.

• Asset management, which uses the seamless logistics system to match available assets with needs, identify total shortfalls of assets, and then interface with Government and industry suppliers to acquire additional assets.

All aspects of the acquisition cycle need to be supported—from requirements determination through purchase and payment. This is why the seamless logistics system needs to be a seamless window to commercial electronic commerce.

The Global Combat Support System (GCSS) and its Army component, GCSS-Army, represent the first steps toward achieving a seamless logistics system for tomorrow's Army and a start at realizing the RML.

Army Strike Forces on the ground at global crisis points in a matter of hours and dominant land power in the theater in days.

That same technology base also will put the integrated intermodal systems and portable infrastructure of distribution-based logistics on the ground and in operation to sustain the projected strike and dominance forces at unprecedented levels of combat tempo. The agile acquisition system will plug into the global electronic commerce network to ensure an uninterrupted flow of sustainment into the distribution system, ensuring that Army XXI and the Army After Next forces always will have "the right stuff—at the right time."

Seamless Logistics System

Focused Logistics relies on precision logistics management. This precision management will rely in turn on modern information systems and the networks that connect them. The demands of fast-paced Information Age warfare, combined with the realities of the emerging global, information-based economy, make it essential that this RML seamless logistics system achieve unprecedented levels of interconnectivity and interoperability.

This interconnectivity and interoperability extends well beyond the Army-owned tactical and administrative portions of the information chain. By necessity, it encompasses joint, combined, and commercial systems. On the military side, the seamless logistics system obviously must interface with command and control systems, but it also must connect with digitized weapon systems so it can pull in and use the data available from those systems' sensors and onboard prognostics. It must reach in lateral and rear directions to interface seamlessly with the logistics and financial systems of the other services and the Defense agencies. Finally, it must connect to the global network of electronic commerce; this will enable industry partners to track and support Army forces in the field, and it will allow Army logisticians to locate suppliers expeditiously and do business with them. But the seamless logistics system is much more than a

Distribution-Based Logistics

The key change marking the RML, distribution-based logistics, involves much more than the increased use of transportation in the supply chain or incremental improvements in the chain's velocity. Distribution-based logistics represents a whole new way of doing business. Velocity offsets mass, as echelons of inventory are replaced by managed flows of materiel. The key is inventory in motion. The distribution pipeline effectively becomes the RML warehouse.

Will there still be actual stockpiles of supplies in this new supply chain? Well, yes and no. All along the distribution-based supply chain, there will be small, temporary inventories of fast-moving supply lines and in-transit materiel. But the size of those inventories will be determined by the mission, not mandated by historical demand, and their locations will reflect operational realities, priorities, and available lift resources. Faster and more plentiful lift will allow fewer and smaller in-transit holding inventories. Occasionally, the Army will still want to exploit the economic advantages of shipping larger quantities and temporarily establish supply activities to safeguard those commodity holdings.

Will there still be a need for Quartermasters? Definitely *yes*! The materiel management of inventory in motion will more than ever call for the talents of supply chain experts of all ranks and from all components. Under distribution-based logistics, the inventory quantity as well as the demand are extremely dynamic. The RML materiel manager needs to be able to anticipate demand, judge the arrival of assets, and direct appropriate adjustments to the supply system in real time. Since the fastest lift still will be cargo jets, this anticipation of supply demand must extend out 24 to 48 hours. To get this level of anticipation, RML materiel managers will rely on prognostic data from digitized weapon systems, real-time situational awareness of current and planned operations from both the Global Command and Control System (GCCS) and GCSS, and close and continuous coordination with the operational planners they are supporting.

Will the Quartermasters take over the Transportation Corps? Of course not! Professional transporters are essential to distribution management. The materiel managers set up the problem—what has to get where—but the transporters still must make it happen.

And what about the Ordnance Corps—business as usual? Not really. The distribution network works in all directions. There is tremendous opportunity to achieve unprecedented repair efficiencies by moving the work to the best facilities and workers available and then moving the repaired systems and major assemblies rapidly back to the fighting units. To do this, RML repair managers need to focus the distribution-based logistics system to bring together labor, skills, parts, and special equipment at the critical location and the critical time.

Agile Infrastructure

The RML requires agility in a number of dimensions. Army logistics will have to become more agile—structurally, physically, and mentally—in order to cope with the demands of dynamic RML support to the agile and mobile forces of Army XXI, ushering in a Revolution in Military Affairs (RMA).

Structural agility refers to total integration of all Army components, as well as incorporation of support teams from other services, allies, and the Army's partners in industry for specific missions. Teaming and task-organizing are key RMA skills that apply especially to RML support forces. Logistics task forces need to be able to scale up and down in size, as well as in technical expertise. Personnel, teams, and units from all components need to be capable of deploying and moving independently to an intheater rendezvous location. Active and reserve component units must be ready to accept, employ, and in some cases support Department of the Army (DA) and Department of Defense (DOD) civilian augmentation, as well as contractor personnel and equipment. All must be prepared to integrate with allied and host nation support organizations.

Physical agility refers to the need to deploy and maneuver the operational infrastructure of the distribution-based logistics system. Distribution-based logistics depends on an integrated, intermodal network of information systems, distribution platforms, and automated materials-handling equipment. To keep pace with fast-moving Army XXI forces, and to stay one jump ahead of an opponent's long-range weapons, the logistics units and personnel operating this network must be able to maneuver the component systems and control the movement of the distribution platforms on the fly. And they must be able to do so without degrading the throughput of sustainment to the fighting forces.

Mental agility refers to attitude. RML logistics is fast logistics. All logistics managers in the supply chain need to think several steps ahead, all of the time. Real-time, 24-hours-a-day, 7-days-a-week operations will be the norm. Organizations need to staff for this tempo and train team members to work in such a fast-paced environment. Additionally, many of the initiatives in the Revolution in Business Affairs that streamline and improve logistics, acquisition, and financial processes contribute to this new, heightened agility.

Acquisition agility is a key Army goal in RML. In order to keep pace with the fast-changing demands of RMA warfare and RML support, the acquisition system must support rapid and flexible access to a wide range of commercial sources of supply. The agile acquisition system also will be crucial to designing, building, and fielding the advanced systems and modernization packages that will make Army XXI and the Army After Next a reality. Reduced development cycles will provide state-of-the-art technology to our forces in the field at a price the Nation will be willing to pay—if we are agile enough to exploit it!

Total Asset Visibility (and Control!)

Total asset visibility (TAV) is absolutely essential to precision-focused distribution-based logistics. Not only does the current TAV capability need to be fielded completely, it must be enhanced to support the needs of a dynamic supply chain for locating assets with real-time precision. Furthermore, real-time control needs to be added to TAV and to the RML distribution platforms and infrastructure components, and all must be put under the control of the Seamless Logistics System evolving out of GCSS-Army.

What does control mean in TAV? TAV tracks sensor feeds and key events in the document flow to tell logistics managers the location and status of a particular requisition in the supply chain. When the automated infrastructure components of distribution-based logistics become a reality, TAV data also can support decisions by materiel managers to redirect shipments, whether to redistribute unclaimed assets or keep up with changing unit locations and requirements.

Here's how it could work. Assume all shipments have automated tracking devices of some kind—bar codes or radio frequency (RF) tags. A materiel manager notes that a unit has just posted a specific requisition for a key part. The anticipatory capability of distribution-based logistics has pre-loaded the distribution pipeline with a quantity of that part based on projected requirements for the total force for the mission at hand. Now, the first of many specific unit claimants has asked for one of the parts.

By allocating the part to the unit, the materiel manager automatically creates a need in the distribution management subsystem of the seamless logistics system to break out and redirect a portion of the total shipment to the theater. The seamless logistics system sends a command to the first deployable automated sort hub the shipment will pass through to pull the multipack with the part and redirect it to a repackaging unit. The hub also updates the automated manifest of the shipment to reflect the new destination of the part. The multipack is opened, the contents scanned, and several new single and multipack shipments created. The shipments go to the sort hub, and once again they're on their way. Two hubs later, the part is routed to a logistics unmanned aerial vehicle (UAV), having been integrated into a precision airdrop pallet programmed for the requesting unit's dynamic location in the field. The pallet's automated shipping tag information triggers a flight program input to the UAV, which schedules a drop point and adjusts the route of flight. After taking on several other pallets, the UAV is off. En route, drop points are updated to reflect current unit positions and the pallets are updated with the new coordinates. Our box reaches the drop point, is kicked out of the UAV, and is guided by a global positioning system to the requesting unit. Now that's total asset visibility *and control* !

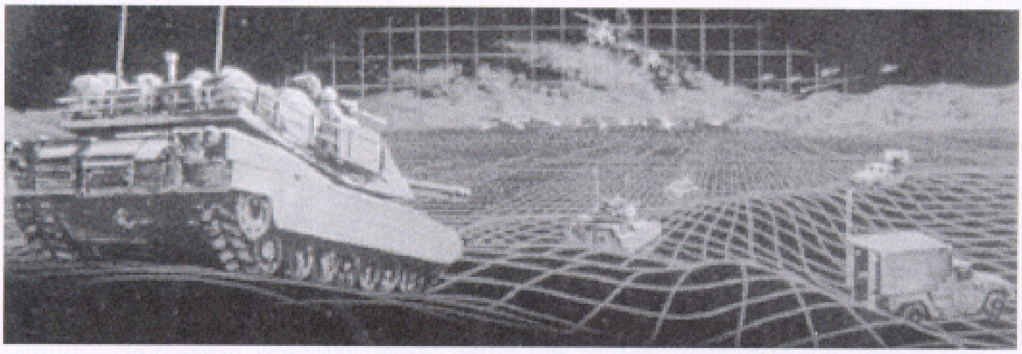
Rapid Force Projection

RML rapid force projection has three key components: strategic force projection of initial early entry forces and strike forces, strategic projection of dominant maneuver forces, and operational and tactical intratheater mobility of units and forces. All three are essential to fighting and winning on an RMA battlefield.

Early initial presence at a crisis location is key to controlling that crisis. U.S. Forces may have to meet opposing forces on their terrain or stop further incursion into a third country's territory. Or the U.S. Forces may need only to be present in a region or on a key border to deter further aggression. Either way, there is a need for speed. Current Air Force strategic-lift aircraft meet that need for speed today, largely as a result of the farsightedness and determination of Army and Air Force senior leaders of the last decade. In the future, this robust and unique capability to introduce ground forces rapidly anywhere in the world must be nurtured and preserved. Make no mistake—this capability is a key source of superpower status in the post-Cold War world.

Just getting forces on the ground fast doesn't win wars. History indicates that dominant land power is required to do this. The United States also enjoys an unrivaled capability to project war-winning ground forces globally. Currently, the fleet of LSMR ships is being built and filled with battle-ready unit sets of heavy force equipment. This capability must be deployed as planned, and it then must be nurtured with maintenance of both the ships and the unit packages they carry. Army-sponsored researchers are looking into even more advanced sealift capabilities. Adaptation of the commercial Fast Ship technologies, as well as more advanced ideas such as massive hydrofoils and surface-effect ships, are all options under review.

Rapid movement on the RMA battlefield also is crucial. Here the picture is not so bright. The Army now relies on the aging fleet of C-130H transports, which are provided primarily by highly dedicated Air National Guard units. Even with the proposed enhancement of C-130J-series aircraft, this still is essentially 50-year-old aviation technology. To deliver 21st century RMA dominant maneuver, the Army will need 21st century aviation technology. This is possibly the most severe shortfall in RMA and RML planning at this time.



Finally, projection of combat forces is of little value if those forces cannot be sustained at a high level of battle readiness. In addition to modern transportation platforms, deployable infrastructure for an integrated, intermodal distribution system is needed to ensure rapid and efficient sustainment of our deployed forces.

Adequate Logistics Footprint

The last tenet reminds us that efficiency is more than just doing more with less. Army logistics has risen to the challenge of RML and responded with a concept, backed up by a plan, that provides previously unheard-of levels of capability as well as previously unheard-of levels of efficiency and economy. But there always will be a limit to how small the logistics system can get without sacrificing support to the combat units.

Maintaining an adequate logistics footprint involves a number of things. One is presence in the theater of operations. In today's complex world, there is always a significant tradeoff between capability and force protection. Commanders in chief (CINC's) understandably are reluctant to have any more soldiers and civilians placed in harm's way than is absolutely necessary. When the theater force must be limited and exposure of personnel reduced, cutting support forces is an attractive option. Unfortunately, those support forces are often the key to sustaining the dominant combat power of modern U.S. fighting forces. Operational planners need to be sensitive to the sustainable force level as well as to the total deployed force level. The readiness maintenance and enhancement capabilities of logistics support forces need to be considered when force packages are being designed. Typically, combat forces are *empowered by logistics*, not encumbered by logistics!

Operational logistics infrastructure also takes on a new dimension in the RML. As envisioned in the Army After Next operations support command (OPSCOM), the RML logistics support for an engaged CINC will be operationally, not geographically, focused. This means that the CINC's logistician—the OPSCOM commander—will command and direct forces, units, agency offices, and contractor operations on a global basis, all focused on the CINC's operations. This will give the CINC and his OPSCOM commander great flexibility in moving work to workers and workers to work. However, care must be taken in sizing future logistics organizations so that when missions are moved to allow a reduction at one level of command, they are not given to organizations whose capabilities have been reduced under previous mission transfers. In other words, we must avoid making a shell game of our total logistics capability.

Maintaining a viable logistics infrastructure between operations also is vital. Today's logisticians throughout the Army and DOD perform numerous essential tasks every day, efficiently and with little fanfare. The ability to project a sustainable force on a few hours' notice is possible only through their constant effort. In the same way, institutions need to maintain and pass on a corporate memory and corporate culture to remain great. Army logistics does this well at all levels and in all components. However, the toll of the series of drawdowns has had its effect. In future sizing decisions, the viability of institutions to continue operations and grow leaders must be considered. To do less is mortgaging our national future.

Seamless logistics system, distribution-based logistics, agile infrastructure, total asset visibility, rapid force projection, adequate logistics footprint—these are the tenets of the Revolution in Military Logistics, and the hallmarks of the future. They will reshape how we project and sustain, and they will ensure that the U.S. Army of the future will be what it is today—second to none.

ALOG

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Reserve Component Roles and Missions in the Revolution in Military Logistics

by William R. Cousins and Roger Houck

The Army National Guard and the Army Reserve contain over 65 percent of the Total Army's combat service support force structure. They will be key players in the revolutionary logistics future.

As the Army of Excellence evolves into Army XXI, empowered by technology and information dominance, and then into the Army After Next (AAN) of approximately 2015 and beyond, the Total Force—that is, the active Army and the reserve components, as well as our partners in industry—will undergo significant change as we transform from a supply-based system to one structured to exploit velocity and transportation. From a logistics perspective, the way we organize, equip, train, deploy, and sustain forces and equipment today will not meet the demands associated with supporting the battlefield operations envisioned in the AAN era. That's one reason for the phrase, "There will not be a Revolution in Military Affairs unless there is a Revolution in Military Logistics."

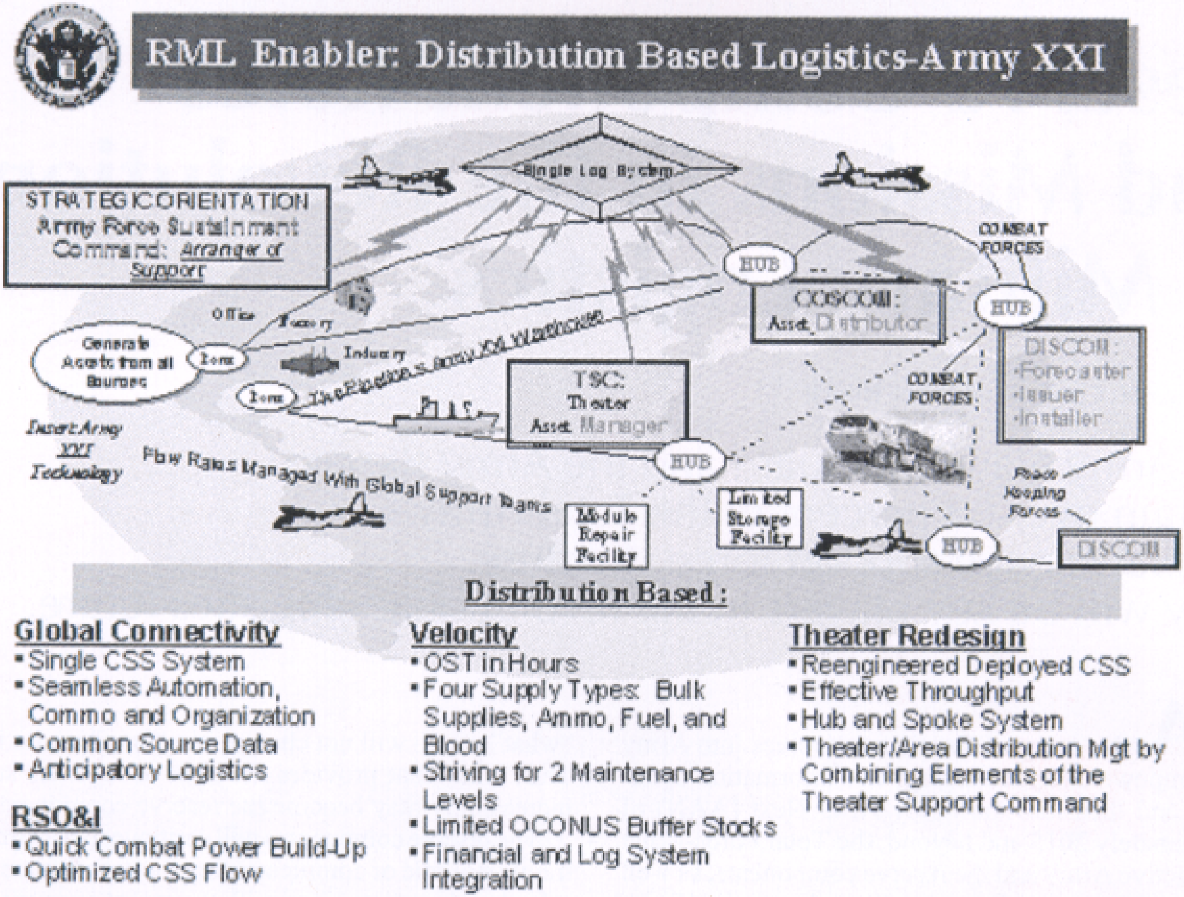
Costs have driven down the size of the force, although technology continues to offer the potential to let us "do more with less." While potential logistics support concepts for the AAN continue to be examined under the AAN process, a preliminary conclusion is that neither the present-day active component nor the reserve components currently have the logistics capability to support the mobility, speed, and strategic maneuver requirements of the AAN era.

The reserve components will have a logistics support role in the Army of the future—most likely a significantly increased one. With over 65 percent of the combat service support force structure, the reserve components are facing the same challenges as the active component in implementing a transformation strategy that will produce the required capabilities. Embedded in the Revolution in Military Logistics is the belief that "what" we do will not change, but "how" we do it will. The "who" that provides the bulk of logistics support increasingly may become the reserve components.

The reserve components will continue to perform their traditional role of complementing the active force. That role already is expanding with the recent announcement that the Texas Army National Guard's 49th Armored Division will follow the 10th Mountain Division (Light Infantry) in Bosnia, early in 2000. In addition to traditional roles, the reserve components could perform other roles in the future. As we seek to determine the optimum mix of active, reserve, and commercial capabilities to provide logistics support on the Army XXI and AAN battlefields, vigorous dialogue and debate must continue to identify and examine appropriate roles and missions for the reserve components and to determine what must be done to achieve those required capabilities.

A number of potential roles already have been identified. For example, urban logistics in support of Military Operations on Urbanized Terrain (MOUT) and Operations Other Than War (OOTW) might well be an appropriate fit for reserve component units, as would peacekeeping and disaster relief operations. Reserve component units already have supported peacekeeping operations in Bosnia.

As envisioned in the AAN, theater-level operations support commands will be logistics "orchestrators" and managers, providing logistics support from split-based operations located in the continental United States (CONUS), as well as in or near a theater of operations. In such a scenario, reserve component units would be ideal



to provide and reconstitute "Log Pulses" (rapid-response, specialized logistics forces that go into an area of operations to solve specific logistics situations and then withdraw) and plan and coordinate logistics interventions in concert with all logistics entities (Army, joint, combined, and commercial).

Transportation sort hubs in a "hub and spoke" system already have been used successfully in the Army to expedite shipments in a theater. As we transition to a distribution-based logistics system as depicted above, the future could require deployable, automated intermodal sort hubs to transfer and reroute shipments to and from all transportation modes. These hubs must be able to be deployed and set up rapidly, then be torn down and relocated quickly as the situation dictates.

Reserve component units could be equipped with vehicles having folding conveyors and lifting equipment that are deployable by air, sea, and ground. These units might be the centerpiece of the distribution-based logistics system. Active component and reserve component truck, and perhaps rail, units would fall in on the hub to provide the ground transportation support. Additionally, in order to operate within this distribution-based system, all partners of support to the warfighter will interface seamlessly throughout the system. Within a distribution-based system, reserve units and their infrastructure will be critical to the success of the logistics system.

As the Army gets smaller, yet another role for the reserve components would be to operate power projection installations, not just following deployment of the active units, but full time.

This logistics system will provide balanced, multifunctional support that is more predictive and more responsive. Our challenge is to shape and integrate—as a Total Army Team—a multitude of programs and initiatives and then test, evaluate, and improve the synergy of the whole. The goal is a system that has the users' complete confidence—one that will be anticipatory, focused, agile, and seamless. The reserve components' contributions toward planning, developing, and achieving this will be significant. **ALOG**

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SEAMLESS LOGISTICS SYSTEM

Seamless Logistics System

by Roy Wallace and Dr. Christopher R. Hardy

One of the key tenets of the Revolution in Military Logistics (RML) is an enterprise-wide seamless logistics system. This concept envisions integrating the Army's logistics management framework, command and communications processes, and automation architecture into one seamlessly accessible system that will be transparent on one end to the user and on the other end to the supplier. Such a system underpins much of what we characterize as revolutionary in the future of military logistics, because it will leverage the best commercial business processes, infrastructure designs, and global information and electronic commerce technologies.

Defining the System

To better understand what is meant by a seamless logistics system, it might be helpful to define the term fully. In our context, what is meant by "seamless," "logistics," "system," and, together, by "seamless logistics system"? By seamless logistics system, we mean the following—

• ***Seamless***: Integrated, single, collaborative, transparent, unbroken, and without boundaries.

• ***Logistics***: All activities that facilitate military operations, including design and development, acquisition, storage, distribution, maintenance, and disposition of materiel; movement and evacuation and hospitalization of personnel; acquisition or construction, maintenance, operation, and disposition of facilities; and acquisition or furnishing of services.

• ***System***: A group of integrated, interrelated, interactive, interdependent elements forming a complex and synergistic whole.

As you can see, these definitions are broader than just transportation, supply, and maintenance, and they are inclusive and consistent with the definition of logistics in Joint Publication 1-02, DOD Dictionary of Military and Associated Terms.

Seamless Logistics System: The Concept

The concept of a seamless logistics system and its enabling information technology are so tightly intertwined that they must be discussed together. In the spring of 1998, the Army's Deputy Chief of Staff for Logistics hosted a seminar attended by chief executive officers and vice presidents from world-class commercial logistics firms, active and retired senior military leaders, and academic experts. Out of the seminar's discussion of best commercial practices, two key insights emerged: information is critical to logistics, and logistics is a strategic asset.

Since information has become so integral to logistics, the definition and description of a seamless logistics system take on the characteristics of a single, integrated information system. All functions, missions, and organizations must be connected and integrated by an enterprise-wide, end-to-end information system. While a seamless logistics system is more than just an information system, without an enterprise-wide information system, a seamless system would not be possible. The information system, without question, is an essential ingredient, providing us with the ability to see, know, anticipate, model, link, and trade off available resources to fulfill support requirements and create a never-before-envisioned support capability. This seamless logistics system will revolutionize not only logistics operations but also Army thought and doctrine.

With an enterprise information system, the Army will gain the greatest synergy from the entire logistics system by integrating its parts, both vertically (from the tactical through strategic levels) and horizontally (across multiple logistics functions). When achieved, the result can be described accurately as a single, fully integrated, seamless, distribution-based, end-to-end logistics system. It is this seamless logistics system that will enable the logistics force to provide world-class, focused logistics support to the warfighter.

Capabilities and Characteristics of the System

With the aid of tools such as natural language processing, agent technologies, optimization decision support aids, constraint-based scheduling, and enterprise-wide supply chain solutions, the seamless logistics system will include the following—

• During planning, the capability to translate the commander's concept of operation directly into logistics terms.

• During execution, the capability to anticipate losses, monitor supply consumption, and automatically generate replenishment to a predetermined level based on operating tempo and battle requirements.

Additionally, the seamless logistics system must—

• Be distribution-based. Real-time situational awareness and end-to-end connectivity will produce this new environment. No longer will the Army need to maintain iterative, redundant inventories because of the uncertain linkage between historic demand and actual operational requirements.

• Be served by an enterprise-wide, end-to-end logistics information system capability as described above.

• Be able to apply the whole of its capabilities to achieve consistently balanced support across all functions with the assistance of technology (applying technology to provide improved support to the soldier of the 21st century).

• Be responsive to the dynamic re-planning requirements of the warfighter.

• Be able to integrate and optimize across the entire logistics system by focusing the enterprise on the warfighter as its end customer.

Operational Synergy

A global, integrated, real-time seamless logistics system provides visibility of logistics resources, enhances management decision-making, and provides effective and efficient support to the soldier.

The seamless logistics system developed for Army XXI will prove to be one of the most important factors in laying the foundation for the RML. Real-time situational understanding of combat requirements and logistics capabilities, and the embedded decision support systems to orchestrate those capabilities, will enable the Army to generate, project, and sustain the 21st century forces in a truly revolutionary manner. By focusing on the end-of the-line customer's needs, the entire logistics system dynamically anticipates requirements before the mission is degraded and provides seamless support that will not encumber operations.

The basic technologies are available and in use by commercial industry now: enterprise information technology solutions, prognostics, modeling, enterprise resource planning software, and global communications. To achieve a seamless logistics system, the Army will have to invest strategically in these technologies. Additionally, the Army will have to undergo massive organizational and business-process changes to implement the new system.

Logistics Performance Metrics

A seamless logistics system operating in a world-class logistics environment requires metrics to focus the system's performance. Performance metrics are essential in framing and targeting the objectives of the logistics system. The world-class performance potential of a single, integrated, seamless system and its associated user-oriented performance metrics will provide the basis of logistics support of the future.

The seamless logistics system should be focused on specific warfighter metrics as true measures of the success and accountability of the entire logistics system. These metrics should include an organization's ability to sustain the fight, sustain movement, and sustain combat power generation. These and other end-customer performance criteria should be expressed in quantitative terms. Optimization planning, execution schemes, and decision support also are based on enterprise-wide and end-to-end global performance measures.

This conceptualization also is consistent with the best-in-class commercial logistics concept of customer line-of-sight support. Under a customer line-of-sight system, the processes and attitudes of the entire logistics community are focused toward the final customer, above any intermediate needs of the supporting infrastructure.

The seamless logistics system and its components—agile infrastructure, integrated business processes, dynamic decision support, real-time responsiveness, and distribution-based functionality—must be seen as a whole. In the past, we have developed communication and automation systems, separate logistics functions, and institutional layers and levels of support that only optimized local and separate logistics systems and prevented the entire logistics system from operating at the highest level. In contrast, the seamless logistics system is enterprise-wide and focused on the warfighter's performance measures. It is a new way of thinking and a new way of doing business. It will change fundamentally how we support. The seamless logistics system will exact the greatest possible synergy by providing connectivity and situational knowledge from factory to foxhole, thus focusing the entire logistics system in anticipation of the warfighter's actual needs.

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GCSS-Army—Making the Revolution in Military Logistics Happen

by Colonel Edward J. Shimko and Lieutenant Colonel Thet-Shay Nyunt

An hour before dawn, Alpha Troop's Bradley fighting vehicles and Abrams tanks arrived at the designated global positioning system coordinates and dispersed to form a defensive perimeter camouflaged by woods. In last night's encounter with enemy armored probes, Alpha Troop successfully blocked penetration and denied intelligence. The only intelligence obtained from the encounter was that it was like Armageddon—Alpha Troop held back nothing and gave no quarter. To the enemy, it seemed as if the Americans used ordnance and fuel with abandon and drove their vehicles to the breaking point. What the enemy did not know was that sensors on Alpha's combat vehicles transmitted system diagnostics and ammo and fuel status to command and logistics elements, enabling continuous support. Systems monitoring each vehicle then alerted Alpha Troop's crews when and where ammo, fuel, and maintenance points would be located. The enemy must have thought they had encountered a battalion task force when they faced Alpha Troop's relentless maneuver and firepower. Running out of fuel and low on ammunition, the enemy withdrew, exhausted and bewildered at losing several armored personnel carriers and a light tank.

Alpha was not without its own wounds. After their last contact, they evacuated the wounded to ambulances. Medical information systems transmitted patient data and diagnostics to ensure appropriate medical support would be ready when they arrived at treatment facilities. In the fighting, an Abrams' road wheels were blown away, leaving the tank temporarily disabled. At the moment of component failure, onboard sensors relayed parts, disposition, and diagnostics information to the nearest maintenance support element. This process permitted maintenance technicians to orchestrate the repair work load. In spite of recovery data and forward delivery of parts, it would be mid-morning before the tank could be put back into action; retrieval and wrench-turning still would require hands-on soldier work.

An Abrams float and a replacement crew awaited Alpha at the designated location. As Alpha settled into its new location, fuel and ammo carriers quickly made their rounds and disappeared, just as they had in the lulls between engagements the previous night.

This vision of Alpha Troop's seamless support is in the Army's not-too-distant future. If this vision was only technological, it could be achieved today. However, the Revolution in Military Logistics (RML) is more than technology. It is the teaming of technology with new support techniques and dynamic logistics doctrine. The precision delivery of combat service support (CSS) is anticipatory and provides significant efficiencies in both supply and distribution. To harness these economies, the Army must capture, process, and manage the disparate data and communications systems that make CSS occur. At the heart of the CSS information managed for Alpha Troop is the Global Combat Support System-Army (GCSS-Army).

GCSS-Army, teamed with vehicle-based sensors (Force XXI Battle Command Brigade and Below [FBCB2]) and the Combat Service Support Control System (CSSCS), allows logisticians and commanders to anticipate and manage the CSS battlefield, not just react. Better information necessarily improves economies and in turn allows combat energy to be expended fully against the enemy rather than remaining idle in reserve. To support Alpha Troop with current systems and processes, a commander would have to dedicate an armored cavalry squadron's support element. Additionally, the support element would have to distribute communication assets to each CSS vehicle, pre-position and coordinate caches, and provide real-time intensive supervision. In short, the command and control and CSS capabilities of an entire squadron would have to be allocated to support a screening action involving one troop.

GCSS-Army is much more than a close combat coordination and CSS delivery information system; it is a system that integrates and fuses information from the factory to the foxhole, coordinating, expediting, and managing the numerous activities in between. Performing these functions requires communications and interactions not only within and between command layers and theatres but also between sister services. Knowledge allows leaders to be aware. Precise, real-time knowledge of the disposition of their assets would allow commanders to maneuver CSS assets as quickly as they maneuver combat elements, thereby shaping the battle. As the Army continues to streamline its operations, both in peace and in combat, the passive approach to logistics simply is not acceptable. Waiting for support is not a strategy.

The Concept

GCSS-Army is an evolutionary logistics information system that builds on the functions and processes of existing systems to generate data, integrate data bases, and fuse CSS information from external sources as necessary to execute the RML.

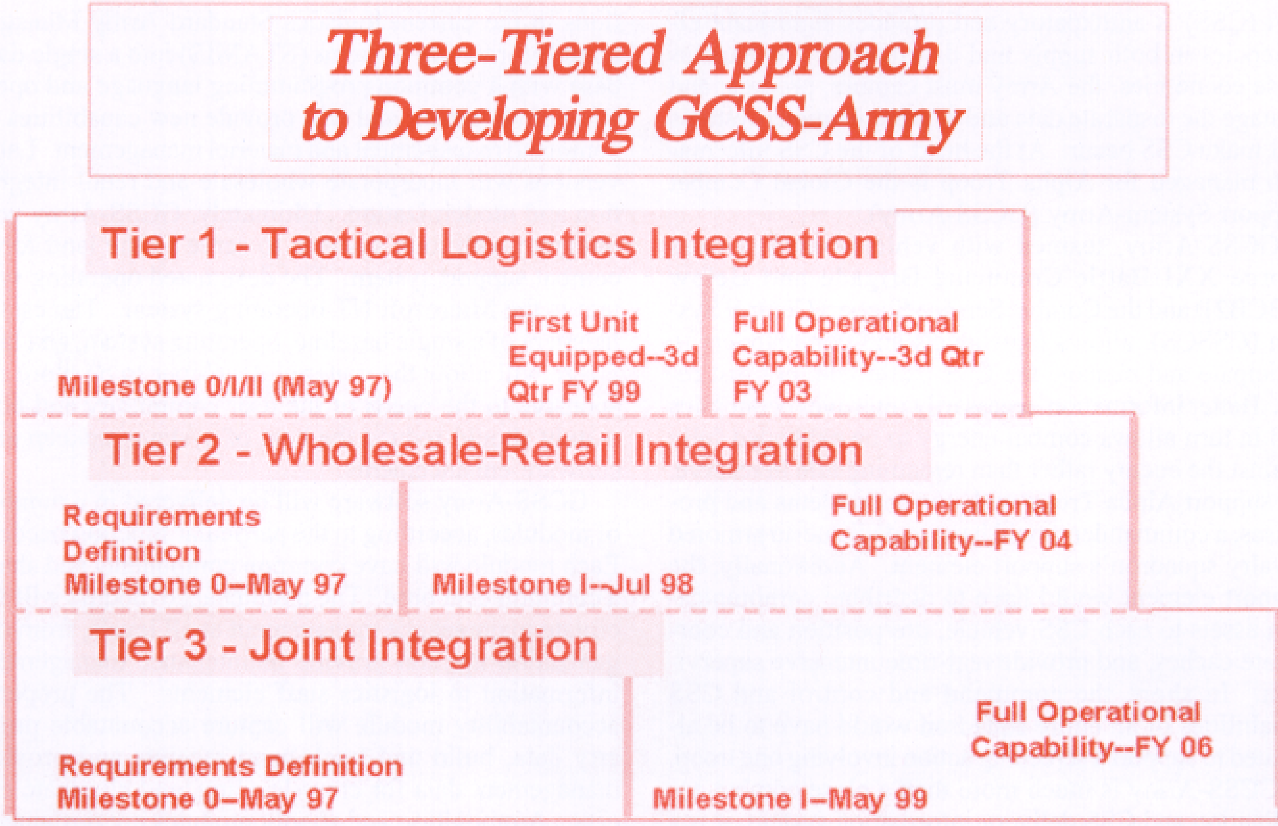
GCSS-Army modernizes CSS automation through its integration of three hardware configurations, seven operating systems, eight programming languages, and five communication protocols into a single system baseline. Initially, GCSS-Army will integrate the existing functions in the current logistics Standard Army Management Information Systems (STAMIS) into a single data base with a common programming language and operating environment and will provide new capabilities in command management and materiel management. Later versions will incorporate wholesale and retail integration and modernization. Ultimately, GCSS-Army will integrate with joint systems to serve as the land force combat support system. The designated operating system is the Microsoft NT operating system. The establishment of a single baseline, operating system, and language will allow the materiel developer to be more responsive to the needs of the user community and ultimately should reduce the cost of systems upkeep and software enhancements.

GCSS-Army software will be delivered in a number of modules, according to the particular function needed. Each module will have common components and share a common data base. The maintenance module will facilitate maintenance management at all levels, from organization up, and provide maintenance management information to logistics staff elements. The property accountability module will capture accountable property data, build and track hand receipts and provide management data for cross-leveling, and eliminate excess. Ammunition and supply modules are designated for support organizations with supply support activities and ammunition supply units. The integrated materiel management center (IMMC) module allows MMC-level users to "see" and manage the stocks on the ground and in-transit in their support area. The management module will give commanders and staff officers visibility and management information for CSS assets in their areas of responsibility. Additionally, the management module will fuse information from non-GCSS-Army data bases such as the Standard Installation/Division Personnel System, Transportation Coordinators' Automated Information Management System II, and others as needed.

GCSS-Army, as the CSS component of the Army's warfighting systems, complements the Army Battle Command System and provides commanders with the full logistics picture. The diagram on the next page illustrates the command, control, communications, computers, and intelligence (C4I) architecture and where GCSS-Army will serve on the battlefield.

Technology—Only One Tool

Although RML and GCSS-Army are tied to technological innovations, they will succeed only if fundamental processes are captured in this development. Development of GCSS-Army must encompass state-of-



the-art hardware, employ the best practices of software development, and manage the Army's business process reengineering (BPR) to deliver not only a "soldier friendly" product but a system capable of further evolution.

The fielding of state-of-the-art hardware is complex, given the volatility of the information technology marketplace. Currently, a 300-megahertz processor is the mid-priced standard. By the time this article is published, that standard may be a 400-megahertz chip. Making the fielding of hardware even more challenging is the need for hardware configurations that are compatible with older interfaces, set-ups, and peripherals and, at the same time, can be integrated with emerging technology. GCSS-Army's plunge into server-based technology, wireless local area networks, and the tactical internet will bring CSS technology closer to civilian information systems, thereby easing the learning curve between office automation practices and military applications.

To use the best practices of modern software development, requirements and materiel developers must scan the horizon continually for dynamic processes and tools. The Joint Application Development (JAD) Process brings over-the-shoulder coordination between functional process subject matter experts (SME's) and software programmers. This process allows for continual feedback and dramatically reduces development time.

Modern hardware and software development practices alone would not produce revolutionary results if the business practices incorporated in the software did not reflect the dynamics of RML. BPR, in part, calls for the re-evaluation of the elemental questions: Why does a certain business process exist? If such a process is necessary, is there a way to improve it? Business processes must be evaluated from the factory to the foxhole. Another way to do this would be to conduct a top-to-bottom evaluation of CSS business processes. The processes then could be captured as the template upon which to develop software. BPR potentially could require us to examine force structure and globally change fundamental CSS battlefield operations and wholesale logistics. The risks, obstacles, and parochial interests for such a process are formidable, and change may not be achieved early in the program.

The Road Map

GCSS-Army is a large and ambitious project, but its development strategy is a lot like the technique proposed to eat an elephant—one bite at a time. In GCSS-Army, the "bites" are logically ordered to allow delivery of products as each is completed rather than wait for the fully functional system. This strategy allows for continual feedback from systems in the field and modification of products under development.

GCSS-Army products and functions are organized into three tiers: Tier 1 is retail modernization; Tier 2 is wholesale and retail integration and wholesale modernization, to include BPR; and Tier 3 is joint interoperability. Parallel development will allow work to progress simultaneously while allowing interaction and coordination among tiers, functional and technical levels, and with agencies and commands throughout the total Army.

Tier 1: Retail modernization. Modernization of retail processes requires the transfer of current logistics STAMIS functions to new software and hardware baselines. As mentioned earlier, new features, such as management and IMMC modules, will augment current STAMIS. Then all functions will use distributed and replicated data in a network environment, which will give soldiers and leaders alike unparalleled access to CSS information. The standards for software include a "point-and-click" interface with the look and feel of a popular software in a Microsoft Windows environment.

Tier 2: Wholesale-retail integration and wholesale modernization. The modernization and integration of wholesale and retail systems requires BPR. The goals of Tier 2 include—

- Rapid identification, location, and status of in-transit stocks; establishment of methods, technology, or processes to ensure data quality; and reduced requirements for manual entry of data into systems.
- Processes and interfaces that provide data accessibility by the field.
- Systems capable of supporting surges in requirements and operations for contingencies and war.

Establishing metrics in this tier ensures that the definition of "success" is not arbitrary. The metrics established to date seek to identify quantifiable improvements in materiel management, personnel efficiency, customer service levels, and readiness. These include—

- Reduced operating and support costs.
- Less data redundancy and inaccuracy.
- Optimized inventory levels.
- Total view of all supply chain information.
- Reduced cycle time.
- Reduced infrastructure requirements.

Tier 3: Joint interoperability. The integration of GCSS-Army into joint systems will be achieved at full operational capability. That is when GCSS-Army will have interfaces with the joint community, national sustaining base, and allied nations' systems. In this tier, GCSS-Army has full access to all CSS data sources. It has complete interoperability and is technically integrated with the Global Command and Control System. To reach this tier, the Army not only must access and provide data to joint systems, but must provide services required to support sister services as well.

Listening to the Field

To produce a credible and usable system, developers of GCSS-Army actively sought ideas from the field, both formally and informally. They wrote articles, conducted briefings, established websites, and convened "user conferences" to make sure they did not overlook any good ideas. In the more formal development setting, SME's were assembled from throughout the Army to validate the functions that were essential for transferring the new software in Tier 1. The SME's validated the essential functions from STAMIS by describing the business processes and subprocesses down to the data element level. The products of SME working sessions then were passed to the standing JAD team, which consists of senior warrant officers representing functional areas. After scrubbing the SME's requirements lists, the JAD team presented them to the Software Requirements Review Board for re-evaluation and Army leadership approval. Software will be developed for those requirements making the cut. Similar work will continue for each tier.

GCSS-Army is an ambitious program, but it is well within the bounds of current technological capabilities and warfighting doctrine. By integrating tested CSS functionalities, redesigning business processes, and exploiting proven technologies, GCSS-Army will allow full execution of the Army's role in the Revolution in Military Logistics.

As Alpha Troop reviewed their actions of the previous night and anticipated new missions, rations were replenished, mail and supplies were delivered, and mechanics replaced parts for components identified as nearing failure. Logging onto the Battlefield News website, Alpha's crews saw their actions plotted on the situation screen, and it looked like the enemy main force was going to move on and try a penetration elsewhere. Finally, Alpha could rest. **ALOG**

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Communication Technologies for the Revolution in Military Logistics

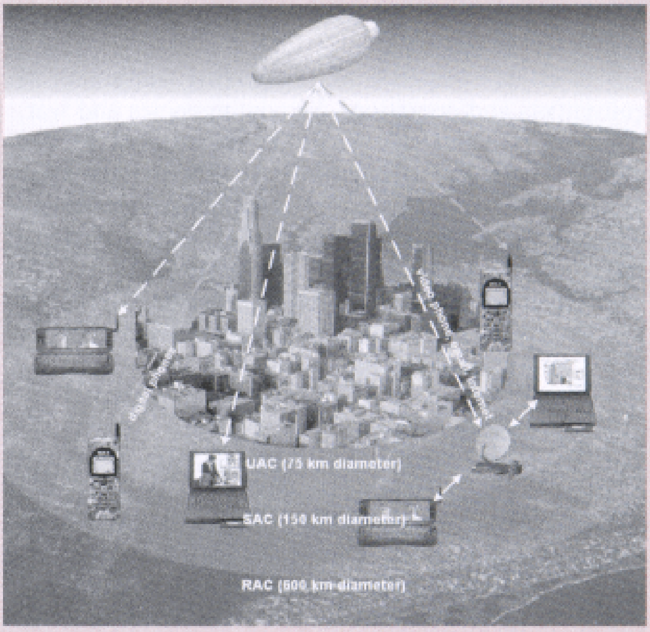
by Roger Houck and William R. Cousins

Chief Warrant Officer and master mechanic John Miller sits in the brigade rear watching a bank of monitors display the real-time location and readiness posture of an armored task force set to engage an enemy force in 2 hours. His trained and watchful eye notices that the data stream from one of the vehicles is showing abnormally high metal particles and a steadily rising oil temperature, a condition that will cause engine failure in the next few hours. Mr. Miller dispatches his "alert" crew with an engine and the right tools to make the swap. An onboard artificial neural network is receiving prognostic or predictive data from dozens of the vehicle's systems and transmitting the exception data to Mr. Miller's console.

The Revolution in Military Logistics will require a dynamic new approach to logistics support. A seamless logistics system that ties all parts of the logistics community into one network of shared situational awareness and unified action can be achieved only in an environment dominated by global, wireless, assured communications. Many world-class commercial companies have reduced inventories significantly and now rely on real-time information, coupled with rapid transportation, to meet customers' demands. Substantial cost savings in acquisition, warehousing, packaging, and transportation have been achieved by reducing inventories. Much of their inventory is in motion in the logistics "pipeline." To manage their reduced inventories, these companies employ global, wireless communications systems that give them up-to-the-minute status on shipments and deliveries.

In the above scenario, Mr. Miller knows not only the location and readiness status of the units he is responsible for supporting, but also that they plan to engage the enemy today. The information he is receiving allows him to predict equipment failure, to know where the parts and people are to fix it, and to fix it before it breaks. In the future, by leveraging information technologies, logisticians will be empowered to provide the right support at the right time at the right place. They no longer will rely on "historical" data but will have real-time, predictive information to make intelligent decisions and optimize force readiness. Global, wireless communications will provide soldiers the capability to reach and "see" virtually anywhere on the battlefield or in the world.

Today there are about 200 communications satellites orbiting the Earth. It is predicted that there will be over 2,000 by the year 2010. The market for commercial use of global, wireless communications, both voice and data, is growing exponentially. Therefore, providers are scrambling to increase total capacity by putting up more



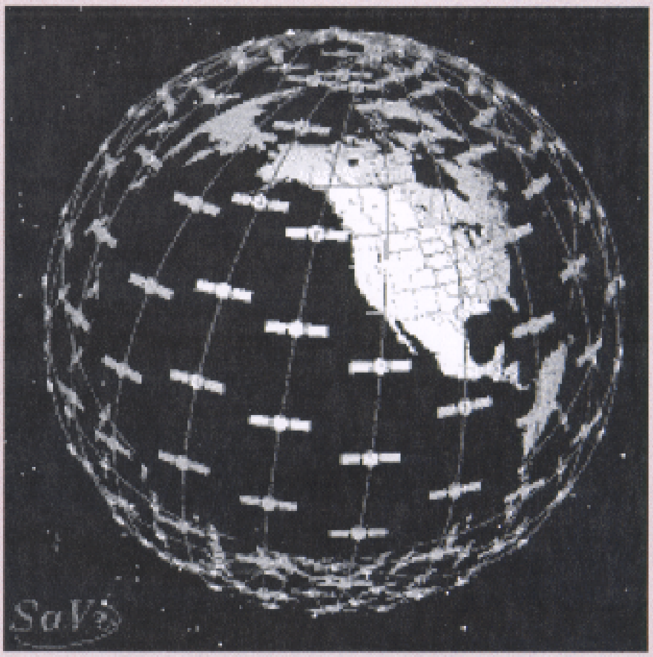
☐ **SkyStation in a stationary position can provide links in a 500-Kilometer (km) radius.**

satellites and to increase the speed of information flow by improving technology. Competition for market share is driving down the size and cost of mobile equipment, while battery life is increasing steadily.

Commercial systems are available now, with more coming on line in the near future, that can provide soldiers with the wireless communication capability they need. Several companies already have begun to launch hundreds of low Earth orbit (LEO) satellites that provide voice, data, and fax communications to global customers. The satellites can communicate with mobile devices on the ground and can be linked to fixed ground stations, or gateways, providing access to existing, low-cost telephone systems. LEO satellites will improve on geostationary satellites that were commonly used a few years ago. Geostationary satellites are fixed at about 22,000 miles above the Earth, so they move with the earth and appear to stay in virtually the same position. At that altitude, the length of time it takes for the signal to go from a ground station to the satellite and back to the ground often causes a delay or echo in voice communications. The newer LEO satellites are launched to an altitude just a few hundred miles above the Earth, so there is virtually no effect on voice communications.

A few of the companies planning to have a global, wireless communications system capability in the near future include the following—

- Iridium completed launching their 66-satellite array, plus 6 in-orbit backup satellites, in the summer of 1998. The 1,500-pound satellites—orbiting the Earth in just over 100 minutes in a staggered array at an average altitude of 485 miles—give Iradium the capability to provide global wireless coverage for their mobile telephone system for voice, data, and fax. Subscribers can have one telephone number and be reached anywhere in the world without the caller knowing where the called party is located.
- GlobalStar has begun to launch their fleet of 56 satellites, 48 in service and 8 spares, to be placed in orbit approximately 750 miles above the Earth. Their fleet will provide voice, data, fax and, other telecommunications service to customers worldwide.
- ORBCOMM, a joint venture of Orbital Sciences Corporation and Teleglobe, Inc., plans to launch 36 small LEO satellites in 1999 to provide global personal messaging services.
- SkyStation is planning to launch a fleet of lighter-than-air vehicles that will remain geostationary approximately 13 miles over major metropolitan areas to provide their stratospheric telecommunications service or "Internet in the sky". Their equipment can be brought down for hardware swap and upgrade and repositioned for continued service.
- Teledesic plans to launch a fleet of 288 LEO satellites to provide broadband, global, wireless service to businesses, schools, and individuals worldwide. The $9 billion project is scheduled to begin service in 2003.



☐ Teledesic's system will consist of 288 satellites divided into 12 planes with 24 satellites each.

These types of communications systems are being developed for a global commercial market but have broad applications for military use at the strategic, operational, and tactical levels. These technologies can provide the capability to receive, transmit, store, and retrieve information in a single seamless logistics system supporting a modern force in tomorrow's Army.

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William R. Cousins is a principal logistics analyst with Innovative Logistics Techniques, Incorporated (INNOLOG), in McLean, Virginia.

Single Stock Fund

by Sue Baker

Out with the old; in with the new. Army logistics processes are being integrated to increase efficiency and eliminate unnecessary stockpiling.

The Single Stock Fund (SSF) is a Headquarters, Department of the Army (HQDA), initiative to reengineer inventory management functions and associated financial processes throughout the Army. It represents one of the most sweeping changes to logistics functions and business processes in recent memory. Once completed, the SSF will consolidate management of current wholesale, theater, corps/installation, and division authorized stockage list inventories into a seamless logistics and financial system, thus creating a single, virtual supply and maintenance organization. The SSF is fundamental to achieving the Revolution in Military Logistics.

Background

Secondary items for weapon systems have traditionally been funded by two revolving capital funds. These stock funds have been structured around wholesale practices that were managed by Army Materiel Command (AMC) and retail activities that were managed by other major Army commands (MACOM's) at the installation level. The traditional separation between wholesale and retail systems has served us well in the past. But as force structure and technology have changed and the need for speed and agility has increased, the old way has become cumbersome. It reduces efficiency, because it involves nonintegrated requirements determination, maintenance and repair requirements processes, accumulation of excess stocks, and duplication of workload and infrastructure. Today's problems include—

- Lack of stockage visibility between the wholesale and retail levels causes retention of redundant inventories.
- Customers may wait long periods of time while items are purchased from manufacturers.
- Poor communication channels between wholesale and retail inventory managers cause retail managers to maintain stocks "in case of need."
- Retail and wholesale management decisions are made independently. Therefore, these decisions often reflect perceived local priorities at the expense of Army stockage goals and objectives.
- HQDA separately issues stock fund obligation authority to the wholesale level and eight retail divisions. Each element independently manages its own logistics and financial processes.

• The wholesale and retail activities have differing credit rates and credit polices for turn-in of serviceable and unserviceable items.

Drivers for Change

The Army began to focus on these problems in 1987 with a study of its stock fund operations. At the same time, the Department of Defense (DOD) was turning its attention toward reducing its logistics "footprint" and associated costs through the Defense Management Review Decision (DMRD) process. DMRD 927J, Consolidating Retail and Wholesale Systems, and DMRD 901, Reducing Supply Systems Costs, mandated that the Army integrate its business practices to produce process improvements and reduce costs.

Additionally, the DOD Logistics Strategic Plan and the Army Strategic Logistics Plan (ASLP) serve as the roadmaps for logistics modernization. The ASLP calls for the development and implementation of a single system "to provide its managers with system-wide asset visibility, superior responsiveness to customer refund costs (credit), and the authority to direct redistribution of assets to locations." The SSF process became a means to accomplish both DMRD and ASLP goals.

SSF Campaign Plan

In mid-1997, the Deputy Chief of Staff for Logistics, Department of the Army, commissioned a review of the Army's SSF initiative. From that effort, a group of senior logistics and financial experts developed the current four-phased campaign plan. This campaign plan, approved by the Vice Chief of Staff of the Army in November 1997, is the blueprint for current efforts. This blueprint calls for a single Army Working Capital Fund–Supply Management Army (AWCF–SMA) account. The schedule to implement SSF is—

• Milestone 0 ran from January through September 1998. It was the initial planning phase for the SSF.

• Milestone 1A began 1 October 1998. It sets the conditions for SSF by integrating financial management actions of the retail stock fund elements with the wholesale stock fund. During fiscal year (FY) 1999, the Army will demonstrate its ability to link existing wholesale and retail information systems to create a single point of sale, one point of credit, and an integrated requirements determination process. The Standard Army Retail Supply System–Objective and Commodity Command Standard System information technology systems will remain in place and be linked using software interfaces.

• Milestone 1, targeted to begin in FY 2000, will build on the foundation of Milestone 1A and merge existing wholesale and retail stock funds into a single fund.

• Milestone 2, scheduled to begin in FY 2001, will extend the scope of AWCF–SMA operations down to division authorized stockage level.

• Milestone 3, planned to begin in FY 2002, will extend the fund through the division authorized stockage level.

The mechanism to integrate these financial and inventory practices is envisioned to be a linkage of existing information technology systems, at least through Milestone 2. At Milestone 3, or shortly thereafter, the Global Combat Support System–Army (GCSS-Army) will be the single, seamless system to deliver SSF business practices throughout the Army.

SSF serves as the mechanism to reengineer current Army horizontal logistics business practices into a seamless vertical arrangement. This vertical management and visibility will create a virtual, single inventory for the Army, with much more flexibility to maximize Army-owned assets. It will also integrate our maintenance capability from our depots down through our installation directorates of logistics.

SSF truly is a revolution in how the Army conducts business. It is a revolution that the Army is beginning in its current legacy system and will complete when GCSS-Army is in place to allow full, seamless integration of all logistics and financial practices. It will set the stage for supply chain management and agile, flexible support for the Army After Next. **ALOG**

Sue Baker is the Single Stock Fund Program Manager, Office of the Deputy Chief of Staff for Logistics, Department of the Army

Government Purchase Cards: Putting the "U" Back Into Purchasing

by Bruce Sullivan

By authorizing nonprocurement personnel to buy supplies and services with a Government purchase card, the Army has conserved diminishing resources and increased efficiencies.

Corporal Spanner is working on a vehicle brought into the motor pool yesterday for routine maintenance and repair. The vehicle needs a new manifold gasket. Looking in the supply room for a replacement gasket, Corporal Spanner finds that none is available. He then goes to the computer terminal in the motor pool office, logs onto the Web, and orders the $80 part directly from Trak-Auto. He uses his Government purchase card to pay for it, and the part is delivered later that afternoon.

Does this scenario sound futuristic? It is—*and it isn't*. Today, many soldiers and Army civilians order commercial supplies directly over the phone or via the World Wide Web and pay for the goods with their purchase card. Throughout the Department of Defense (DOD), more than 150,000 uniformed and civilian personnel—72,000 of them soldiers and Army civilians—have been issued purchase cards. During fiscal year (FY) 1997, the Army made 2.4 million card purchases totaling more than $1 billion.

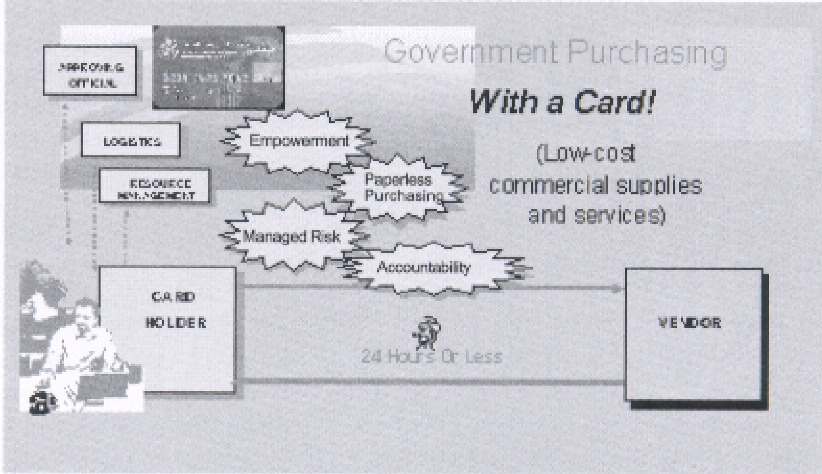
Purchase cards first were proposed for Federal Government use in the early 1980's as part of an effort to cut the cost of buying goods and services. In 1986, several agencies piloted the use of a Government commercial purchase card to reduce such costs.

The results of the pilot program concluded that the purchase card had advantages over other procurement methods. Specifically, the card provided a less costly and more efficient way to buy low-cost commercial goods and services, because Government personnel could purchase items directly from vendors instead of going through procurement offices.

The first Government-wide commercial purchase card contract was awarded by the General Services Administration in 1989, and DOD entered the program at that time. In 1993, the Vice President's National Performance Review (NPR) identified use of purchase cards as a major acquisition reform and encouraged all Federal agencies to increase their use. Using the card was emphasized again by the Federal Acquisition Streamlining Act of 1994 and Executive Order 12931, issued on 13 October 1994, on Federal procurement reform.

Before the card came into use, anyone with a requirement—regardless of its dollar value—had to fill out a purchase request. The purchase request was presented to the individual's supervisor for approval, then forwarded to the supply manager. The supply manager determined if the item was available in local inventories or was being inventoried by an item manager. The supply manager also determined if the item was made by industries for the blind or severely handicapped and if it required property book accountability. At the same time, the supply manager captured demand statistics for the item, which would be used to determine whether or not it should be added to local inventories to meet future needs. The requisition then was forwarded to the financial office to determine if funding was available and, if so, an entry was made in the accounting records to identify the individual purchase. An accounting citation was placed on the requisition, and then it was forwarded to the contracting or purchasing office for action. For purchases under $25,000, the contracting office was required to solicit three quotes from small, disadvantaged businesses and award a contract. The contract included numerous clauses and contractor compliance provisions, as required by law.

The Federal Acquisition Streamlining Act of 1994 (FASA) established the "micropurchase threshold." FASA eliminated the need to incorporate clauses and provisions previously required by law for purchases under that threshold. This change, which was the single most important modification of purchasing regulations, acted as the catalyst for greater use of the card. Without the need to convey contractual clauses and provisions in writing, orders now could be placed orally and charged to a purchase card. Reengineering the business practices in contracting, logistics, base operations, and re-



□The Government purchase card allows personnel to buy items directly from vendors instead of going through procurement offices.

source management became key to achieving internal savings.

The Army reengineered its procurement process and delegated procurement authority for low-cost services and supplies to user organizations. The delegation of authority empowers noncontracting individuals to make purchases valued at $2,500 and below with a VISA purchase card. By authorizing nonprocurement personnel to buy supplies and services within the micropurchase threshold ($2,500), the Army has been able to conserve diminishing resources and increase efficiencies. Cardholders have pre-approved authority to purchase a broad range of supplies, and they are provided bulk funds on a routine basis (for example, monthly or semiannually) instead of for each purchase.

By moving the acquisition of many supplies and services directly to the using organization, the Army has streamlined the purchasing process. The Army Audit Agency has found that, when these streamlined procedures are used, there is a 60-percent saving over the use of a purchase order. The average saving when the card is used instead of a purchase order is $92. The largest percentage of those savings occur in contracting offices (46 percent); however, significant savings also are realized in supply (22 percent), budget (19 percent), and using (12 percent) organizations.

While most items purchased today by cardholders are commercial, cardholders also are buying more items that are available through the integrated materiel management system. Under current regulations, cardholders may buy centrally managed items valued at $2,500 and below if they are not critical, sensitive, or classified and if doing so is in the Government's best interest. This means that a cardholder can buy a centrally managed item by ordering directly from the supplier if it is less expensive or can be obtained faster than through the supply system.

Since the card was implemented, the Army has been the leader in finding ways to expand the program. For the last several years, the Army has led DOD in purchases, both in dollars and number of transactions. In FY 1997, half of the $2 billion spent by DOD in charge card purchases was spent by the Army. Over 2 million of the 5 million charge card transactions made by DOD were made by the Army—almost eight times the number of purchases made in FY 1994. However, through the third quarter of FY 1998, the Army and Air Force were neck and neck, with over 95 percent of their simplified acquisitions being made with the card.

When the DOD Electronic Mall (EMall) is fully operational, the Government purchase card will become even more important. Users such as Corporal Spanner will be able to search the EMall on the World Wide Web for supplies of any dollar value (both commercial and military unique) and use a purchase card to pay for them. (See "A-Mart: Army Shopping On Line," on page 68, for more information on the EMall.)

Where will we be tomorrow? Seeing the savings that have occurred in the acquisition community, the Deputy Secretary of Defense, in a 20 July 1998 memorandum, directed the Services to expand their use of the card into other areas. The purchase card now is to be considered for all previously contracted actions costing $2,500 and below. In addition, training costs up to $25,000 and interdepartmental fund transfers and transportation actions amounting to $2,500 or less must be paid with the card.

On 4 May 1998, the Secretary of Defense, together with the Under Secretary of Defense for Acquisition and Technology, presented the Army with the David Packard Excellence in Acquisition Award. The award recognized the Army's dedicated efforts to reengineer the acquisition process, which provided Army personnel with the tools for making purchases better, faster, and cheaper. The award marked a high point for the Army after many years of developing and perfecting purchase card use. The award is a tribute to the many soldiers and Army civilians who developed a system that works better and costs less. **ALOG**

Bruce Sullivan is the program manager of the Department of Defense Joint Purchase Card Program in the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition.

Filling the Gap in Soldier Support

by Patrick J. Kofalt and Paula J. Perry

The Army Soldier Systems Command (SSCOM) was established in November 1994 to eliminate shortfalls in support of the Army's most important weapon system—the soldier. The basic components of SSCOM were the Natick Research, Development, and Engineering Center (RDEC) in Natick, Massachusetts; the Project Manager-Soldier (PM-Soldier) Office at Fort Belvoir, Virginia; and the Army Support Office (ARSO) in Philadelphia, Pennsylvania. Shortfalls were identified during Operation Desert Storm and subsequently addressed in 1992 by the Army Science Board Study (Summer Study). The basic objective of the study was to ensure that the soldier of the future is the best-equipped and best-supported soldier in the world. The Army Materiel Command (AMC) historically has done an outstanding job in developing, fielding, and supporting major weapon systems (tanks, helicopters, missiles, artillery, and communications systems). However, SSCOM was created to give soldiers higher visibility and greater emphasis in the drive for money as the Army reengineered to improve business practices.

With the establishment of the SSCOM Integrated Materiel Management Center (IMMC) on 1 October 1997, AMC made the commitment to provide the same level of excellent logistics support to the soldier that it has provided to major weapon systems. This commitment is key as the Army moves into the 21st century. The Army has participated in a number of low-intensity operations other than war since Operation Desert Storm, and participation in still others surely looms in its future. It is critical that American soldiers have state-of-the-art equipment that delivers the best possible protection, optimal mission support, and quality of life in the dangerous and harsh environments into which they will deploy.

Initially, materiel management of SSCOM items was a disjointed effort. Soldier support items, such as parachutes, field service equipment, and shelters, were managed by the Army Aviation and Troop Command (ATCOM) in St. Louis, Missouri. Personal soldier items, such as dress and field uniforms and the equipment soldiers wear and carry, were managed by the Defense Personnel Support Center (DPSC) in Philadelphia (now the Defense Supply Center Philadelphia [DSCP]) under the direction of ARSO. To ensure strong SSCOM involvement in the materiel management of SSCOM items managed at ATCOM, the Sustainment and Readiness Directorate was established at SSCOM, and the Soldier Systems Management Office (SSMO) was formed at ATCOM. To provide optimal support for soldier items managed at DPSC, ARSO was moved under the PM-Soldier Office. However, these initiatives still didn't give SSCOM a strong role in the materiel management of the soldier items it had developed.

By the spring of 1995, the latest round of base realignment and closure (BRAC) announcements significantly enhanced SSCOM's ability to provide materiel management support to the soldier. BRAC 95 closed the ATCOM operations in St. Louis and moved the soldier support functions to SSCOM in Natick. This set in motion the establishment of the SSCOM IMMC, AMC's first IMMC totally dedicated to support of the soldier.

The SSCOM IMMC was created to provide one central materiel management center for all soldier items. Inventory and maintenance management, integrated logistics support (ILS), initial and follow-on provisioning, publications management, security assistance, and logistics assistance for soldier items were now directed by the IMMC at SSCOM in Natick, including those items managed by ARSO in Philadelphia and PM-Soldier at Fort Belvoir. With the SSCOM and Army Chemical Biological Defense Command (CBDCOM) merger, which created the Army Soldier and Biological Chemical Command (SBCCOM) on 1 October 1998, the IMMC assumed responsibility for materiel management functions from Rock Island, Illinois, and Edgewood, Maryland. This merger merely reinforced the goal of the 1992 Army Science Board Study—to optimize soldier support. Now, by rolling in the chemical and biological defense mission, the new SBCCOM IMMC will play a vital role in implementing this vision.

Due to the small number of personnel moving from St. Louis to Natick (only 38 of the 122 IMMC positions were filled by St. Louis transferees), the SBCCOM IMMC needed to employ a significantly large number of contractors to perform their mission. The IMMC currently employs approximately 40 contractor personnel at the Natick site and is conducting an Office of Management and Budget Circular A-76 Study to formalize the contractor-Government space breakout. This initiative will be completed and implemented by 1 October 1999 and will be used as a model for future A-76 studies for other AMC IMMC's.

Today, SBCCOM is on the cutting edge of performing IMMC functions in a virtual environment. Specifically, the SBCCOM IMMC mission covers five geographic areas—Natick, Rock Island, Philadelphia, Fort Belvoir, and Edgewood. However, initiatives are underway to identify functions that should be consolidated and to assess functions that must remain decentralized. Because of these initiatives, the AMC Project Manager for the Virtual Single IMMC (PM V/S IMMC) is using the SBCCOM IMMC as a proof-of-principle test bed. Lessons learned from the SBCCOM IMMC virtual operation will be applied throughout AMC IMMC operations in the future.

So how is the SBCCOM IMMC poised to address the challenge of optimizing materiel management support to the soldier? On 1 October 1998, the SBCCOM IMMC was broken into product line teams structured to support the major programs managed within SBCCOM: clothing and individual equipment, air delivery equipment, chemical defense, field service equipment, smoke obscurants, biological protection, and shelters. These teams interact with the program directors from the project management offices, the science and technology teams, and engineering support teams from the RDEC Centers of Excellence at Natick and Edgewood. This is to reinforce readiness and make sure sustainment is designed into and maintained throughout the life cycle of SBCCOM's product lines. These product line teams are supported by logistics support, logistics business, retail interface, and logistics operations teams that provide assistance across all the product lines. The ultimate goal is to minimize decentralization and optimize the centralized support of the product line teams.

The operations at Rock Island support the chemical defense, smoke obscurant, and biological missions. Product line teams have been established consisting of materiel management personnel (item managers, ILS personnel, provisioners, and equipment specialists) and engineers (technical data developers), along with matrix support of the Army Tank-automotive and Armaments Command (TACOM) contracting personnel, to maintain the chemical and biological defense equipment at maximum readiness. In addition, equipment loans and depot maintenance for the entire SBCCOM IMMC are managed at the Rock Island site. The Rock Island operation performs a materiel management mission that is critical to the Army, especially considering the increased threat from chemical and biological warfare, in deployed operational scenarios and domestically. This mission includes maintaining a war reserve stockpile and a testing program for limited-shelf-life items crucial to the protection of both soldiers and citizens in the event of a biological or chemical attack. This office also plays a key role in the implementation of the Army Chief of Staff's initiative to centralize management of "go-to-war stocks" of key biological and chemical defense equipment for deploying units.

The Philadelphia site interfaces with DSCP for clothing and individual equipment (CIE). Close coordination with the PM-Soldier at Fort Belvoir ensures that readiness and sustainability are designed into these items and that the items are maintained at peak readiness throughout the life cycle.

The Philadelphia operation is broken into three distinct functions: modernization and readiness, war reserve support, and heraldic support. In the area of modernization and readiness, the Philadelphia office processes supply request packages (SRP's) for newly developed CIE for DSCP. These SRP's contain basic provisioning data the DSCP needs to initiate procurements for new CIE items. The Philadelphia office also develops materiel fielding plans (MFP's) for these items and coordinates direct delivery and prime vendor support of new fieldings with DSCP to minimize depot storage and transportation costs. This is a significant mission, since more than 100 new CIE fieldings are projected for the next 5 years. This mission involves working with both the Natick RDEC and DSCP to resolve issues impacting the readiness of more than 15,000 CIE national-stock-numbered items managed for the Army by DSCP.

The Philadelphia site has a war reserve requirement that exceeds $1.2 billion worth of CIE and packaged rations. There is $800 million worth of stocks on hand worldwide. Fifteen percent of this amount is pre-positioned both overseas and afloat, and 85 percent of it is commingled with DSCP stock in Defense Logistics Agency depots. This poses two major management concerns: maintaining the integrity of Army-owned stocks, and incorporating DSCP data into the AMC Army War Reserve Automation Program computation processes. Because this mission is unique, a significant number of off-line processing and bridging programs are required to mesh the two programs.

The Philadelphia office works directly with the Institute of Heraldry at Fort Belvoir in managing over 10,000 drawings of flags, guidons, and streamers for Army units (both active and inactive, active duty and reserve component). These drawings are used by DSCP to procure heraldic items requested by units. In addition, the Philadelphia office works with the Army Reserve Personnel Comand (AR-PERSCOM) in St. Louis to assemble and issue medals to Army veterans. There is a staff of eight wage-grade medals assemblers at the Philadelphia site to fabricate and engrave medals. This is an extremely high-visibility program that averages more than 200 congressional requests or inquiries per week.

Natick is the site of the IMMC headquarters. Natick also provides assistance for soldier support items developed and fielded by the PM's for Soldier Support and Force Provider. This involves item management, provisioning, ILS, and equipment specialist and maintenance engineering support. The goal, as for all the sites, is to ensure that readiness and sustainment are designed into the products as they are developed and tested. Peak readiness must be maintained throughout the life cycle. In addition, the Natick site provides most of the centralized management for the IMMC, as well as some additional functional support unique to the SBCCOM IMMC.

The Natick site centrally manages the Army Working Capital Fund (AWCF) for the SBCCOM IMMC. Before the SSCOM IMMC was established in October 1997, and before SSCOM's merger with CBDCOM in October 1998, the AWCF programs for the SBCCOM commodities were rolled into the aviation and armament programs. Since both were high revenue-producing programs, and the soldier and chemical programs were relatively low cost, not a lot of attention was paid to the actual operating costs for these programs. However, when these programs were broken out, it quickly became apparent that they did not fit the AMC and Army guidance to operate independently as profit-making centers without a significant surcharge. During its first year of operation, the SSCOM IMMC successfully implemented several significant cost-saving initiatives. Procurements were scrubbed and reduced by 20 percent (from $19 million to $15.2 million), and sales were increased by over 29 percent (from $17 million to $22 million). These savings resulted from managing soldier items separately from the high-dollar and high-profit aviation items. The result was efficient management and, more importantly, significant enhancement of soldier support. Now soldier requirements are anticipated better, and scarce resources are spent on what the soldier truly needs.

Teams dedicated to SBCCOM's logistics assistance representatives (LAR's) and two SBCCOM parachute riggers at Fort Bragg, North Caroalina, (site of over 35 percent of the SBCCOM-generated AWCF requirements) provide heads-up information on that installation's near-term requirements. With a move to long-term flexible indefinite delivery-indefinite quantity (IDIQ) contracts, adjustments can be made to spend funds wisely and optimize soldier support. Ultimately, operating costs have been reduced significantly while depot stocks have been minimized. Despite this minimization of depot storage, stock availability for soldier items has increased to over 85 percent.

The 24 LAR's located worldwide to support the soldier and biological and chemical defense missions were previously troop LAR's at ATCOM and armament LAR's at TACOM. The SBCCOM IMMC is undertaking an aggressive training program to bring them up to speed in the areas of soldier and biological and chemical equipment. The number of LAR's in the soldier and biological and chemical defense programs is small (about 10 percent) when compared to other AMC LAR programs. To optimize its operation, SBCCOM is working with the Army Logistics Support Activity (LOGSA) to administer the SBCCOM Logistics Assistance Program. Under a memorandum of agreement (MOA), LOGSA administers the SBCCOM LAR program, while SBCCOM is responsible for technical direction and training of the LAR's. This MOA has been in effect since October 1997 and currently is being revised to incorporate lessons learned. However, the emphasis remains on enabling the SBCCOM LAR's to optimize their support to the soldier.

Natick also is the centralized site for stock control (minus loan management), security assistance, and Commodity Command Standard System (CCSS) functional systems analysis and serves as the emergency operations center for the decentralized IMMC. Procedures are being developed for these centralized operations, and lessons learned will be offered throughout the AMC IMMC communities.

Not to be forgotten is SBCCOM's unique retail operations mission. The SBCCOM IMMC manages 20 installation laundries throughout the Army, provides direction for the operation of 56 central issue facilities (CIF's) worldwide and, via an MOA with the Army and Air Force Exchange Service (AAFES), operates 103 Army military clothing sales stores (AMCSS's) throughout the world. A recent Army Audit Agency study recommended that SBCCOM assume management of the 56 CIF's. This entails $760 million worth of on-hand inventory and over $40 million a year in replenishment requirements. SBCCOM is currently reviewing various implementation plans and will present its recommendations to Headquarters, Department of the Army, in January 1999. SBCCOM, in coordination with the Army's Office of the Deputy Chief of Staff for Logistics, pays approximately $20 million to AAFES per year for operation of AMCSS's. Various initiatives are underway to reduce operating costs.

Establishment of the SBCCOM IMMC introduced "one-stop shopping" that was sorely lacking within AMC for soldier and biological and chemical protective items. It continues to provide soldiers the very best in materiel management support in the most cost-effective manner possible. Soldiers can deploy to future operations with confidence that they have the highest quality and most readily available equipment to support their operations and to keep them safe and comfortable. **ALOG**

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Commercial Logistics Best Practices for the Revolution in Military Logistics

by Larry Smith

What are commercial best practices and why does the Army need them to achieve the Revolution in Military Logistics (RML)? Methodologies and applications used in private industry that set a commercial enterprise above the competition are referred to as "commercial best practices." Best practices enable leading-edge organizations to deliver world-class standards of performance to their customers.

These best practices and standards of performance have generated a lot of interest within the Army logistics community, where we constantly are being asked to do more with less. The emergence of commercial best practices took place because of downsizing and a hunger for profitability, or doing more with less, so it stands to reason that there could be a great deal of benefit to Army implementation of these best practices.

The leveraging of commercial best business practices appears frequently in the literature and during presentations concerning the Army of the future, the RML, and the Army After Next (AAN). The RML, as a precursor and roadmap to the AAN, could be accelerated greatly by investigating and embracing many commercial logistics best practices. Integrated supply chain management, industry's changing view of logistics, electronic commerce, automated identification technology, direct vendor delivery, load optimization, outsourcing, and smart simple design are all examples of commercial best practices that could be very useful in helping the Army achieve the RML. This article will briefly discuss the emerging trends, capabilities, and best practices of commercial firms that perform the logistics function and move assets and information throughout the supply chain. The parallels with the RML and the Army's modernization of business practices and information technologies are striking.

Integrated Supply Chain Management

The Massachusetts Institute of Technology defines integrated supply chain management (ISCM) as a process-oriented, integrated approach to procuring, producing, and delivering products and services to customers. In this context, ISCM has a broad scope that includes suppliers, customers, and internal information funds flows. Thus, the scope of supply chain management includes the supplier's supplier and the customer's customer. In recent years, supply chain management software providers and consultants have emerged as multibillion-dollar businesses.

The information technology and software solutions offered by global vendors, many of whom have Fortune 500 client lists, offer the tools, visibility, and connectivity to facilitate supply chain management, integration, and optimization. Supply chain management solutions have been most successful when a holistic, end-to-end approach is taken and processes and information are integrated throughout the enterprise.

Implementation of software to manage the supply chain must integrate many different processes, including supply and demand planning, transportation and distribution management, and advanced planning and scheduling (for asset management or manufacturing operations). This approach can result in inventory reductions, increased on-time deliveries, reduced total product cycle (make-to-sell) time, increased revenues, and better customer service. Together, these factors can mean significant savings and an important gain in competitive advantage.

Communication throughout the supply chain is essential to synchronized, seamless business operations. Collaboration and integration of supply chain partners and their processes, both internally and externally, are produced by system-wide connectivity, near-real-time process monitoring, and dynamic planning and control. Leading-edge supply chain management tools use embedded optimization methodologies to assess optimal inventories and synchronized scheduling of inbound and outbound transportation and can be used to review distribution center locations.

Using models and optimization techniques in business process management has begun to expand recently and will grow rapidly in the future. One big trend is toward intensive quantitative management of supply and manufacturing chains. Just a few years ago, industries that saw tremendous gains by going from 60 percent on-time delivery to 80 percent now must work at 95 percent or higher just to be competitive. Industry leaders and big customers are demanding 99 percent accuracy and efficiency. Supply chain management tools are part of the operational processes used to achieve these high levels of performance.

Changing View of Logistics

Applying tailored, integrated, enterprise-wide business process management software suites when implementing supply chain management techniques is creating a growing revolution in corporate-wide logistics management. Many companies are promoting their logistics chiefs to executive vice presidents and senior vice presidents for logistics. Senior logisticians are being included as members of executive committees. This trend illustrates the institutionalization of the value of logistics to the bottom line. Likewise, using logistics metrics in the corporate suite for planning and policy decision-making also is increasing.

Not only is logistics being managed at the corporate level across one enterprise, but groupings of different business entities representing more than one enterprise now can assemble to form agile enterprises. Agile enterprises are networks of strategically aligned firms that replace individual companies as the unit of competition focused on specific market opportunities. Agile enterprises are made possible by exploiting global near real-time communications and electronic commerce technologies. Use of the Internet for corporate communication is growing at a phenomenal rate. It provides a means to move and retrieve information to and from virtually any site in the world. It allows a "virtual office" environment.

Electronic Commerce and the Internet

The uses of electronic technologies and applications have expanded to affect many aspects of logistics. U.S. companies have used electronic commerce to increase productivity by enabling rapid business transactions, data and information exchanges, business process reengineering, organizational changes, and process automation.

Through the ability to handle tremendous volumes of transactions and the ability to amass, analyze, and control large quantities of specialized data, organizations have improved efficiency and accuracy and reduced costs while providing faster, more reliable, more convenient services. These capabilities and the concomitant benefits will be enabled further by rapidly developing intelligent agent technologies that greatly enhance information filtering, search, retrieval, and off-line delivery. Electronic commerce and the sharing of information among entities and organizations facilitates vendor-managed inventories (VMI), paperless contracting, collaborative forecasting, and workflow management.

Through VMI, suppliers can control inventory and replenishment and manage forecasting for improved customer service and increased inventory rotations. With VMI, suppliers can generate more accurate forecasts, which can lead to better production scheduling and reduced operational costs.

Workflow management now can be improved by using growing numbers of commercial-off-the-shelf (COTS) transportation and distribution management products. These products use workflow management to automate and streamline supply chain business processes. Among these processes are automatic payments based on delivery, communications between supply chain partners, proactive alerts on out-of-tolerance activities, and in-transit consolidation monitoring.

Electronic catalogs post product information on the Internet. Many sites offer interactive capabilities such as on-line ordering. Internet purchasing and electronic catalogs are being used to streamline order cycle times, cut administrative costs, and speed product delivery to the customer. The ability to order supplies over the Internet can reduce cycle times drastically throughout the supply chain. This means that a low-cost, web-based, distributed procurement and resupply system can be delivered by standard web browsers.

Another use of the Internet is embedded web server technology. Embedded web technology provides a means for remote devices to share and publish data using standard web protocols. By incorporating a web server into any product (for example, automobiles, mobile phones, alarm systems, fax machines, and televisions), these devices can be accessed or controlled through the Internet from a standard web browser. These devices also can post status and sensor information on the web. Embedded web server technology will be used for such diverse applications as remote automobile diagnostics; interactive traffic signals; and remote monitoring of appliances, vending machines, and manufacturing equipment. This is an extremely broad area in which we will see tremendous applications and efficiency improvements in the coming decade.

Automatic Identification Technology

Automatic identification technology (AIT) includes bar codes, radio frequency (RF) tags, satellite tracking, "smart" cards, and laser cards. COTS satellite tracking provides real-time monitoring of transportation assets and customer products. Some examples of the capabilities of COTS satellite tracking solutions are—

• Vehicle-based data, such as driver performance, engine diagnostics, and reefer alarms, can be forwarded to fleet information systems. A number of parameters can be defined as critical. In the event that any of these values are exceeded, an alarm is generated and logged. If the alarm is severe enough, a speech alarm may be sent.

• Two-way communications can link every vehicle in a fleet to the dispatch center, providing vehicle location and real-time position reporting. Host-based data, such as new load assignments, can be transferred automatically to the truck.

Bar codes, the most widely used form of AIT, and the visibility they provide have enabled a great deal of the agility found in today's world-class manufacturers and retailers. The visibility of goods and assets in storage, in transit, and in process has resulted in reduced inventory levels and order and ship times and improved overall responsiveness to customers.

Direct Vendor Delivery

Direct vendor delivery (DVD) means that shipments are sent directly to the customer from the supplier, bypassing unnecessary storage points. DVD reduces inventory levels, order and ship time, and administrative lead time.

DVD is not cost effective for all shipments. An analysis must be performed to determine which shipments could benefit from DVD. Benefits occur only when non-value-added transportation movements, storage, and handling are eliminated.

Load Optimization

Load optimization software plans and optimizes loads for trucks and containers. Use of these tools has increased transport capacity and reduced logistics costs associated with container handling, tracking, and transportation equipment (trucks, railcars, and ships).

Outsourcing

The outsourcing of non-core competencies is a recognized best practice. The reasons for outsourcing logistics functions include lower costs, a streamlined labor force, access to top personnel, and cutting-edge technologies. According to the Outsourcing Institute, 85 percent of companies now outsource work they used to do in-house. Outsourcing expenditures are expected to reach $121 billion by the year 2000, according to the International Data Corporation.

The key reasons to outsource a function are cost and performance. Third-party logistics providers can leverage their core competencies to improve enterprise-wide performance. They provide significant economies of scale through their specialization. By partnering with world-class providers of logistics services, a company can improve its service levels, profitability, and response times dramatically.

Smart Simple Design

Smart simple design can be achieved by designing equipment with fewer, standardized parts, at reduced cost, with higher quality, faster manufacture and assembly cycle times, and better serviceability. The smart simple design initiative encompasses two processes. The first includes using Design for Manufacture and Assembly (DFMA™) methodology in the early stages of the design process to achieve significant benefits in cost and logistics. The second process involves assembling a design oversight and comparison process team to achieve parts reductions and standardization across different product lines.

DFMA software allows designers to analyze a product's total structure (how everything functions and fits together) to come up with a design that can be produced cost efficiently. The underlying principle is to simplify the structure—by reducing the number of parts, either by eliminating or combining them—to simplify the assembly process. Then, determine the best designs for each part to keep material, manufacturing, and total costs at a minimum. *Design News Magazine* reports that Ford Motor Company has trained thousands of engineers to use DFMA and estimates savings of $1 billion over a 3- to 4-year period.

The key to some of the best practices found in world-class organizations is an integrated information system with total, real-time asset and activity visibility. The technology and expertise currently exists to leverage best business practices into Army operations and execute the RML. Industry has found that, to have successful implementation of these best practices, which would have system-wide impact and/or result in extensive change, it must also have top leadership's commitment, support, and involvement. The Army After Next cannot be successfully supported with the resources and infrastructure that are expected to be available. We need best-in-class logistics practices. The Army must partner with world-class logistics providers when beneficial and become a world class provider itself by leveraging the best industry has to offer. The challenge is to determine where and when to pursue each of these industry-proven strategies. **ALOG**

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Functional Domains of the RML—

- **Technology Application and Acquisition Agility**
- **Force Projection**
- **Force Sustainment**

DISTRIBUTION-BASED LOGISTICS

Distribution-Based Logistics

by David Payne

A key tenet of the Revolution in Military Logistics (RML) is distribution-based logistics. While broadly acknowledged within the Army logistics community as a key to achieving the RML, the full scope and potential of distribution-based logistics is not completely understood and appreciated. Distribution-based logistics goes well beyond velocity management and a "transportation based" approach to supplying forces in the field. The full adoption of distribution-based logistics requires a broad revision of how Army logisticians manage the entire sustainment process. Beyond this revision will be changes in how warfighters and logisticians coordinate both the scope and timing of support. Great opportunities exist to use dynamic distribution-based logistics to empower Army XXI and Army After Next combat operations. By maneuvering the distribution system, 21st century commanders will be able to enhance responsiveness of support, enhance survivability of the support infrastructure, and reduce the logistics footprint simultaneously, thus delivering a Revolution in Military Logistics.

Distribution-based logistics is more than just increased velocity in the supply system or better and more efficient transportation links. It's a new and different way of doing business, and it will take the understanding and support of logisticians along the entire supply chain to make it work.

Value Chain

Successful modern enterprises have embraced the idea of a *value chain*. This concept calls for customer focus throughout a business process. All parts of the enterprise and all enterprise partners adjust their structures and management approaches to optimize their ability to enhance the value chain and ultimately serve the customer better. For the individuals making up a value chain, the concept calls for free and unhampered collaboration at what the Army would call the "action officer" level. For example, a truck manufacturer using the value chain concept would encourage direct coordination among customers; customer maintenance technicians; its own key managers and technical and clerical personnel; and its suppliers. All players in the value chain would know that it is their job to ensure that the customer has maximum satisfaction and return on his investment.

For Army logistics, the value chain concept would mean a less bureaucratic logistics management approach. It would support vehicle operators and commanders with a value chain stretching back through direct support technicians, operational and theater logistics managers, national-level logistics first-line managers, and even to the original equipment manufacturers' technical and supply staffs. The electronic linkage envisioned by a digitized Army XXI and the ongoing fielding of the Global Command and Control System (GCCS) and the Global Combat Support System-Army (GCSS-Army) would support this direct interaction to solve basic logistics problems.

How Distribution-Based Logistics Would Work

The RML states that distribution-based logistics requires a seamless logistics system for managing logistics operations. A seamless logistics system is envisioned as a fully modernized and integrated information system built to support RML logistics management and proactive logistics value chains.

A seamless logistics system and the value chains it supports are focused on sustaining the readiness of Revolution in Military Affairs (RMA) combat units engaged in high-tempo operations. The basic methodology proposed to control distribution is managing the flow rates of supplies along each arc and node of the distribution-based logistics network. How would tomorrow's logisticians determine the right flow rates to ensure support? The RML documents give some clues. RML envisions proactive monitoring and management of Army unit readiness in terms of the units' abilities to meet the operational or training missions assigned. RML logisticians then would correct any readiness shortfalls with tailored packages of logistics interventions. Other RML logisticians in the interconnected value chain would acquire and move the required supplies and services through intensive real-time distribution and asset management. Let's take a look at these new RML techniques in detail.

Managing Distribution-Based Logistics

The key to full adoption of distribution-based logistics is a change in mindset, from managing static stockpiles to managing dynamic materiel flows. Equally important, though, the entire supply chain must adopt a value chain approach to logistics support—focusing all efforts and activities on delivering the right supplies to the right location at the right time.

Readiness Management

The distribution-based logistics process starts with intensive, real-time readiness management. Readiness managers should be able to determine the current status of unit equipment and supplies from Army XXI digitized information fed from diagnostic sensors and prognostic systems. These prognostics likely will be a mix of onboard systems and distributed logistics system software model hosts. But status alone is not enough. The readiness managers also need to be involved actively in operational planning with the warfighters. Then online combat models and simulations can fuse the projected systems' status with the mission requirements facing those systems. Readiness managers can identify shortfalls and then set to work to balance operational requirements with feasible logistics interventions.

Logistics Interventions

Logistics interventions are packages of supplies and services that correct a specific readiness shortfall. These packages would be formulated by using specific requisition and work order documents. Think of a logistics intervention as a kit that contains parts, supplies, labor, special tools and equipment, and technical expertise, all assembled to fix a specific system problem in a specific unit. The result is a specific improvement to the unit's readiness.

Tracking all related logistics components as a package means that the logistics intervention also can be cancelled as a package. This would free up assets and labor hours that can be reassigned to new logistics interventions, greatly enhancing the responsiveness of support. Such tracking also would create the flexibility to plan alternative and backup logistics interventions that can be run simultaneously until one solution solves the readiness shortfall. Then the backup logistics interventions can be cancelled and their asserts reapplied to other problems without adding to excess or costing units money.

Distribution Management

The key to making distribution-based logistics work is intensive, real-time distribution management. Distribution managers will be juggling many balls at once. Not only will they be tracking, expediting, and redistributing the components of thousands of logistics interventions, they also will be coordinating a vast intermodal distribution network. They will be ensuring a constant and seamless link between the commercial and military distribution systems.

To build such a system, the Army, Air Force, Defense Logistics Agency (DLA), and U.S. Transportation Command will have to work together with industry to integrate a number of systems and standards. These include electronic commerce, electronic data interchange, automatic identification technology, materials-handling equipment, packaging, containers, and the interfaces within and between distribution platforms. New tactical systems, such as the conceptual deployable intermodal sort hub (DISH), may need to be developed and fielded to expedite the handoffs in the distribution-based logistics system. Optimization capabilities will have to be built into the seamless logistics system to maximize network flows simultaneously, balance distribution platform scheduling, and plan and optimize the physical layout of the distribution network.

Asset Management

Finally, asset managers still will need to track and control the total asset inventories in a dynamic distribution-based logistics system. This is the RML function that is closest to today's inventory management function. But the focus will be on managing a "virtual inventory." The total quantity of a particular resource needs to be compared with the forecast of how much of that resource will be needed at what times, whether or not it is assigned to a specific logistics intervention. Then the asset manager can determine if more of that resource needs to be acquired from DLA or industry sources, or if assets in the global distribution network simply need to be relocated to a better position in the overall system to meet anticipated demand. This capability can evolve out of total asset visibility.

Additionally, asset managers need to be able to control the redistribution of assets in motion. This could be done through automated links between the seamless logistics system and the automated components of the physical distribution system. Then packages with automatic identification technology labels or tags could be redirected as they flow through automated sort hubs, effectively redistributing and routing assets on the go. Asset managers also would use the seamless logistics system to interface with prime vendors and the global economy to add new stocks to the system. Achieving this interface drives a need for compatibility between emerging international electronic commerce standards and the evolving military logistics information systems that will eventually form the seamless logistics system.

Leveraging a Two-Way Distribution Network

Logistics interventionists and asset managers also will be able to exploit the bidirectional nature of the distribution-based logistics system. Not only can they depend on the distribution managers to move support to the warrior efficiently, they also can task the distribution network to move work to the support forces and contractors. Then repairs can be made at the location that is best equipped to repair systems and line replaceable units (LRU's), rather than attempting repairs in the dirt on a rapidly shifting battlefield. Both reparables and systems can be removed and replaced through the distribution network. Assets can be redirected and redistributed readily. RML logisticians can use focused distribution to create "virtual logistics bases"—short-duration rendezvous of labor, skills, tools, and materiel that use the "best" location to fix, package, reconfigure, and perform the logistics service required. Then the assets can be broken up and reassigned when the work is done or requirements change. This rapid reconfiguration capability is well suited for contractors on the battlefield, where key functions can be contracted and put into operation when and where needed, for the specific time needed.

The RMA warfighting capabilities called for in Joint Vision 2010 will result in a decisive power projection force designed to meet the global challenges of the next century. Inherent in these concepts is the need to project the distribution network globally into an undeveloped, and likely hostile, operational environment.

Once projected, the distribution-based logistics system must be maneuvered to keep up with the highly maneuverable Army XXI forces and the rapidly changing RMA war fight. It also will have to be maneuvered to stay one jump ahead of the opponents' long-range precision weapons and weapons of mass destruction. To do this, we will need an integrated intermodal system that smoothly passes shipments between commercial and military carriers as well as among trucks, aircraft, ships, and railcars. Such a dynamic distribution system promises revolutionary gains in agile, effective, logistics support to maneuver forces, while maintaining a relatively light footprint in the theater of operations.

Anticipation Throughout

Anticipatory logistics will be the key determinant of the success of distribution-based logistics. From fusion of continuous real time logistics planning and force prognosis through the management of multiple logistics interventions, RML logisticians will have to deal with uncertainty. Since the fastest intercontinental shipments still will be by subsonic air, logistics requirements must be anticipated at least 24 hours ahead of current operations. This lead time may stretch to 72 hours or longer if materiel is procured from commercial sources. Specific unit and weapon system platform-level requirements may not be known this far out. However, gross requirements for the forces involved and operations planned, as well as regional delivery areas, can be known well ahead of specific recipients and delivery points. If RML logistics managers funnel the gross force-level requirements into unit requirements and then into platform requirements, the dynamic distribution system and total asset visibility and control can be used to assign and redirect bulk quantities of assets on the fly to specific units and platforms.

Great opportunities exist to use dynamic distribution-based logistics to empower Army XXI and Army After Next combat operations. By maneuvering the distribution system, 21st century commanders will be able to enhance simultaneously the quality and survivability of support. By anticipating and coordinating continuously through the virtual value chain, 21st century logisticians can use the distribution-based logistics system to focus the global industrial base on the critical resource needs of the warfighter. The result truly will be a Revolution in Military Logistics, supporting a Revolution in Military Affairs. **ALOG**

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Extending the Logistics Revolution at the Operational and Tactical Levels

by Captain Jeffrey D. Witt and Captain Shawn P. Feigenbaum

Today's Army is transitioning rapidly from an industrial age Army to a knowledge- and capabilities-based power projection force. The current force is highly mobile and more than 35 percent smaller than the force that won the Cold War and Desert Storm. This smaller, more agile Army must be able to execute missions that span the entire spectrum of military operations, from humanitarian and peacekeeping missions to major theater wars.

The Army now is based primarily in the continental United States (CONUS), but it also maintains a limited forward presence in Europe and Korea. The goal is to build the capability to project strategically and close this battle force and all associated support anywhere in the world within 75 days. The Army also must develop the capability to meet future demands. The challenge for Army logisticians is to develop a reliable, agile, and efficient logistics system that will keep pace with tomorrow's Force XXI power projection Army on an increasingly complex and lethal battlefield.

The traditional means of supporting the force through logistics mass with globally positioned stockpiles is no longer viable for today's CONUS-based Army. It is prohibitively expensive in peacetime and insufficiently responsive to support the dynamics of a changing military. The power projection concept also requires the Army to deploy its forces, fight initial battles, and support itself simultaneously. In order to respond to these demands, the Army is undergoing a dramatic revolution in the way it sustains the warfighter.

The Combined Arms Support Command (CASCOM) at Fort Lee, Virginia, is spearheading the Revolution in Military Logistics by bringing together the institutional knowledge of the entire combat service support (CSS) community and focusing it on changing the way we provide support. By harnessing the collective CSS resources, CASCOM is concentrating on four basic concepts: updating doctrine, reshaping force structure, designing and fielding technological enablers, and transforming training programs. The result of this revolution is the distribution-based logistics system.

Improving Logistics Velocity

Distribution-based logistics is designed to maximize and prioritize the throughput of forces, supplies, and sustainment material from the port of debarkation to the warfighting unit. Logistics managers at every echelon on the battlefield will synchronize resources in order to optimize the flow of supplies throughout the theater. Improvements in logistics velocity and transportation, coupled with advances in emerging information technology, will make this logistics system possible.

Extending the Revolution in Military Logistics to the operational and tactical levels will enable this system to become a reality. The doctrinal objectives include–

- A single logistics operator, characterized by a centralized distribution manager at each level.
- Anticipatory and predictive logistics, encompassing a shared, relevant view of fused operational and logistics data.
- Minimized logistics footprint, with modular, tailored units and reduced stockpiles at every echelon.
- Maximized throughput of supplies and sustainment, characterized by the bypass of support nodes, reductions in handling, and increased velocity.
- Time-definite delivery, with a stabilized order and ship time, delivery consistency, and the metrics to evaluate the delivery system.

Efficiencies created from these objectives will allow the Army to develop a seamless logistics pipeline for supplies and sustainment material. This distribution-based logistics system will exploit our battlefield distribution concepts and leverage advances in technology, new logistics information systems, and improved situational awareness. As a result, the Army will be able to bypass many of the current echelons of support, reduce materiel handling, and expedite delivery of supplies to the warfighting units.

Redesigning the Battlefield

Force structure is being reshaped based on the concepts of unity of command, increased velocity, and an agile CSS structure. This structure builds on modular units that will allow split-based operations and enable the theater commander to tailor the size of the required support structure. The CSS structure also will incorporate a centralized logistics operator at each echelon, empowered with real-time logistics information dominance. This operator will optimize the distribution infrastructure and synchronize distribution efforts to maximize throughput of forces and materiel to the maneuver unit.

New logistics units are being developed to support these concepts. Forward support companies have been created in the forward support battalions to provide all of the maneuver battalion logistics support while maintaining a surge capability. The main support battalion will be replaced by the division support battalion, which will provide support to all units operating in the division rear. Direct support and general support maintenance personnel will be combined to form one unit that will focus on replacing components forward and repairing them in the rear.

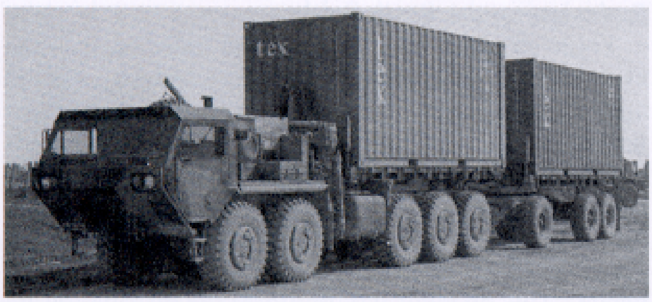
Above the division, a theater support command will replace the current theater Army area command. This new unit will create a multifunctional and tailored support system that will enter the theater early to control and support deploying forces and sustainment. The traditional ammunition companies also are being redesigned into modular units capable of supporting a force of any size with a minimum number of support personnel.

These new units will exploit the doctrinal principles of maximizing throughput, bypassing intermediate support nodes, minimizing materials handling, increasing distribution velocity, and anticipating CSS requirements in an effort to get the optimum sustainment possible in the distribution pipeline to best support the force.

Integrating New Technology

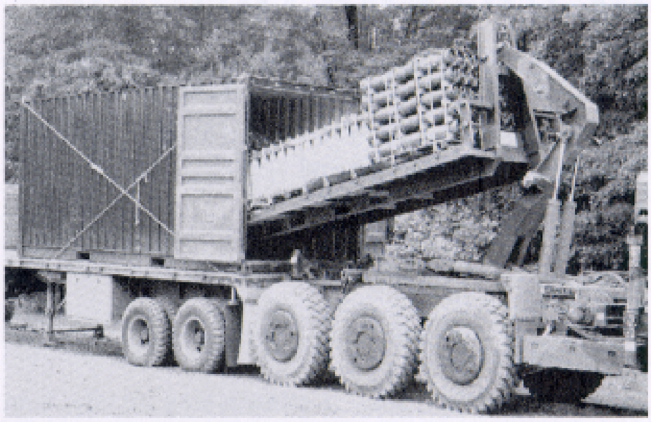
Advances in enabling technologies and our ability to integrate new systems are essential to developing and maintaining effective distribution operations. The fielding of key equipment enablers focused on high-speed delivery and efficient distribution of supplies is changing the way logisticians do business. The battlefield distribution concept is predicated on several key technological platform enablers–

- The palletized loading system (PLS), a mobile, self-contained, materials-handling system engineered to transport, drop, and retrieve flatrack loads, will reduce transloading and the multiple handling of cargo dramatically, thereby expediting the delivery of supplies to the battlefield.



☐ **Palletized loading system (PLS) with trailer.**

- The container handling unit (CHU) uses the same technology as the PLS to drop, retrieve, and transport 20-foot containers.
- The container roll in-roll-out platform (CROP), a rolling flatrack that fits snugly inside a 20-foot container and is compatible with PLS and other load-handling systems, will reduce transloading and materials-handling times significantly, enhance the throughput of supplies, and increase logistics velocity.



☐ **Container roll-in-roll-out platform (CROP).**

- The movement tracking system (MTS), a satellite-based communication system that uses global positioning technology to track and control transportation assets anywhere in the world, will provide real-time in-transit visibility of critical distribution assets.
- The forward repair system-heavy (FRS–H) is a self-contained, multicapable, heavy repair system consisting of an ensemble of hand and power tools, welding and cutting equipment, an air compressor, a 50-kilowatt generator set, and a 5½-ton crane carried on a PLS vehicle chassis.

Transforming Training Programs

Training programs are being developed to tie all of the new concepts together. This will ensure that Force XXI units can execute the new doctrine and effectively apply the enablers to create a seamless support system. Advances in distance learning, simulators, Internet-based information, and training software will ensure that these units are aware of new developments in their respective fields and continue to execute common tactics, techniques, and procedures across the Army.

Incorporating Information-Age Technology

Distribution-based logistics depends on the logistics operators having timely battlefield information. Our ability to harness the power of information will result in reduced logistics response times and transition support from reactive to predictive application of resources.

New-age information systems will give logisticians a common relevant picture of the battlefield and provide asset visibility. Several key enabling information systems will empower logisticians with tactical information dominance–

• Global Combat Support System-Army (GCSS-Army) will be the Army's integrated CSS information systems manager. It will provide interactive information management and serve as the primary operations system for all force support levels. GCSS-Army will provide the commander the capability to anticipate CSS requirements and place requests for support on the appropriate CSS provider.

• The Combat Service Support Control System (CSSCS) provides logistics situational awareness for CSS operations. It presents a concise picture of unit requirements and support capabilities by collecting, processing, and displaying graphical information on key items of supply, services, and personnel. It also supports the decision-making process with a course-of-action analysis application.

• Force XXI Battle Command Brigade and Below (FBCB2) will be the first system to allow logisticians at the tactical level to obtain the same situational awareness as provided to the tactical commander. Through this awareness, logisticians will be able to maintain asset visibility, direct and redirect logistics platforms, conduct traffic management within the brigade area, and, in time, receive prognostic and diagnostic sensor data. It also provides near real-time status on both unit and supply point stocks.

Improved situational awareness will allow distribution managers at all levels to monitor this seamless logistics pipeline from the factory to the foxhole. The managers will accomplish this by using real-time information systems provided by total asset visibility, in-transit visibility, and movement tracking systems. These systems will allow logisticians a dynamic view of the pipeline to maximize throughput and follow-on sustainment with anticipatory and predictive logistics while executing support priorities.

Innovation, experimentation, and concept development will ensure that the Army stays on the cutting edge of technology. Empowered with logistics information dominance, enabling technologies, and increased situational awareness, the distribution-based logistics system will support the full spectrum of tomorrow's Force XXI operations. These logistics concepts are being developed at CASCOM as the Army reshapes its doctrine, force structure, and training systems and purchases the enablers that will facilitate these concepts. When fully developed, this distribution-based logistics system will be the most reliable, agile, and efficient supply system in the Army's history.

□ Logisticians must have timely and complete information on the battlefield.

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JTMO—Delivering the Revolution in Military Logistics

by Colonel Don Lamb

The young vehicle repair specialist in Bosnia picks up the package, eager to unwrap and install the repair parts on the military police high-mobility, multipurpose, wheeled vehicle (HMMWV). She notes that the parts were ordered only 21 days ago and are now in her hands.

At the same time, the repair parts specialist at Fort Hood, Texas, is doing a reconciliation run on his computer. He is happy to see that the latest deliveries from the supply system were averaging 7 days or less.

Both shipments were by surface, not higher cost air priority service. What is happening here is a tangible sign of the Revolution in Military Logistics. A strong team of logistics, maintenance, supply, finance, transportation, and automation systems experts are engineering the change, which is being seen Army-wide.

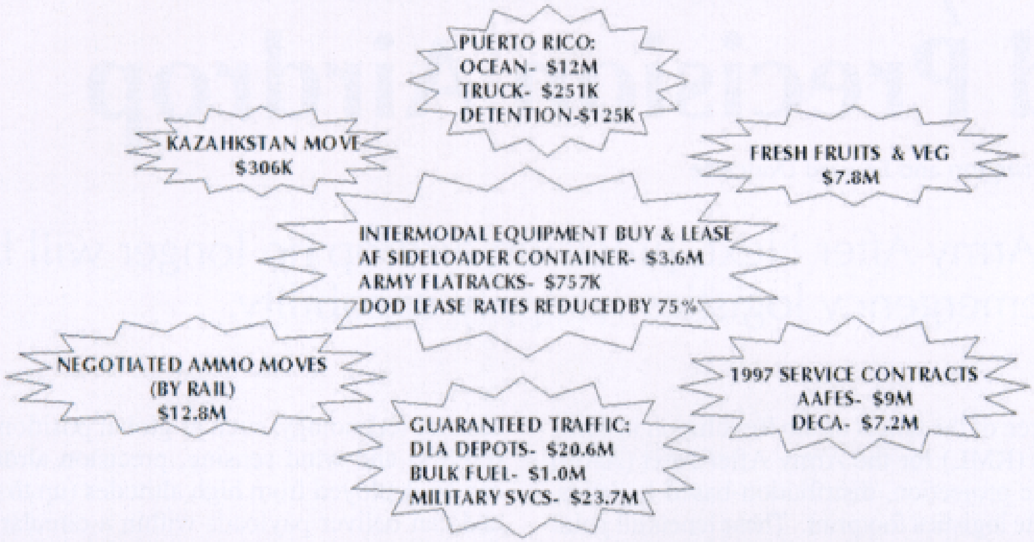
Delivering the final product is a big part of the mission of the Military Traffic Management Command (MTMC), the Army's surface transportation component of the U. S. Transportation Command. The behind-the-scene tasks begin in the offices of the MTMC Joint Traffic Management Office (JTMO), where specialized customer-support teams work with rolled-up sleeves taking on requirements and striving to meet customers' needs. Using the commercial marketplace, these teams move goods worldwide. The growing importance of increasing the velocity of inventories in motion, while reducing warehousing and stock inventories, places greater emphasis on transporting goods to their places of use.

Now accepted as standard by most logisticians and operators, the emphasis on assured, timely transportation is relatively new and still normally associated with air express shipments. The true success in the continental United States (CONUS) lies in linking recurring volume requirements by installations and filling the void with scheduled truck service. The latest breakthrough for overseas installations is tailored customer service using intermodal ocean liners.

A True Success Story

By integrating the customers' requirements and using value-added transportation services, a small team of innovative Government employees used the new JTMO approach to mission accomplishment, built on meeting the service customer requirements, to achieve

EXAMPLES OF JTMO COST SAVINGS AND AVOIDANCES



☐ JTMO has realized significant cost savings with the implementation of dedicated delivery contracts.

success. Key work by JTMO traffic management specialists has made faster deliveries of repair parts and other commodities possible throughout CONUS. These specialists visited Fort Irwin, California; Defense Distribution Depot San Joaquin, California; Fort Carson, Colorado; Fort Riley, Kansas; Fort Campbell, Kentucky; Fort Bragg, North Carolina; Fort Sill, Oklahoma; Defense Distribution Depot Susequehanna, Pennsylvania; Fort Bliss, Texas; Fort Hood, Texas; and Fort Lewis, Washington, to get to know local requirements and issues. They then worked with the Army Combined Arms Support Command (CASCOM); the Army Forces Command; and Headquarters, Department of the Army, to develop procedures for specialized, guaranteed traffic solicitations from many locations.

The volumes to be shipped, specified timeframes for each leg, control procedures, and required reports are issued to all interested motor carriers. Special meetings are scheduled to ensure that commercial truck firms understand the customers' needs. Bids are received and contracts are awarded. The result is daily, dedicated truck deliveries from the supply source directly to the end user, bypassing the middle man and reducing order and ship time (OST).

Overseas Requirements

Velocity management procedures to build worldwide support capability also are being developed. Joint teams from MTMC; CASCOM; U.S. Army, Pacific; and U.S. Army, Europe, already have made key fact-finding trips. Early success has led to the inclusion of stringent customer-service provisions in the JTMO's Universal Service Contract for Northern Europe. Once ready for movement from the vendor or depot sites, shipments must be delivered to their destinations by day 20. The current ocean carrier, Lykes Lines, has set up special procedures to track and expedite delivery of the cargo containers at a lower negotiation price, well under general cargo rates. This level of assured service, within transit documentation and predictability requirements, is now a reality. Sealift transportation now is capable of high-volume, lower cost, and reliable service that makes it not only competitive with air transport but possibly faster, especially in periods of high competition for air priority.

Through successful teaming of JTMO personnel working on both CONUS and outside CONUS transportation issues, MTMC is providing faster movement of cargo, particularly repair parts, worldwide in a manner that is virtually unnoticed by our DOD customers.

The MTMC staff—from the JTMO traffic managers to the contract staff and the post operators—all serve the goal of delivering combat power to its place of business. Getting down to the installation level, understanding the requirements, and working with industry to tailor a solution are efforts that form the basis of the Revolution in Military Logistics. **ALOG**

Colonel Don Lamb is the Director of the Joint Traffic Management Office, Military Traffic Management Command, Falls Church, Virginia.

Army After Next and Precision Airdrop

by Nancy Harrington and Edward Doucette

For the Army After Next, precision airdrop no longer will be just an emergency logistics resupply capability.

Three of the tenets of the Revolution in Military Logistics (RML) for the Army After Next (AAN) are rapid force projection, distribution-based logistics, and an adequate logistics footprint. These tenets all point toward capabilities that highly precise airdrop can provide that will dramatically improve the ability to conduct operations in AAN at an affordable cost.

The resupply of highly dispersed teams with the essentials for sustained combat will be necessary in the AAN scenario. Thanks to the fielding of ultra-reliable, fuel efficient materiel, the volume of resupply will be significantly lower than today. But what still will be required is far more vital to the sustained operations of the teams and their very survival. Just-in-time instead of just-in-case resupply capabilities will need to be the standard. Precision airdrop will provide rapid, precise, low-cost delivery that doesn't rely on ground transportation or the deployment of Army aircraft to the point of delivery. Increased stealth, lower vulnerability, and lower cost are all achievable with this resupply method.

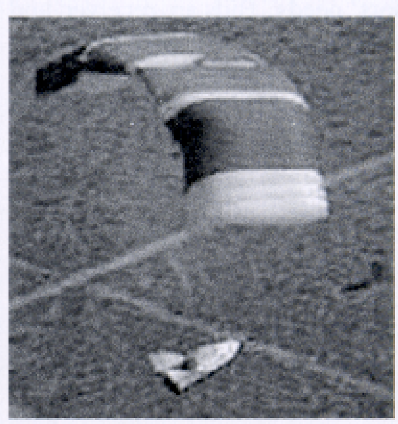
High-altitude delivery significantly reduces aircraft vulnerability in nonpermissive airdrop environments where small arms, light antiaircraft artillery, and manportable missiles are prevalent threats. Increased delivery accuracy will result in smaller drop zones (DZ's) and reduced load dispersion on the DZ, resulting in faster operational readiness and force projection. Revolutionary precision airdrop capabilities will provide aerial delivery options that enhance mission flexibility, increase safe areas of operation, and complement the rapid forced-entry tactics required to counter anticipated threat environments.

The Army Soldier and Biological Chemical Command's Natick Research, Development and Engineering Center (NRDEC), and its military, academic, and commercial partners are focused on developing a flexible, affordable precision airdrop capability that will provide the Army with a cornerstone capability for AAN operations. Capitalizing on advances in guidance and sensing technology, such as global positioning systems (GPS's) and wind sensing, precision airdrop systems can be deployed from high altitudes (up to 25,000 feet) and can deliver payloads within a circular error probable (CEP) accuracy range of 100 meters or less. Delivery accuracy in the 10- to 20-meter range is envisioned for AAN.

To achieve a flexible, affordable precision airdrop capability, two approaches will be used. The first is using gliding decelerators to provide maneuverable, three-dimensional delivery; the second approach uses ballistic or semiballistic decelerators to provide low-cost precision.

Smart, Gliding Airdrop Systems

The Advanced Precision Airborne Delivery Systems (APADS) are a family of autonomously guided airdrop systems that provide the warfighter with a revolutionary capability: the ability to autonomously deliver payloads accurately from high altitudes *and* offset distances through the application of gliding decelerators. An autonomously guided, offset delivery system has a "drop and forget" capability that enables one delivery aircraft to deliver to multiple targets, thereby increasing mission flexibility. This capability also enables the mili-



□ **Guided parafoil air delivery system (GPADS)-M.**

tary to respond to a broader spectrum of air delivery missions by providing a covert, all-weather insertion capability for nontraditional air delivery loads, such as sensors and munitions. Each APADS variant consists of a gliding delivery platform (for example, a semi-rigid-wing parafoil) integrated with an autonomous GPS-based Guidance, Navigation, and Control System (GNCS) to achieve a 100-meter CEP accuracy.

Guided parafoil air delivery system (GPADS)-medium (M) and -heavy (H). GPADS–M and –H use large parafoils or gliding parachutes (3,600 and 7,350 square feet, respectively) to deliver heavy payloads (10,000 to 42,000 pounds) precisely. Both systems are deployable from altitudes up to 25,000 feet and have a glide ratio of 3:1. At an Army advanced technology demonstration in 1996, world records were set for the largest parafoil ever deployed (7,350 square feet) and the most weight ever recovered with a parafoil (36,000 pounds).

Once a parafoil is deployed, the GPS-based GNCS, consisting of a microprocessor and sensors, allows the canopy to be maneuvered along a pre-set navigational path to the target. This pre-set path is determined by mission-planning software. Before the flight, the operator enters target data, waypoint positions, wind information, and desired release point into the mission planner. The software plans the mission and determines the optimum flight path and minimum release altitude. A three-dimensional visualization of the mission is provided to the operator, along with warnings of marginal missions. Once the desired mission is planned, it is downloaded to the on-board guidance unit. In flight, the GNCS navigates the system using a guidance algorithm that is updated continuously according to changes in wind conditions.

In 19 successful tests of the GPADS–M and –H, all performance objectives were met, including autonomous delivery of an operational payload (a high-mobility, multipurpose, wheeled vehicle) with a soft landing (velocity less than 30 feet per second) and within 100 meters of the target. GPADS technology is being developed by the National Aeronautics and Space Administration (NASA) as the parachute landing system for NASA's X–38 crew return vehicle, the future International Space Station emergency crew return "lifeboat." NASA and NRDEC collaborations continue in the areas of parafoil design and testing and in parafoil modeling and simulation using coupled computational fluid dynamics and structural codes. Atmospheric drop tests of the X–38 will continue for the next 2 years, leading up to deployment of an unpiloted space test vehicle from a space shuttle in 2000. Successful demonstration of this technology could pave the way for military space-based resupply and insertion.

Guided parafoil air delivery system (GPADS)-light (L) and -extra light (XL). GPADS–L and –XL are container delivery systems that use smaller parafoils and the same GNCS and mission-planning system as GPADS–M and –H. Their load capacities are 700 to 1,500 pounds and 220 to 650 pounds, respectively. As with the larger GPADS, the mission planning system allows the user to plan and simulate a mission. The mission then is downloaded to the airborne guidance unit (AGU) that steers the parafoil in flight by using servo-actuators to pull down the trailing edges of the parafoil. A military GPS is used to determine its position and the location of the intended impact point. Real-time wind and flight corrections are made to achieve the best accuracy possible.

☐ Guided parafoil air delivery system (GPADS)-L.

The GPADS–L program was started as one of the first two Department of the Army Warfighting Rapid Acquisition Programs (WRAP's). During successful completion of technical and operational testing, GPADS–L met or exceeded all technical performance requirements, including deployment from altitudes of 5,000 to 25,000 feet and delivery to a DZ offset 20 kilometers from the release point with a 100-meter CEP accuracy. The usefulness of this technology was demonstrated by the Marine Corps during the Hunter Warrior Advanced Warfighting Experiment (AWE) at Camp Pendleton, California, in 1997. Six GPADS–L airdrops provided cache pre-positioning and troop resupply. These missions were extremely successful and supported the Marine Corps' "logistics over the shore" concept.

In response to a Marine Corps and Special Operations Forces (SOF's) need for a smaller payload capacity system, GPADS–XL was developed using a smaller, more conventional, and easily packed parafoil with a cargo capacity of 250 to 650 pounds. SOF units are training with GPADS–L and GPADS–XL to incorporate the precision delivery concept into their tactics and procedures. Additionally, the effectiveness of integrating a propulsion system with GPADS–L for an extended range capability is being explored.

Semi-rigid deployable wing. The semi-rigid deployable wing (SDW) is a double-surface, inflated airfoil stiffened with an internal rigid structural frame and mated with a cargo pod. Due to its rigidity, the SDW has a higher glide ratio than current state-of-the-art parafoil-based systems (6:1) and can maneuver much the same as a rigid wing with precise control. Its high glide ratio allows for delivery of supplies to a DZ up to 25 kilometers away.

To facilitate deployment from standard Air Force cargo aircraft, the 30-foot-span, 500-pound-capacity SDW is rigged in a stowed or folded condition inside the aircraft. Once outside the aircraft, a drogue parachute is used to pull a slider mechanism, similar to an umbrella, which fully opens the wing. Once fully deployed, the autonomous GNCS takes control of the system, keeping it trimmed and maneuvering it to the preprogrammed target area. Deployment of a 30-foot SDW from a C–130 aircraft at an altitude of 25,000 feet with autonomous flight to a DZ with a 6:1 glide ratio has been successfully demonstrated.

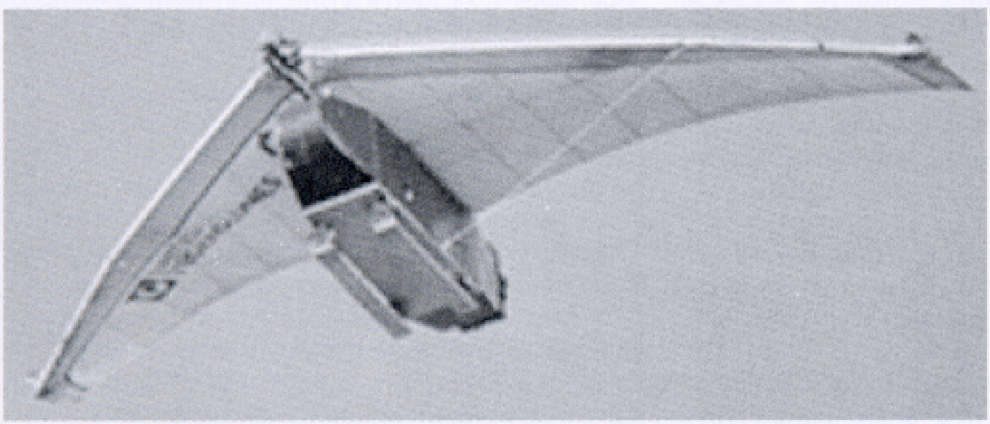
Development of SDW technology continues as an Army science and technology objective entitled Precision Offset, High-Glide Aerial Delivery of Munitions and Equipment. The purpose of this objective is twofold and focuses on improving payload capacity and range. The first is to demonstrate the SDW–M, which is capable of delivering a 2,000- to 5,000-pound payload. Extraction testing of a high-fidelity mock-up of the 58-foot-wingspan SDW–M has been conducted to verify the dynamics of the SDW–M during exit from cargo aircraft. Flight testing of the full SDW–M is scheduled for the third quarter of fiscal year (FY) 1999. The second objective is to increase the offset range of the smaller SDW from 75 to 300 kilometers using an optional glide augmentation system. Initial testing of the powered SDW successfully demonstrated wing deployment and mid-air start of the glide augmentation system. Flight testing and demonstration of an improved delivery range with an updated SDW design should be completed in the first quarter of FY 1999.

High-Altitude Airdrop Systems

The New World Vistas Precision Air Delivery (NWV–PAD) research initiative is a 4-year basic research program sponsored by the Air Force Office of Scientific Research to explore technologies for substantially improving the accuracy of Container Delivery System (CDS)-sized (2,200 pounds), high-altitude airdrop systems by using ballistic or semiballistic decelerators. The NWV–PAD is potentially a low-cost solution to the high-altitude precision challenge. It will require synergistic Air Force and Army advancements, such as decelerators, wind sensing, and release-point determination, because mission success is much more dependent on release point and winds. The NWV–PAD's greatest disadvantage is a lack of offset release point, which increases aircraft vulnerability in some air defense scenarios.

The NWV–PAD integrated product team, composed of personnel of NRDEC and the Air Force Research Laboratory's Flight Dynamics and Weather Directorates, identified three key research areas for improving accuracy—

• Advanced decelerators and containers. NRDEC is investigating using both controllable semiballistic and high-speed ballistic decelerators as low-cost solutions to precision delivery. A semiballistic decelerator, either a modified round or cross parachute, integrated with novel pneumatic muscle control actuators, provides the ability to maneuver and make small trajectory corrections necessitated by changing winds. High-speed ballistic systems that use a cross parachute increase accuracy from high altitudes by minimizing wind effects.



☐ **Semi-rigid deployable wing.**

☐ **High-altitude, ballistic or semi-ballistic airdrop systems.**

Innovative reefing techniques are being developed to keep the initial cross parachute drag area small, resulting in a high-speed trajectory. Near the ground, the parachute is fully deployed to effect a soft landing. State-of-the-art parachute modeling is used to predict the performance of both concepts and provide aerodynamic parameters for an autonomous guidance, navigation, and control system.

• All-weather wind sensing. Research focuses on investigating mesoscale models based on computational or empirical data that enable high-resolution forecasting of winds in and around a DZ. With high resolution mesoscale models, it would be possible to make highly accurate wind predictions for the DZ with limited wind data.

• Automated computed aerial release point (CARP). The objective is to develop advanced release point planning algorithms that exploit advanced multidimensional wind characterizations and enable the delivery aircraft crew to re-plan an airdrop release as new wind data become available while en route to the drop area.

Preliminary wind tunnel testing of the cross parachute and subscale testing of a manually controlled semiballistic system have been completed and resulted in initial performance estimates and component sizing. Additional testing and initial development of a low-cost guidance system that uses APADS technology is slated for early FY 1999. Continued development of these concepts, leading up to a full-scale demonstration integrating all three technologies (decelerators, wind sensing, and CARP), is planned for FY 2001.

An Expanded Spectrum of Missions

As precision airdrop technologies evolve, so do the tactics to employ them effectively. This in turn expands the spectrum of missions airdrop can perform beyond logistics resupply. The AAN concept of using mated ground and air vehicles with both strategic and tactical deployability for delivering mounted forces and AAN fighting vehicles can be augmented by gliding precision airdrop using C–130 and C–17 aircraft. Under this scenario, continental United States-based legacy aircraft and large, guided parafoils will deliver heavy combat vehicles from delivery aircraft that are flying at high altitude and offset from the intended DZ. This precise delivery method will provide efficient strategic deployment directly to the tactical level while removing the valuable delivery aircraft from direct enemy fire.

Dispersing autonomous, remote sensors forward of the battlefield will provide the AAN forces with information dominance capabilities. Small package, precision airdrop systems that can loiter, have extended range and ground take-off capability, and are reusable are achievable in the AAN timeframe. Using autonomous precision airdrop to deliver remote sensors and other autonomous systems will eliminate the need to place forces in harm's way and will provide a high degree of stealth. These characteristics, combined with the expected low cost of AAN precision airdrop, will contribute to the operational utility of remote sensing on the battlefield.

Precision airdrop is key to achieving AAN logistics resupply. Technical advances are headed in the right direction, and required capabilities are achievable in the AAN timeframe. Additionally, precision airdrop is valuable in areas other than resupply. For the AAN, airdrop no longer will be just an emergency resupply capability but will support all aspects of the mission. **ALOG**

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Edward Doucette is the Business Area Advocacy Team Leader in the Soldier Center of Excellence.

Medical Prime Vendor

by Tom Cardella

Six years is not a long time, but for the Directorate of Medical Materiel at the Defense Supply Center Philadelphia (DSCP), it was enough time to revolutionize medical logistics. Until 1992, the typical medical treatment facility (MTF) spent 43 percent of its operating budget doing business (19 percent product costs, 24 percent overhead costs). Product procurement and delivery lead times averaged 30 to 60 days. Numerous sources of supply were the norm; so were duplication of effort and increased ordering costs.

Escalating costs and distribution inefficiencies had been bad for some time, but they had become intolerable at a time when the Government was searching desperately for ways to cut costs. The media was full of stories about warehouses of waste, Department of Defense (DOD) shopping sprees, and excessive and aging Pentagon inventories. Clearly, the time had come to do something and do it fast.

Looking for a Fix

DSCP (known then as the Defense Personnel Support Center) established a task force in March 1992 to change radically the business practices for the wholesale management of medical supplies in the DOD. One of the keys the task force found was the Medical Prime Vendor Program.

A medical prime vendor is a single distributor of brand-specific medical supplies. The prime vendors, who are leading distributors in their industry, provide next-day delivery. The Medical Prime Vendor Program provides for procurement and delivery of a full range of commercial brand-specific pharmaceuticals and medical and surgical supplies to a group of MTF's in specific geographical regions of the United States, Europe, and the Pacific Rim.

The Prime Vendor Program is innovative, customer oriented, and consistent with commercial practices. It is really a cooperative effort between industry and the medical logistics system that is designed to satisfy our customers' medical needs. As such, it quickly has become a model for the new era in public-private business partnerships.

Understanding Prime Vendor

To understand just how revolutionary Prime Vendor is, one only has to look at the way we used to do business at DSCP from the customers' perspective. DSCP controlled what they got, when they got it, and how much it cost. We were the "specification-preparing activity," the purchasing activity, and the supply depot. In a sense, the customer was our hostage, trapped in a closed system with no way out. Internal Government regulations dictated that all military customers had to come through us for their medical supplies. There was no way to sidestep the bureaucracy.

□ **Medical supplies for the 67th Combat Support Hospital at the Taszar Airfield in Kaposvar, Hungary, are provided by the U.S. Army Medical Materiel Command, Europe, a Medical Prime Vendor customer.**

Under Medical Prime Vendor, the customer is in control. The customer selects the brand-specific item he desires. DSCP does not have to buy the item, get it into a depot, and ship it to the customer. Instead, the prime vendor has the item in its inventory and ships it to the customer within 24 hours of receiving the order. The customer gets what he wants, and he gets it overnight.

A natural question from prospective customers is, "How do my bills get paid?" The facility places the order and lets the Directorate of Medical Materiel at DSCP know the dollar amount of the order. The prime vendor electronically invoices the directorate for the order, and we pay the bill for the customer. The directorate then gets reimbursed through interfunding or direct billing to the customer's agency. Prime vendor fees vary according to the circumstances.

Today, Medical Prime Vendor has reduced product procurement times to 24 hours. MTF inventories have been reduced by up to 85 percent. We have been able to get over 95 percent of the requested items in less than 24 hours. Warehouses have been closed and materiel management staff redirected to provide direct healthcare support. All of this has resulted in drastic reductions in the total delivered cost of medical materiel.

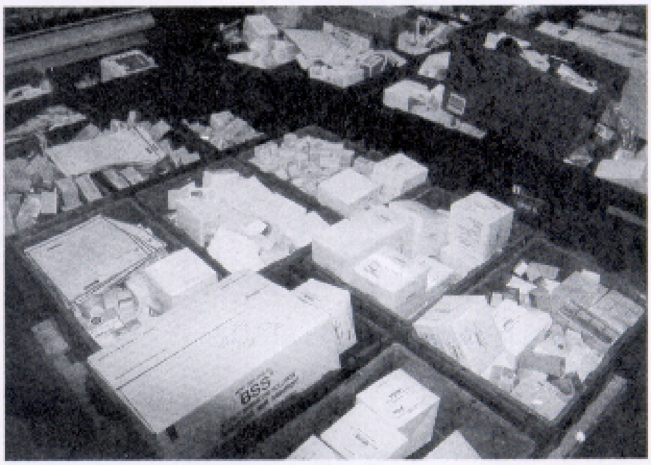
The pricing for items under the program comes from distribution and pricing agreements (DAPA's) that the DSCP Directorate of Medical Materiel has entered into with the manufacturer or, in some cases, a distributor of the product. DAPA's represent a vendor's most immediate access to our logistics system. They are paperless agreements that establish very favorable pricing for standard commercial commodities used in hospitals.

DSCP ensures that the customer is receiving the best value from the prime vendor through item selection reports. These reports are created by DSCP through working closely with each MTF to identify usage data on pharmaceuticals, medical and surgical supplies, and medical equipment items. We provide this report to the prime vendor, who then sets stock levels based on the information provided. MTF's can update their requirements at any time.

DSCP also provides a monthly update called the universal data repository (UDR) that contains data on all medical items used throughout the Federal sector. The UDR allows system customers unprecedented visibility of technical price and ordering data for these items. Virtually all prime vendor items can be found in the UDR. Using their ability to compare prices, products, and usage data, MTF logistics personnel can order the most appropriate product at the best price.

Participation in the Medical Prime Vendor Program is open to any federally funded medical facility, which includes the Department of Defense, Department of Veterans Affairs, Public Health Service, and federally funded local hospitals.

When we embarked on the Medical Prime Vendor Program, we heard from doubters who recited a laundry list of reasons why the new concept would not work. In the end, the program worked because our people were encouraged to create a new paradigm. We were empowered to implement new processes without a lengthy approval process or review. The employees who were involved directly in making the program a success were able to identify the areas that needed innovative solutions and then implement them without fear of reprisal or second-guessing by higher management. When we went out on a limb, top management climbed out there with us. They supported our decisions and looked for ways to remove any obstacles to success.



☐ Prime vendors pack medical supplies in "totes" for shipment to using units.

Six and Growing

The Medical Prime Vendor Program is still growing today. The pharmaceutical program covers over 24,000 items, the medical and surgical supplies program includes over 180,000 items, and we are adding many equipment items as well. If the exact item that a customer requires is not covered, there may be substitutes available. However, if there is a need for a specific item, the DSCP Directorate of Medical Materiel makes every effort to get that item added to the program.

Medical Prime Vendor is not a static program. It can't afford to be static in our rapidly changing defense environment. The program continues to evolve to meet the needs of our customers. DAPA's are now provided to cover custom surgical prepacks. Surge support has been built into the program to provide for military contingencies. New systems have been developed to assist us in ensuring that prime vendors are meeting their contractual responsibilities. But one thing has not changed since the inception of the program: the Medical Prime Vendor program puts the customer first. ALOG

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Velocity Management and the Revolution in Military Logistics

by Thomas J. Edwards and Dr. Rick Eden

By now every logistician in the Army should recognize the famous sound bite from the Chief of Staff: "There will not be a revolution in military affairs unless there is a revolution in military logistics." When General Reimer identified the Revolution in Military Logistics (RML) as a necessary precondition of the revolution in military affairs (RMA), he seemed to issue a clear challenge to the Army logistics community.

Yet recent studies of the RMA commonly express little hope for delivering an RML, at least in the near term. For instance, in the article, "Strategic Logistics for Intervention Forces" (*Parameters,* Winter 1997-98), Lieutenant Colonel Yves J. Fontaine counters the Chief with another precondition: "The revolution [in military logistics] will occur only after our research community provides us with combat equipment that minimizes the logistical tail needed to sustain it." Similarly, in an article titled "An Appraisal of 'The Brigade-Based New Army'" (*Parameters*, Autumn 1997), Colonel David Fastabend expresses discouragement about achieving an RML. He describes the prospects of supporting the fast operations that characterize most concepts of the RMA: "The major barrier to the concept of flexible, independent maneuver on the battlefield remains logistics. There are no really good solutions for re-supplying these fast-moving organizations without some kind of logistical tail that, inevitably, restricts the speed and scope of the maneuver."

The need for an RML seems to present a classic case of an irresistible force (innovative military operations) meeting an immovable object (the Army logistics system). Something has to give. Either it is possible to achieve an RMA without an RML, or there is a way to achieve an RML without waiting for the Army to field a new suite of major weapon systems. This article supports the latter. The Army can deliver much of the RML quickly and affordably by focusing on the dramatic and continuous improvement of today's key logistics processes. Moreover, such an improvement effort has been underway for several years and has demonstrated remarkable success. It is called the Velocity Management (VM) initiative.

Two Keys to Achieving an RML

The basic point made by Fontaine and Fastabend is incontrovertible: When the Army fields future weapon systems, new technologies will permit design options that reduce the demand for logistics products (particularly consumables such as fuel) and services (particularly maintenance). Of course, logisticians should keep in mind that operators may decide *not* to reduce their demands for logistics services despite more efficient and lethal systems. Instead, they may choose to employ the less demanding weapon systems in much more demanding operational concepts. For example, if the future weapon systems consume half the fuel of today's analogous systems, then future operators may decide to double the amount of territory covered in a day.

But it is a mistake to equate the RML with reduced demand streams alone. Reduced demands for logistics support may contribute to the RML and may facilitate it, but they do not constitute it. Contrary to what many have claimed, it may be possible to deliver much of the RML before the Army fields a new suite of ultrasupportable weapon systems. Moreover, because most operational units will retain the older, "legacy" systems through the Army After Next (AAN) timeframe, most of the Army will need more than an RML that works only when supporting new systems.

A careful reading of the *Army Strategic Planning Guidance* identifies five components of the RML—

• ***Reduced demand streams from more supportable weapon systems.*** "New technologies must produce systems that require fewer supplies and consumables."

• ***More accurate and timely visibility of demands.*** Exploitation of real-time information connectivity, via health and status sensor platforms."

• ***Quicker, more responsive processes***. "Timely, integrated, and predictive support will be more capably executed."

• ***Increased support from afar.*** "Installation capabilities must be leveraged to sustain the force during split-based operations over extended distances."

• ***Reduced footprint.*** "Deployment of fewer logistics support forces into theater."

As the Army considers what might constitute an RML and how it might be achieved, working with a broader definition affords more chances for success.

Moreover, there are important synergies and dependencies among the multiple components of the RML. For instance, achieving the third component in the list, "quicker, more responsive processes, " would contribute to the fifth component, "reduced footprint." In the past, when resupply was slow and unreliable, the more days of supply one held in a theater, the better; in the future, if resupply is very quick and dependable, the goal may become to minimize days of supply on hand. Other of the components listed also would contribute to reduced footprint.

Such relationships among components have important implications for implementing the RML, because they indicate the critical leverage points. Upon examining these relationships, one finds that there are two major keys to achieving the desired RML characteristics. The first is the approach identified by Fontaine and Fastabend: fielding more supportable weapon systems. This represents an expensive and long-term approach to achieving an RML.

Fortunately, another available approach requires little or no investment, though investment in appropriate enablers can facilitate it. This is the path of process improvement. Ultimately, these two approaches are complementary, but process improvement should take precedence for several reasons.

First, process improvement is affordable even in periods of declining resources. In cases where existing processes are highly ineffective or inefficient, initial reform efforts can achieve impressive results by "cherry-picking" using existing resources. Moreover, as the targeted processes become more productive, some resources are freed up. Some of these freed resources can be given up or redirected to other processes, while others can be used to fund additional reforms, such as a new information system, requiring an infusion of new resources.

A second, often unrecognized, benefit of process improvement is reduced demand for a service or product. A poorly performing process artificially magnifies or exaggerates demand. For instance, when the order and ship process is slow and unreliable, customers place duplicate orders. Similarly, when the diagnostic process is faulty, technicians remove, inspect, and even "repair" perfectly good parts.

Third, by clarifying the true demand for support, improvement of today's logistics processes may keep the Army from investing too much in improved supportability for tomorrow's weapon systems. Suppose, for example, that developers of concepts for AAN systems establish demand-reduction goals such as 40 percent fewer repair parts in the evacuation pipeline and 50 percent faster diagnosis and repair. It may be that such dramatic goals can be achieved largely, perhaps fully, through improvement of today's processes.

Finally, dramatic performance improvements in key processes also buffer the RML against problems that may arise in acquiring more supportable weapon systems. If these systems are delayed or cancelled, fail to perform as promised, or cannot be employed for political or other reasons, then process improvement at least ensures that the Army still will have achieved much of the RML.

A key question for achieving the RML, then, is whether truly dramatic improvement in the performance of key logistics processes is feasible in the near term. Many have argued that dramatic improvement is not possible; in fact, three distinct groups take this position, though for different reasons. One group believes the current processes are performing about as well as one can expect and that there simply is no room for dramatic improvement (there is more than a hint of this position in Fontaine's assertion). A second group acknowledges that dramatic improvement may be possible, but believes that it can occur only through a major infusion of resources, such as more money and more people, which will not be forthcoming in the foreseeable future. Those in the third group believe that, while dramatic improvement may be technically feasible, deep-rooted organizational and cultural barriers to change inevitably prevent the Army from achieving it.

All of these beliefs once may have been true. Yet there is good evidence that dramatic improvement in the performance of the Army's key logistics processes is possible, affordable, and achievable. For instance, over the past 3 years, the Army has succeeded in achieving more than a 50-percent reduction in order and ship time (OST) for units in the continental United States (CONUS) ordering from wholesale supply sources. Improvement of this magnitude signals a revolution not only in performance but also in the demonstrated capability of the Army logistics community to implement fundamental reform.

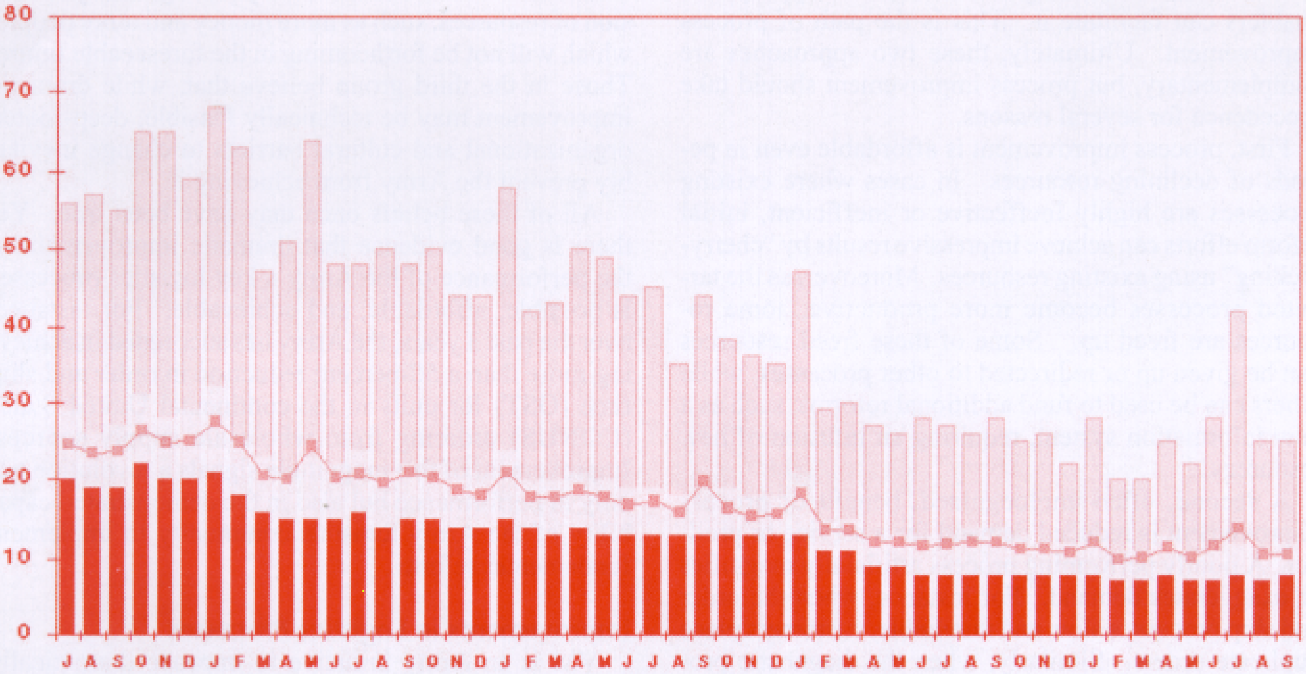
Improvements in Logistics Processes

VM is an Army initiative to improve dramatically the performance of today's key logistics processes. It adapts to the military many of the technological and managerial innovations that have proved successful in the commercial sector. By dramatically improving the speed and accuracy of all logistics processes, VM also seeks to reduce the need for massive logistics resources. The VM initiative was kicked off in January 1995 by the Army's Logistics Triad. Members of the Triad are the Deputy Chief of Staff for Logistics, the Deputy Commander of the Army Materiel Command, and the Commanding General of the Army Combined Arms Support Command (CASCOM), who serves as the executive agent for implementation.

The first focus of the VM initiative was to achieve dramatic improvement in the process used by Army personnel to order and receive supplies. The order and ship process was the logical starting point for major reform for two reasons. First, its criticality to the successful operation of the logistics system was widely understood; in fact, logistics sometimes has been defined simply as "getting the right stuff to the right place at the right time." Second, it also was recognized that improvement was needed. For decades, through peace and war, the order and ship process has been plagued by a catalog of stubborn performance problems. Each segment, from requisitioning an item to receiving the package, not only was slow but also was unreliable. OST's for orders varied widely. Some orders were delivered in a few days, but others took weeks, even when the ordered items were in stock. Moreover, a lack of confidence in the reliability of the order and ship process led some Army personnel to hoard supplies and place duplicate orders.

The figure below shows how dramatically the order and ship process has improved in speed and reliability under VM. The bars on the figure represent the monthly OST performance for orders for repair parts that were placed by active units in CONUS and filled by the wholesale supply system. Because this effort focused on improving the order and ship process for items on the shelf, backorders are excluded from the data. (The backorder problem is the result of a different logistics process and is being addressed separately.) The vertical dashed line distinguishes two periods of performance. The period from July 1995 through July 1998 represents performance trends since the VM initiative took hold. The 12 preceding months, July 1994 to June 1995, are the baseline period and serve as the basis of comparison for gauging progress. The segments on each bar measure each month's OST performance at the 50th, 75th, and 95th percentiles. For example, the 50th percentile indicates the day by which 50 percent of the orders are filled, the 75th indicates 75 percent, and so on. The line running through all bars is the average OST.

As the figure shows with the continuing downward slope of the bars and line, the Army has made dramatic and nearly continuous improvements in the order and ship process under VM. The performance during the baseline period was 17, 25, and 56 days for the 50th, 75th, and 95th percentiles respectively, with an average OST of just over 22 days. Corresponding figures for September 1998 were 8, 12, and 25 days, with an aver-



☐ **Order and ship times in CONUS have fallen about 50 percent under the Army's VM initiative.**

age OST of 10.6 days—in short, more than a 50-percent reduction at all percentiles.

Compared to CONUS units overall, some of the large Army Forces Command installations that were among the first to participate in the VM initiative have achieved even greater gains, suggesting that other units also can expect to achieve further reductions. For instance, for active units at Fort Bragg, North Carolina, the median OST has declined from a baseline average of 18 days to 6 days in September 1998—a 67-percent reduction. The 75th and 95th percentiles show similar improvement. Average OST has fallen from 26.3 days for the baseline period to 8 for September 1998.

Efforts under VM to improve the speed and reliability of the order and ship process initially focused on CONUS OST, but they quickly were extended to units outside of CONUS (OCONUS) with similar success. For instance, mean OST for U.S. Army, Europe, units receiving parts by air shipment (by far the predominant mode) from CONUS depots declined from 23 days during the baseline period to 16.5 days in September 1998, a 29-percent improvement. Similarly, mean OST to Korea over the same timeframe decreased from 26.3 days to 13.1 days, a 50-percent improvement. Gains in other theaters have been comparable. That these reductions are far less, proportionately, than those achieved by CONUS units reflects both the additional complexities of the OCONUS distribution system and the fact that VM generally was implemented later by overseas installations.

In June 1998, on behalf of all Army logisticians participating in the VM initiative, CASCOM received Vice President Al Gore's Golden Hammer award from the National Partnership for Reinventing Government. The award was given in recognition of the Army's dramatic and continuing progress in reducing OST.

Revolution in Capability to Improve

As was the case with the Army's slow and variable OST before VM, many performance deficits in Army logistics processes are longstanding. In most cases, the Army has long recognized these chronic problems, but repeated efforts to identify and eliminate their sources proved ineffective. So it is worth considering how, under the VM initiative, the Army finally made such quick and impressive headway in improving the effectiveness and efficiency of one process as well as how it has begun to extend the same improvement approach to other logistics processes.

Proponents of VM claim that VM is based on a new way of doing business and represents a new paradigm for managing logistics. The VM concept has several components—

- ***A process perspective***. Under VM, the logistics system is considered to be a set of processes that deliver products and services to customers. Typically these processes cut across organizations. Many key activities are performed by non-Army and even nongovernment organizations. In addition to the order and ship process, key logistics processes targeted for improvement by the VM initiative are repair, stockage determination, and financial management.
- ***An improvement focus.*** Management of logistics processes is focused primarily on improving their performance. Improvement is sought in three dimensions: time, quality, and cost. That is, VM seeks to make logistics processes "faster, better, and cheaper."
- ***A process improvement methodology***. The performance of processes is improved by applying a three-step method called D-M-I: Define the process, Measure the process, Improve the process. This cycle is repeated continuously.
- ***An emphasis on performance measurement***. Measurement is the central activity to foster improvement because it helps to identify performance deficits, monitor the effects of interventions to improve performance, and provide motivation and feedback to implementers.
- ***Use of cross-functional teams to increase the capability to improve***. Because processes cut across organizational boundaries, and because each segment may be technically complex, no single organization or individual has sufficient knowledge or power to make dramatic changes. Coalitions of leaders are needed to guide and sustain an effective large-scale effort. In the case of VM, the Triad forms the nucleus of a board of directors (VM BOD), sometimes referred to as the Velocity Group. Teams of experts are needed to identify and implement needed improvements through application of the D-M-I method. VM is implemented by cross-functional teams of two types: process improvement teams (PIT's) and site improvement teams (SIT's). Each PIT is an Army-wide team composed of functional experts representing all segments of a particular process as well as Army and RAND Arroyo Center analysts. (Note: The Arroyo Center is a federally funded research and development center for studies and analyses sponsored by the Army.) Each Army installation has been directed to form a SIT composed of local technical experts.

The effort to improve the order and ship process provides a good illustration of the VM concept in action. In particular, it demonstrates how the cross-functional improvement teams employ the D-M-I method to build the collective expertise and coordination necessary to achieve and sustain dramatic improvement.

"Define," the first step, aims at producing a clear picture of the entire process that the team is attempting to improve. Improving the order and ship process required the participation of experts from many organizations, both within and outside the Army. These experts literally walk the process from the time the need for a part is identified until the part arrives in the hands of the mechanic who is going to install it on the equipment. Such a detailed definition phase is critical because, though many personnel are expert in their own segment of the process, no one has a detailed understanding of every stage. Various functions are involved in the order and ship process—transportation, maintenance, supply—and improving the process requires the involvement of all functional players.

Once the process was defined, it was necessary to determine the best way to measure it to foster improvement. Although VM seeks improvements in time, quality, and cost, as its name suggests, it focuses first on reducing the cycle time of key processes. Often as this time is reduced, quality improves and costs decline. OST was defined as the time between placing an order and receiving the item. Under the Standard Army Retail Supply System-Objective (SARSS-O), it is the time from the supply support activity and back. Because both the speed and the reliability of OST needed dramatic improvement, metrics were developed and approved by the VM BOD that indicated median performance as well as performance at the 75th and 95th percentiles. The percentiles gave information on typical OST performance and focused efforts on reducing the wide variations in delivery time associated with the orders that take the longest time to be filled and delivered. By contrast, the traditional Army metric, average or mean OST, masked the underlying variability of the process and did not accurately represent its typical performance.

The order and ship PIT used the data associated with the metrics to help diagnose systemic problems. Statistical analysis and data mining were used to identify sources of delay. Another tool used successfully by the SIT's was a report that listed each requisition with an OST beyond the 95th percentile. These "outliers" were researched individually by personnel operating in each segment of the process to identify and eliminate the sources of such extraordinary delay.

The definition and measurement stages showed that many segments of the process were being managed with metrics that did not necessarily result in good customer service. For example, in some segments of the process, organizations measured themselves by the efficient use of trucks, so partial truck loads were held up until a full one could be assembled. While this goal and this metric yielded more efficient use of trucks, it delayed getting the needed part to the customer and lengthened OST for many orders. There have been other examples of conflicting goals that resulted in the apparent efficient use of some resources at the overall expense of the whole.

The final stage of D-M-I, "improve," involves combining the end-to-end understanding of the process developed in the "define" stage with the diagnoses of the sources of performance deficits that were isolated in the "measure" stage. Once likely process improvements were identified, the Army implemented the changes that it could do on its own. At the local level, these changes ranged from minor fixes, such as improving the work flow at a specific supply support activity, to abandoning an established way of doing business, such as shifting to a new shipping mode. At the macro level, their cumulative impact on process performance proved dramatic.

Army installations strengthened oversight, simplified rules, increased the use of new requisitioning and receiving technologies, reduced review processes, streamlined on-post delivery, and made use of the information available from the new metrics. These changes enabled installation SIT's to achieve consistent performance standards of 1 day for order entry and 1 day for order take-up and receipt. Other changes required establishing partnerships with the organizations that controlled other segments of the order and ship process, such as the Defense Logistics Agency (DLA), which operates the depots, and commercial trucking and small package delivery firms. DLA improved work flows through its distribution depots, sped up the processing of materiel release orders, packaged and directed shipments to reduce intermediate handling on post, and worked with commercial shippers to provide scheduled deliveries.

The analyses of order and ship process performance that the RAND Arroyo Center conducted in support of the Army's VM initiatives included diagnoses of two process segments that were not under the Army's direct control: the processing of orders in the depot and the movement of items from the depot to the installations. These analyses showed that much of the delay and variable shipping times in these segments reflected the use of a variety of shipping modes in an attempt to match each order with the lowest cost shipping mode that was appropriate to its urgency and characteristics such as size and weight. The mixing of modes caused some orders to be delayed (for instance, to wait until enough similar orders accumulated to fill a truck) and required the installations receiving the materiel to cope with multiple deliveries, most of them unscheduled.

The analyses suggested strongly that the delays and variability in the depot and transit segments could be reduced greatly if the Army and DLA could establish scheduled trucks (similar to regular mail deliveries) as the primary shipping mode to Army installations. Other activities, such as depot processing, then could be synchronized with these regular delivery schedules. Most depot-post combinations had driving times of 2 days or less and sufficient volume to support trucks daily or every other day. In such cases, even high-priority items that formerly were shipped by air could be placed on these trucks, saving the expense of using premium transportation services such as FedEx.

Working closely with the Army, DLA increased the use of scheduled truck shipments for large installations. Under the scheduled truck concept, depots that serve large installations place all the shipments for that installation, regardless of eligibility for air shipment or bulk considerations, on a routinely scheduled truck. To increase the opportunities for capitalizing on scheduled trucks, DLA implemented a number of changes. Its depots applied automation to sort shipments into multipacks and added automated manifest cards for key customers on post, reducing work loads and decreasing the time required to receipt shipments. The stock positions at some depots changed to reflect the needs of the closest Army installations. This permitted more volume to flow between these depot-installation combinations at no additional transportation cost; in some cases, it increased the number of trucks that could be sent cost-effectively per week. More frequent deliveries mean lower OST.

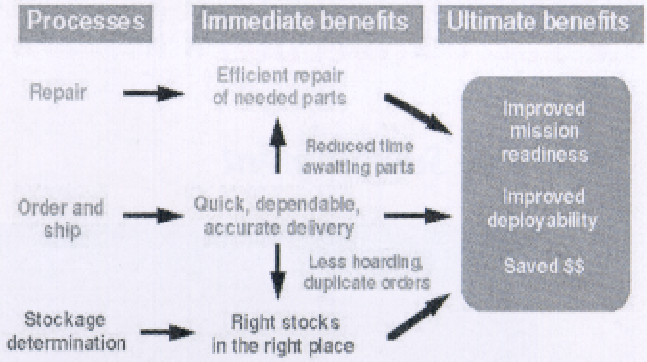
Although this discussion of the VM implementation has focused on actions taken to improve CONUS OST in peacetime, many of these actions also helped improve OST for OCONUS units, including those in deployed operations. This was a natural consequence because most of the CONUS segments of the order and ship process are also part of the OCONUS process. The streamlining of ordering, depot processing, and receiving activities contributes to the reduction of both CONUS and OCONUS OST, as does the improved positioning and sourcing of stocks to accommodate the needs of major customers of the depots Moreover, the same process changes that make peacetime performance faster and more reliable also contribute to fast, agile, and robust wartime performance.

The RML is Underway

The Chief of Staff was right about the dependence of the RMA on an RML. Current thinking about future Army operations routinely postulates a future logistics system that is so much "faster, better, and cheaper" than today's that the Army will require a revolution to achieve the anticipated performance levels. Fortunately, the success of the VM initiative demonstrates that the revolution is well underway.

The VM initiative is not limited to improving the order and ship process or to reducing cycle times. From dramatically improved OST, the revolution in performance can spread quickly and systematically. As the figure above indicates, an improved order and ship process has many benefits, both direct and indirect. Most directly, improved OST means the quick and dependable delivery of spare parts and other supplies throughout the Army.

In addition to giving customers what they need when they need it, a quick and reliable order and ship process also reduces the number of orders in the system because Army personnel are no longer so frustrated that they reorder a delayed part several times. They also have less incentive to hoard parts because they are more confident they will get them when they order them.



☐ Improvements in one logistics process contribute to improvements in related processes.

Improved OST also improves the Army's repair and stockage determination processes. The repair process experiences fewer and shorter delays due to delayed parts supply. Faster delivery means local stocks do not have to be as deep. Some of the money saved from having shallower stocks of a given item can be reinvested in providing a broader array of parts. Thus, more of the necessary parts are available locally, further speeding repairs.

The VM BOD has directed other improvement teams to apply the D-M-I method to the repair process and the stockage determination process as well as to the financial management process. Moreover, for each of these processes, the goal of the PIT's is to identify and eliminate sources not only of delays but also of errors and waste. Focusing on time, quality, and cost will deliver a logistics system that is faster, better, and cheaper.

Dramatic process improvement under the VM initiative is a key enabler of the Revolution in Military Logistics. **ALOG**

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Functional Domains of the RML—

- ***Technology Application and Acquisition Agility***
- ***Force Projection***
- ***Force Sustainment***

AGILE INFRASTRUCTURE

Achieving an Agile Defense Infrastructure

by Colonel William H. Taylor III and Randy T. Fowler

To create an infrastructure that can adapt to rapid changes and challenges, the Defense Department must use competitive sourcing and privatization.

Pressure is on the Department of Defense (DOD) to revolutionize its military and business affairs. Much of this pressure is directed at defense infrastructure, which is often characterized as ponderous, bureaucratic, and unaffordable. Indeed, a common theme of Joint Vision 2010, the Quadrennial Defense Review, the Defense Reform Initiative, and the National Defense Panel is that DOD should shape an agile infrastructure capable of adapting to rapidly changing technologies and responding to a growing array of threats.

When one defense report after another calls for an agile infrastructure, precisely what are they recommending? The studies mentioned above conclude that DOD needs a much more robust, flexible, and cost-effective infrastructure. In brief, Joint Vision 2010 calls for DOD to be able to—

- Deliver tailored logistics packages.
- Adapt support to the needs of dispersed and mobile forces.
- Provide support in hours, not weeks.
- Work with a smaller logistics footprint.
- Reduce inventory levels.
- Create agile organizations that can exploit emerging technologies.

The Quadrennial Defense Review (QDR) specifies the need for—

- Fundamental reengineering of the DOD infrastructure.
- Consideration of more outsourcing for nonwarfighting DOD support functions.
- Robust and modern activities.
- Support activities that enhance, not inhibit, combat power.
- A smaller infrastructure.

The Defense Reform Initiative (DRI) anticipates the adoption or creation of —

- Commercial business practices.
- New operational concepts and organizations.
- Organizations streamlined for agility.
- Privatization of selected functions.
- Just-in-time supply management principles.
- Programs to shed facilities that currently burden DOD.

Finally, the National Defense Panel (NDP) presses the case for—

- A fundamental reform of defense infrastructure.
- Leveraging the capabilities, technologies, and business practices of the commercial sector, adapted to meet unique military requirements.
- Using competition to perform commercially oriented support tasks.
- A smaller logistics footprint.
- Industrial and manpower mobilization to support relatively short wars.

NATO (1950)	Presidential Critical Infrastructure Commission	QDR/DRI/NDP	Commercial Definition
Headquarters		Joint and Service HQ's	
Barracks (Permanent)		Bases and Installations Base Support Housing	Basic Installations and Facilities of a Community
Single Communications (Permanent)	Telecommunications	Central Command, Control, and Communications	Communications
Repair Depots		Maintenance Depots	
Warehouses		Distribution Depots	
		Inventory Control Points	
	Transportation	Transportation	Transportation
Railways			Railways
Roads			Roads
Bridges			Bridges
			Dams
Canals			
Ports			Ports
Pipelines			
Airports			Airports
Harbor Defenses			
Military Airfields			
Permanent Radar Coverage			
Minefields			
Fortified Emplacements			
		Training (Military)	
		Personnel Support	
	Medical Services	Medical Care	Hospitals
		R&D labs	
		Naval Shipyards	
		Test Ranges	
		Defense Agencies	
		Office of the Secretary of Defense	
		Commissaries and Exchanges	
		Dependent Schools	Schools
	Electrical Power	Utility/Energy Systems	Utility Systems
	Water Supply Systems		
	Police, Fire and Rescue		
	Banking and Finance		
	Government Continuity		

☐ Here are four views of what constitutes infrastructure. Note how the definition of infrastructure by recent defense reviews is much broader than that proposed by NATO in 1950.

- Speed in mobilizing, deploying, acting, and resetting for action.

Many themes recur in these reports. The infrastructure must be smaller and more affordable. Flexibility of support options is key to the success of warfighters. Velocity of support is more important than mass of support. The fast turnover of technology will require support providers to be nimble in adjusting maintenance capabilities, supply inventories, personnel training, and other services. Finally—and this is perhaps the most prominent theme of all—infrastructure reengineering must depend on competitive sourcing and privatization strategies. This final point is the focus of this article: to what degree will competitive sourcing and privatization yield a more agile defense infrastructure?

Infrastructure: What Is It?

There are significantly different perceptions about what constitutes "infrastructure." The term has private sector connotations as well as meanings unique to the defense sector. *The Big L: American Logistics in World War II* (published by National Defense University Press in 1997) describes infrastructure as "installations, fabrications, and facilities—both civil and military—necessary for the conduct of war." This definition reflects the "construction" sense of the word, in which infrastructure consists of roads, bridges, airports, fortified emplacements, and other building products that support military endeavors. Interestingly, this definition complements the civilian concept of construction, the difference being that, in a civilian context, such construction products typically support community or state endeavors instead of war operations.

The chart on previous page provides four views of infrastructure. The QDR, DRI, and NDP offer the view that most closely correlates with the perspective of this article. In addition to the traditional elements of infrastructure—depots, shipyards, bases, base support, medical care, transportation, utilities, central communications—these recent defense reviews have included the Defense agencies, national-level logistics management organizations, joint and service headquarters, and the Office of the Secretary of Defense as infrastructure elements. This broadened, contemporary view of infrastructure is useful for assessing our Nation's ability to provide logistics support in peace and war and during mobilization.

Before examining how best to provide future infrastructure requirements, a historical review demonstrates how infrastructure was provided in the past.

Historical Perspectives

History often provides real-life insights or lessons learned that are difficult to model and analyze in a theoretical environment. Similarly, the complex dynamics of strategic logistics and mobilization—particularly across a variety of contexts—are difficult to model. Conclusions often are best drawn from the real world, at least to the degree that historical accounts capture events accurately.

In determining to what degree outsourcing and privatization strategies may yield a more agile defense infrastructure, it is instructive to evaluate the strategic logistics and mobilization efforts of previous conflicts. Let's start by recognizing that the current DOD infrastructure is ponderously large because it is a holdover from World War II and the Cold War. Much of the structure is designed to maintain an industrial and manpower mobilization base inappropriate for the relatively short wars that we expect to fight in the future. However, it is a support infrastructure that has proven successful in previous wars.

World War II. For the United States, World War II represented a massive and unprecedented strategic logistics and mobilization effort. But success did not come easily. The established doctrine before World War II was similar to that of World War I: "no prior commitment," and hence no requirement for great peacetime readiness for war. This was in keeping with the "citizen army" concept that has prevailed throughout U.S. history. Material preparation for war was almost totally lacking, and there were insufficient supplies to support troop mobilizations, let alone combat operations. This American practice and way of thinking resulted in the failure of four mobilization agencies created before the Japanese bombed Pearl Harbor in 1941.

Moreover, there were those in the defense establishment who were reluctant to let civilians run the economy during mobilization. Throughout the interwar period from 1918 to 1941, the War Department sought that role for itself and designed plans to seize it when a national emergency occurred. However, President Franklin D. Roosevelt would not permit this, and so it was accepted that civilian war agencies would be responsible for the overall mobilization and utilization of national resources.

As national-level infrastructure requirements and priorities began to emerge, it became clear that the War Department was not prepared for such a huge undertaking. When the department was reorganized in 1942, responsibility for infrastructure activities was assigned to the Army Service Forces. This organization, under the leadership of General Brehon B. Somervell, emphasized centralized direction and decentralized operations, increased use of civilian personnel and business techniques, and adoption of many management tools already common in private industry. Hundreds of America's most prominent business leaders served in the Army Service Forces, where they were able to apply a variety of business lessons to the problems of supporting the Army on a global scale.

However, because our Nation was at full mobilization, the War Department (operating primarily under the authority of executive orders) exercised full authority over private industrial operations deemed indispensable to the war effort. Rather than privatize functions, the Government sometimes seized management control of a company. Many firms opposed such Government operation and contested its legality in the courts. This was a lost opportunity of historic proportions, because the military could have shifted toward a more agile infrastructure in cooperation with industry partners. Such a partnership might have precluded adoption of the logistics system of "stockpiling" in overseas bases, the stagnant backhauls of supply, and the eventual surplus of goods at war's end.

The enormous industrial potential of the United States was converted into overwhelming combat power on the battlefields of Europe, Asia, and the Pacific during World War II, but at a tremendous dollar cost. In short, in World War II, we had the beginnings of what was to become the standard for fighting subsequent wars: reliance on an expensive and enormous logistics infrastructure.

Korean War. In 1950, the Far East Command was unprepared to support combat operations in Korea. There was the same complete lack of logistics planning, organization, trained personnel, materiel, and supplies that had made our previous wars costly in personnel and money. Because of this lack of logistics preparedness, the immediate response was to send troops into Korea to develop the logistics infrastructure as quickly as possible. The United States hoped that the Republic of Korea could provide logistics support for the operation, but that idea was abandoned after only 2 days.

The logistics infrastructure that was put into place closely resembled the Army structure at the end of World War II, with each of the armed services still directing its individual logistics functions. Equipment and materiel salvaged from World War II stockpiles provided the initial supplies for Korea. In theater, there were no forward elements controlling logistics. Depots, repair facilities, and hospitals were located and directed by the rear headquarters of Eighth Army in Japan. These became the forward bases for projecting forces into Korea. In fact, it is estimated that Japanese workers performed the supply and service functions of 200,000 to 250,000 troops. When Eighth Army relocated to Korea, the Japanese support was left behind and the burden of filling the void shifted to the Army Corps of Engineers, the Air Force's "installation squadrons," and Navy Seabees. Eventually, indigenous labor was used extensively to augment the U.S. military organizations.

Although the U.S. ability to construct the support infrastructure crucial to modern warfare was tested and proven in Korea, military and civilian leaders continued to fail in seeking and developing alternative means of processing supplies for our warfighters. World War II required a massive buildup for global conflict; Korea, a partial expansion for limited war. However, both wars shared similar institutional forms of logistics infrastructure.

Vietnam War. The Vietnam War featured some of the same old problems and revealed some new ones. The initial problem was readiness prior to troop commitment. It is significant that the Armed Forces eventually operated in Vietnam with a logistics tail unequaled in any previous war. This was due to the tactical concepts and weapons being used in the war, as well as to an interest in the welfare of the individual soldier. The Secretary of Defense succinctly characterized support in Vietnam when he observed, "There is some merit to the question of whether the war is costing more per enemy killed than any war in history. We are using in Vietnam what we have more of than anything else—money—instead of that which we value so highly—lives. Never has any Army in history had such equipment and firepower. In short, we are substituting dollars for lives." Vietnam is a good example of overstructuring the logistics support echelons, a practice that placed onerous burdens on the defense infrastructure.

Persian Gulf War. With the end of the Cold War, the forward basing concept of operation that had framed our mobilization and logistics policy became the strategy of the past. Operations Desert Shield and Desert Storm confirmed that the days of huge forward operating bases around the world were history. A study of the Gulf War reveals several new lessons about future mobilization and logistics support.

The concepts of host nation and coalition support became directly linked to the principles of war. These two new concepts, along with host nation infrastructure, significantly assisted in the reception of deploying forces and shortened the time required for building up the force structure. The Gulf War introduced to the military as never before the concept of businesslike approaches to logistics infrastructure. For the first time in the history of American deployments, the United States experienced the agility that support agreements and streamlined procurement procedures can provide in an austere area of operations. The Gulf War mobilization effort demonstrated that significant dividends could be gained by developing new operational concepts, many of which depend more than ever on private sector and other support outside DOD capabilities.

Agility: What Is It?

This article opened with a brief survey of how recent defense reports and strategies have defined an agile infrastructure. However, these views reflect the military culture. How does industry view agility? This is a critical question, since recommendations stipulate that private sector practices and providers be an integral part of an agile defense infrastructure.

Perhaps the preeminent source on private sector logistics is a book published by the Council of Logistics Management (CLM), *World Class Logistics*. This publication recognizes agility as one of the four competencies of world-class logistics providers in the commercial marketplace. It defines agility as "the competency that sustains world class performance over time . . . and is built upon three key capabilities: (1) relevancy, (2) accommodation, and (3) flexibility."

An examination of these three capabilities reveals many similarities with DOD's prescription for agility. CLM describes relevancy as "the ability to maintain focus on the changing needs of customers." Advocates of change within DOD are calling for an agile infrastructure precisely because future peacetime and wartime scenarios will require the ability to change quickly, and affordably, in response to technology and threats.

The second capability, accommodation, is described as "the ability to respond to unique customer requests." In DOD, this is called "support tailoring," a concept that Joint Vision 2010 endorses. Many observers believe that industry provides tailored solutions better than do rigid military services and Defense agencies.

The final capability, flexibility, is described as "the ability to adapt to unexpected circumstances." Flexibility has been a longstanding requirement of DOD logistics concepts. Warfighters covet the logistics capability to encounter, resolve, and, when appropriate, exploit the unexpected emergency or opportunity. Flexibility also is a virtue in mobilization. In industry, flexibility can provide reserve production or distribution power. In DOD, flexibility can provide reserve striking power, which is the essence of mobilization.

Promoting Agility

According to The Outsourcing Institute, the top 10 reasons why companies outsource are to—

- Improve business focus on core competencies.
- Gain access to world-class capabilities.
- Accelerate reengineering efforts.
- Share risks.
- Share resources.
- Correct problems with a function that is difficult to manage or out of control.
- Gain access to resources not available internally.
- Provide a cash infusion.
- Make capital funds available.
- Reduce operating costs.

It is instructive to recognize that every one of these reasons, to varying degrees, coincides with the reasons why DOD is emphasizing competitive sourcing strategies. Similarly, it is interesting to note that most of these reasons help organizations become leaner, more robust, and thereby more agile. The pursuit of agility through competitive sourcing solutions appears to be a common objective of industry and Government alike.

But exactly how do competitive sourcing strategies contribute to more agile organizations and processes? The following advantages of competitive sourcing are particularly relevant to DOD's pursuit of a more agile infrastructure. Competitive sourcing will—

- Give DOD access to a broader range of sources for support and surge capability.
- Speed incentives for internal reengineering (improving processes). For example, the Air Force has been influenced by the leading-edge practices of commercial airlines.
- Reengineer vertically integrated organizations that have grown obsolete, making enterprises smaller, more focused, and more fluid.
- Provide for speedy capture of innovations, which allows technology to be leveraged quickly.
- Gain access to resources or expertise not available internally.
- Permit contracting flexibility for things the Government cannot do.
- Allow development of integrated supplier concepts, such as those several commercial airlines are adopting (for example, British Airways and Southwest).
- Allow lower inventory levels, nimble transportation, and reduced cycle times.

Conclusions

If DOD can acquire the benefits cited above and supercharge its stodgy infrastructure simply by adopting competitive sourcing and privatization, why is there hesitation? Because history confirms that the successful mobilization and projection of infrastructure to support a variety of military scenarios has depended on a *partnership* between Government and industry. It is too soon for DOD to abdicate infrastructure management. In the historical scenarios discussed earlier, the private sector had a huge role in assembling, producing, and projecting the elements of infrastructure; however, none of those scenarios involved the degree of private-sector performance, management, and control of defense infrastructure elements being espoused today. DOD buyers of infrastructure services should be cautious about relying on contractors, particularly where real-time control is critical. Competitive sourcing and privatization imply the formation of strategic relationships with external suppliers that will lead to some loss of DOD control over essential functions. The fog and friction typical of war caution us that losing such control could be instrumental to losing the war.

Still, there is little doubt that DOD must increase its reliance on private-sector providers, particularly to support the small- to medium-scale deployments associated with our current geopolitical objectives. Today, many of DOD's infrastructure activities consist of support functions that are not directly related to core military competencies. These functions claim an unaffordable 60 percent of the DOD budget. Yet cost reduction is not the most important reason to use private sector providers of infrastructure services—performance improvement is. Industry has bypassed DOD in most areas of logistics support capabilities: responsiveness, innovation, expertise, surge, and agility.

Unfortunately, much energy still is being expended across the military services and Defense agencies (and in Congress) to preserve and protect organic assets that are not essential to defense missions. A better use of this energy would be integrating DOD's and industry's core competencies. Long-term integration of contract suppliers and military buyers will yield the infrastructure agility highly prized during peace, mobilization, and combat. **ALOG**

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Modernization Through Spares

by E. Carroll Gagnon

A product manager provides his vision of the Army's Modernization Through Spares initiative and the challenges of executing the program.

After years of implementing acquisition reform, the Department of Defense (DOD) and the Department of the Army now are in the process of extending these reforms to logistics. The Army has introduced numerous initiatives as part of its Revolution in Military Logistics. One of these initiatives—one that is critical to the success of the Revolution in Military Logistics—is the Modernization Through Spares (MTS) concept.

In January 1996, Gilbert E. Decker, Assistant Secretary of the Army (Research, Development, and Acquisition), and General Leon E. Salomon, Commanding General of the Army Materiel Command, designated the Paladin/M109 family of vehicles (FOV) as the pilot program to test the MTS concept. This program evolved and was renamed the M109 FOV life-cycle fleet management pilot program in a May 1996 letter from Kenneth J. Oscar, Deputy Assistant Secretary of the Army (Procurement). The ability to execute MTS is critical to the success of the pilot program. The M109A6 Paladin is a 155-millimeter self-propelled howitzer. Other vehicles in the M109 FOV are the M109A2/A3 and M109A4/A5 as well as the M992A0/A1/A2 field artillery ammunition support vehicle.

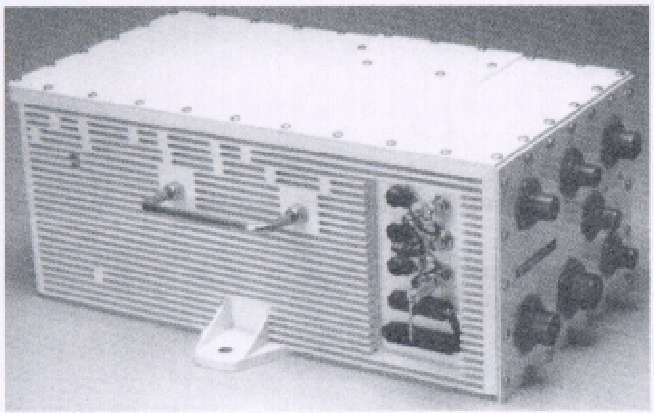
M109 Fleet Management, as the program has come to be known, is an effort to reengineer the current system and establish a fleet manager as the single focal point for M109 FOV life-cycle sustainment support.

Automatic Fire Control Modernization

Historically, the Army has controlled the engineering development and production processes by directing industry in microscopic detail on how to design and manufacture weapon systems. Commercial industry, on the other hand, does not have the same relationship with its general public customers. The commercial business world determines market needs for products, then designs, manufactures, and supports these products without any customer input on how to do its business. DOD has moved in this direction through acquisition reform and the use of performance-based specifications that basically describe what the performance requirements are for a weapon system and not how to build weapon systems, as was traditionally done with military specifications. The Army now is taking this acquisition reform practice one step further into the logistics reform process with the acquisition of spare parts to performance-based specifications. This provides industry greater flexibility for cost-effective technology insertion, because DOD no longer dictates how to design and produce these spare parts. This is consistent with commercial business practices.

Midway through the Paladin production cycle, it became obvious that continuing to build the Paladin automatic fire control system (AFCS) to the traditional Army technical data package, with all of the how-to's, was contrary to the principles of acquisition reform. Problems with obsolete parts and the inability of the defense industry to produce electronic parts economically were beginning to impact AFCS production. This presented a challenge to the Paladin production program. If the AFCS could not be built in production, how could it be supported during the sustainment phase?

To meet this challenge, the principles of acquisition reform were applied. The microscopic technical data package was eliminated, and a performance-based specification to modernize the AFCS was developed. An accelerated acquisition maximized commercial technology. The AFCS military specifications system used a 32-bit military processor and a unique software operating system that was written to the military Ada standard. The modernized AFCS, as shown in the photograph on the next page, uses a commercial Pentium processor and operates in the Windows NT operating environment. The production and maintenance costs were reduced by 75 percent using an open system architecture technology that can be readily supported and upgraded during the sustainment phase. The AFCS now is in production and is being retrofitted on fielded Paladins. For this modernization action, the Paladin pro-



☐ **Modernized automatic fire control system developed for the Paladin.**

gram saved $28 million and received the 1997 Defense Standardization Program annual group award.

The AFCS modernization program was a nontraditional development and acquisition but was achievable because acquisition reform empowered the program manager (PM)-Paladin to make it happen. Since Paladin was in production and adequate procurement appropriation (PA) funding was available to fund the development of this modification to the Paladin vehicle, no funding polices prohibited this modernization.

The Fleet Management Program

The M109 Fleet Management program will establish a single contractor who will have primary responsibility for life-cycle sustainment support of all M109 FOV customers, including the Active Army, Army National Guard, and approved foreign customers. This is a significant step in the process of migrating to the commercial practices of letting industry design, manufacture, and support its products without directing the how-to. It is consistent with the primary objective of this pilot program to reengineer the sustainment process to maintain and improve system readiness while reducing life-cycle support cost for the M109 FOV. Accordingly, the contractor will use best commercial practices and new technology to establish an enterprise that integrates the best capabilities of the private and public sectors. The fleet manager will provide M109 FOV life-cycle sustainment support, including overall program management and support, fleet logistics sustainment support, system engineering and technical support, and secondary items support. It is expected that industry will provide the Army a system of distribution based on commercial business practice to replace the Army's current system of supply.

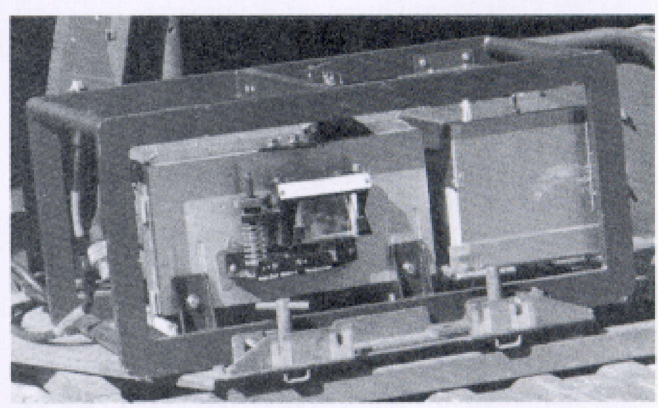
The memorandum implementing the Army MTS concept emphasized "dramatic reductions in life-cycle costs and dramatic improvements in performance and reliability." Critical to the life-cycle process is the process of replacement parts acquisition. Traditionally, the Army developed detailed technical data packages full of how-to methodology and, year after year, units would procure the same spare parts because the new technology to improve reliability was untimely and difficult to insert.

The cost of these parts has increased over the years, and the reliability of the parts has either stayed the same or declined. Therefore, the Army must improve the reliability of these parts in order to control skyrocketing sustainment costs. Of the systems the Army will have in 2010, 75 percent are being developed or fielded today. If no action is taken now, sustainment costs will escalate at even higher rates because of parts obsolescence and the inability of industry to cost effectively support these legacy systems. Commercial industry's answer is to modernize its products continuously in order to conduct business cost-effectively and compete in the marketplace.

The Need to Modernize Policy

The Paladin program is coming rapidly to the end of the production phase of the life cycle. With the end of production comes the end of availability of PA funding. This presents the PM with a dilemma on how to modernize and maintain the fleet with only operations and maintenance Army (OMA) funding. The fleet management concept will combine all of the appropriated OMA OPTEMPO funds into one account available for incremental funding to the fleet manager. Under the fleet management and MTS concepts, OMA funds cannot be used to improve reliability.

On 18 May 1998, the Principal Deputy for Acquisition, Army Materiel Command, issued a decision on MTS funding of the positioning and azimuth determining system (PADS) initiative (see photo below). This policy decision basically determined that modernization is the same as modification, and modifications cannot



☐ **MTS funds supported the development of the positioning and azimuth determining system.**

APPLICABLE APPROPRIATION	IN PRODUCTION: MODIFICATION		OUT OF PRODUCTION: MAINTENANCE	MODERNIZATION	UPGRADE
	INCREASE IN PERFORMANCE	NO INCREASE IN PERFORMANCE	NO INCREASE IN PERFORMANCE	NO INCREASE IN OPERATIONAL PERFORMANCE	INCREASE IN PERFORMANCE ENVELOPE
RDTE	YES NON-RECURRING	NO	NO	NO RAM-D & EFFICIENCY OK	YES
PA	YES RECURRING COST	YES RECURRING & NON RECURRING COST	NO	YES IF PA FUNDS AVAILABLE	YES FOR NON-RECURRING COST
OMA	NO	NO	YES WHEN INTENT IS TO MAINTAIN REQ'D PERFORMANCE ENVELOPE	YES WHEN INTENT IS TO MAINTAIN REQ'D SYS PERFORMANCE RAM-D INCREASE OK AFTER MS III	NO WHEN INTENT IS TO INCREASE PERFORMANCE ENVELOPE
INTENT	MEET REQUIRMENTS		READINESS	COST REDUCTION	PERFORMANCE

☐ This chart can be used to determine appropriate funding for item development and modernization.

be funded with OMA. OMA can only be used to fund maintenance.

The maintenance versus modification distinction comes from the DOD Financial Management Regulation (FMR). The FMR broadly defines modification as the "…alteration, conversion, or modernization of an end item…which changes or improves the original purpose or operational capacity in relation to effectiveness, efficiency, reliability, or safety of that item." Therefore, to execute MTS as part of the fleet management program, policy will need to be changed.

Unlike the Army, commercial business does not have to deal with policies and restrictions in their continuous modernization activities. The DOD and the Army have made significant changes and improvements in their business processes relating to acquisition reform. The Army now is moving into logistics reform by maximizing use of contractor logistics support. However, for the combined acquisition reform and logistics reform initiatives to succeed, policy reform is needed so MTS can be executed successfully.

These policy reforms are outlined in the chart above. The chart illustrates current policy and adds a new column for modernization. These policy revisions are critical to the success of MTS. Given the current Defense budget funding levels, more funds will be required for sustainment, leaving less funding for PA's. Competition within DOD and the Army for PA funding will become more intense and will concentrate on new start weapon systems. Without the necessary changes to policy to permit using OMA to fund MTS, this budget situation will continue to deteriorate.

The Military Deputy to the Assistant Secretary of the Army (Research, Development, and Acquisition) sent a memorandum to the Deputy Chief of Staff for Operations and Plans, the Deputy Chief of Staff for Logistics, and the Director of Program Analysis and Evaluation requesting their support to restore momentum to the Army's MTS effort. He emphasized that the MTS program is the best tool we have to achieve a collective obligation to ensure that our soldiers have access to the finest, safest, and most efficient systems available. We can make the MTS vision happen with leadership support. **ALOG**

E. Carroll Gagnon was the Product Manager for the Paladin/Field Artillery Ammunition Support Vehicle Program at Picatinny Arsenal, New Jersey, when he wrote this article.

A-Mart: Army Shopping On Line

by Jodi Santamaria

I call upon all Internet users—both in Government and in the private sector—to join me in seeking global consensus...so that we may enter the new millennium ready to reap the benefits of the emerging electronic age of commerce.

–William J. Clinton
President of the United States

This excerpt was taken from the President's message to Internet users on 7 July 1997. It underscores the ongoing acquisition reform movement in the Department of Defense (DOD).

On 21 May 1997, Dr. John J. Hamre, Deputy Secretary of Defense, issued Management Reform Memorandum No. 2 directing that DOD "...undertake a revolution in business practices in conjunction with the Quadrennial Defense Review." That mandate stipulates that DOD must adopt a paperless contracting process by 1 January 2000. It was followed by an addendum directing a completely paperless acquisition process by 2002 and requesting support from the logistics community.

To achieve these goals, the Services have initiated paperless projects to address different contracting processes. One such initiative is the establishment of a DOD Electronic Mall (EMall) to empower our buyers to make decisions and simplify on-line ordering and purchasing with a Government purchase card. Financial resources can be focused on modernization, and the expertise of contracting personnel can be focused on providing value-added support to our ultimate customer, the soldier.

DOD EMall

To help implement the Paperfree Contracting Defense Reform Initiative, the Army currently is participating with its sister Services, the Joint Electronic Commerce Program Office, and other agencies in constructing the DOD EMall. Mall shoppers will be able to browse through the "commodities corridor" sponsored by the Defense Logistics Agency (DLA) to find DLA inventory items; medical supplies; products available through the Army Tank-automotive and Armaments Command's direct vendor delivery system (http://www.tank-edi.com); items made under Federal Prison Industries' (UNICOR's) corporate contracts with the Army Communications-Electronics Command; or clothing from the Defense Supply Center Philadelphia's Automated System of Catalogs and Orders for Textiles (ASCOT). Or, they can search for information technology (IT) products in the IT corridor run by the Navy, including Joint Technical Architecture-Army [JTA-Army]-compliant IT products offered by the Army Small Computer Program (http://www.pmscp.monmouth.army.mil). Shoppers seeking services or construction can review lists of services and construction contracts in the services and construction corridors built by the Army in partnership with the Air Force.

A-Mart

A-Mart is the Army's door to the DOD EMall. Technically, it is the front page for Army users of the mall. It contains the search engine for the services and construction corridors, as well as links to the commodities corridor for information technology products.

A-Mart uses cutting-edge commercial web technology to provide access to Government-awarded, indefinite-delivery contracts; blanket purchase agreements; and vendor catalogs in an on-line, paperless medium. Army users worldwide can conduct market research quickly and easily by browsing among products and comparing features and prices. Buyers can initiate electronic order processing and payment with their Government purchase card throughout the mall, or by using the traditional DOD Military Standard Requisitioning and Issue Procedure requisition in the commodities corridor. Real-time status of the order then can be tracked on line.

"Electronic malls and catalogs are an excellent way for us to take full advantage of the efficiency offered by electronic commerce technologies, while providing better and faster acquisition support for the warfighter," says Colonel Bill Phillips, Director of Information Management and Assessment in the Office of the Deputy Assistant Secretary of the Army for Procurement and project officer for Army paperless contracting. "A-Mart is a critical part of the Army's vision for acquiring supplies and services that are necessary to support Army Vision 2010 and Force XXI."

A-Mart development and testing was conducted last summer. The system is expected to be fully operational by the first quarter of fiscal year (FY) 1999. The initial operating capability target of the DOD EMall is the end of the second quarter of FY 1999.

Benefits of Using A-Mart

The Army is committed to building a more versatile, deployable, and powerful 21st century force. Only by enhancing current equipment with advanced technology and by providing high-quality soldiers with state-of-the art weapons systems can the Army build a full-spectrum force capable of fulfilling America's security needs well into the next century. The Army is also improving its information infrastructure at installations with advanced communications, which increases total asset visibility and logistical efficiency and allows the Army to manage distribution from factory to foxhole.

—United States Army Posture Statement Fiscal Year 1998

The Army also is committed to providing the tools necessary to sustain a more versatile, deployable, and powerful 21st century force. We must use technology to become effective and more efficient. Soldiers need access to the latest technology, as well as a means by which to acquire it rapidly.

A-Mart increases visibility of the contract vehicles that currently exist and gives decision-making authority to buyers. With this tool, users can leverage the purchasing power of the Army and the DOD to ensure that they are getting the best prices for the items and services they need. Access to A-Mart is access to competition and real-time pricing. A-Mart gives users multiple choices of suppliers and a source of information on the products and services offered.

A-Mart helps build better decision makers. These decision makers can place orders from existing contracts and under existing agreements, thereby drastically reducing the administrative costs of issuing new contracts. The decision makers can refer to the real-time, on-line order status to update their readiness posture. And, to ensure that demand data are captured and tracked to provide total asset visibility, links to Army supply systems also will be established as the DOD E-Mall continues to develop.

Most important is the reduction in cycle time. By shortening acquisition lead time and reducing the number of items ordered from Government stock, soldiers will receive products and services faster than ever before. Soldiers are our Army. A-Mart is a way to empower our Army with the tools necessary to sustain our forces and meet the challenges of the future.

Register for A-Mart shopping today. E-mail santa@sarda.army.mil for more information. ALOG

Jodi Santamaria, a contract specialist in the Army Communications-Electronics Command Acquisition Center, currently is on a year-long developmental assignment in the Office of the Deputy Assistant Secretary of the Army for Procurement. She is the project leader for A-Mart.

Prime Vendor Support—The Wave of the Future

by Lieutenant Colonel William M. Gavora

Department of Defense (DOD) and Department of the Army budgets have declined drastically over the past decade. Support and infrastructure costs have required an ever-increasing share of our resources and consistently consumed more than half of our budget. Fielded systems continue to age, while the costs of ownership escalate. The simple truth is that the more money we spend on support, the less money we have available to fund modernization and preserve combat capability. The challenge for the military planner of the 21st century, then, is to provide integrated support to the warfighter while we systematically restructure logistics support using modern technology and management principles to generate significant cost-of-ownership savings.

Imagine that the opportunity exists to modernize a major Army weapon system, significantly reducing its cost. Consider, though, that in order to accomplish this, civilian and possibly military personnel strength would have to be reduced, and soldiers would have to coexist with civilian contractors on the battlefield. The advent of an innovative contractor logistics support (CLS) concept known as Prime Vendor Support (PVS), also known as Fleet Management, represents such an opportunity. PVS is an initiative with industry that saves operations and support (O&S) costs by having the prime contractor assume responsibility for total performance of a weapon system and its modernization by integrating modernized spare parts.

Using Best Commercial Practices

The Army intends to revamp the current logistics system by taking advantage of "best commercial practices," which will reduce support costs and provide performance guarantees. The Army must look at new and innovative ways to reduce overall support costs, improve spare parts availability, maintain weapon system readiness rates, and provide funds for modernization. At the same time, any concept that the Army embraces must be effective in peacetime, during contingency operations, and in war. It must conform to the Army's logistics vision, which states, "We must provide the best value logistics to the warfighters without inhibiting mission execution." This means we must use the best commercial practices industry has to offer, maximize rapid distribution, and reduce stock levels while maintaining readiness. Any system we ultimately adopt must guarantee uninterrupted support and be transparent to the user. While the CLS concept certainly is not new to the Army or to our sister services, the notion of contracting directly with an original equipment manufacturer to provide complete logistics support is revolutionary, as noted by the Deputy Chief of Staff for Logistics, Lieutenant General John G. Coburn (*Armed Forces Journal*, August 1997).

The mobility, deployability, and sustainability essential to the 21st century Army, in fact, cannot be achieved without a Revolution in Military Logistics. This revolution has begun. It is an open-ended process with specific milestones, goals, and objectives. Among the key ingredients required to achieve this revolution are assured communications, improved automation and information management systems, and, of course, a seamless logistics system that PVS can provide.

Apache Helicopter PVS

The Army received a joint proposal from Boeing-Lockheed Martin for implementing a PVS for the Apache helicopter in April 1997. The Boeing-Lockheed Martin concept, on which the Army has negotiated a tentative agreement, would transfer responsibility for complete wholesale support for the Apache to a single, accountable entity, a limited liability company known as Team Apache Systems (TAS). Essentially, TAS would eliminate the need for Government personnel and facilities to acquire, manage, store, and distribute spare parts and would interface directly with, and provide repair parts to, the soldier at the retail level.

The major advantages of such an arrangement would be improved system readiness based on increased availability of spare parts and a significant reduction in O&S costs that could provide badly needed funds for system modernization. By reducing the length of the supply pipeline, the Army is virtually guaranteed to receive spare parts quicker. There also will be few, if any, zero balances and a significant reduction in overhead, since Government facilities and personnel no longer will be needed to store and manage these spares.

We also should be well positioned to take advantage of Boeing-Lockheed Martin's best commercial practices and "just-in-time" delivery, now known as Velocity Management. More efficient supply management, coupled with a serious reduction in Government overhead, will reduce our O&S cost burden substantially. The money the Army saves as a result can be reinvested directly in modernization of the weapon system. For example, with the O&S cost savings projected as a result of Apache PVS, the Army theoretically could fund the acquisition of second-generation, forward-looking (SGF) infrared sensors. SGF sensors are presently the number one requirement of the aviation user, but they currently are unaffordable at a price in excess of $700 million. Likewise, original equipment manufacturers will modernize the aircraft continually as they install spare parts. In effect, the contractor will be encouraged to design parts that last rather than require a spare.

The current Apache PVS proposal comes with significant performance guarantees that should reduce the average flying-hour cost approximately 20 percent, reduce the Army's investment in inventories, and improve requisition fills, which ultimately will have a positive impact on fleet readiness. The contractor will be allowed to share additional cost savings above and beyond those that are guaranteed. This savings incentive, along with increased competition as more logistics service companies seek to enter the fray, should provide even greater savings opportunities.

Potential Pitfalls

While there are many advantages, entering into such an arrangement is not without risk. The integration of civilian contractors into the wholesale logistics process must be balanced with Federal civilian worker and soldier reductions directed in the Quadrennial Defense Review. While the effects on overhead are expected to be good, the potential loss of organic capability must be considered.

The presence of civilian contractors on the battlefield also must be considered. Although contractors have worked with operational units for years, including service in Operation Desert Storm, the changes in mission and scope caused by their presence are significant. What is in the best interest of national defense ultimately will determine the agreement reached. This approach will enhance our defense posture by fostering an agreement between the contractor and the Government depot to enable us to manage our work load better.

Finally, there are threshold legal issues that must be resolved before Apache PVS can become a reality. First, Office of Management and Budget Circular A–76, U.S. Code Title 10, and the annual appropriations acts require the preparation of cost comparison studies before converting an activity to or from in-house performance. Title 10 also specifies that not more than 50 percent of the funds available to a military department in a given fiscal year for depot-level maintenance and repair may be used to contract for that service with non-Federal Government personnel. In addition, there are certain inherently Governmental functions, such as airworthiness certification, that the Government is prohibited from contracting out. An inherently Governmental function is one which, under the totality of circumstances involved, is related so intimately to the public interest that performance by Government employees is mandated.

A justification and approval document was approved in October 1997. This permitted the Army to conduct "alpha" negotiations with TAS as the only responsible source. Likewise, Congress was notified formally of the Army's intent to pursue Apache PVS as a pilot program. The Army is seeking Office of the Secretary of Defense Pilot Program designation as a way to streamline the review and approval processes.

Fleet Management

The Army is pursuing a similar, parallel initiative, known as Fleet Management, for support of the M109 family of vehicles (FOV). The proposed M109 Fleet Management program will be competitive rather than sole source and will attempt to provide the Army a more modern, less costly system. According to the plan, the Fleet Management pilot program will streamline, reengineer, and consolidate M109 FOV logistics and technical and engineering support by competitively selecting the best-qualified contractor to provide total life-cycle logistics support. This approach also will use best commercial practices to realize a 20-to-30 percent savings in sustainment costs.

PVS arrangements for the support of major Army and DOD weapon systems may indeed be the "wave of the future." Previous CLS contracts for other items of equipment include the Army's fixed-wing aviation fleet, the Army Aviation Center's support services contract, the Air Force's interim CLS program for temporary support of the C–17 transport; the Navy's and Marine Corps' use of direct vendor delivery (essentially PVS for selected components on selected weapon systems); and even the British military's Merlin Support and Spares Availability System (MSSAS) for the Merlin multipurpose helicopter.

PVS fits well within the Army's logistics vision, and has the potential to provide us with a simplified, reduced management structure; a clear, single point of accountability; reliability-based logistics; trigger-based item management; reduced spares acquisition time and inventory levels; major reductions in administrative and procurement lead times; more affordable readiness; a more modern weapon system; and reduced O&S costs. PVS is an exciting concept that promises new and efficient ways to support combat forces with increased performance at reduced cost. **ALOG**

Lieutenant Colonel William M. Gavora is the Aviation Team Chief, Office of the Assistant Secretary of the Army (Research, Development, and Acquisition).

Medical Logistics—Ready for the Future

by Colonel Stuart A. Mervis

The underpinning required to achieve the medical logistics support envisioned for the 21st century is being designed and implemented today.

Medical logistics support to the Army and to the entire Department of Defense (DOD) healthcare system has undergone dramatic change in recent years and is poised for even more rapid and exciting change as we look into the 21st century. Army medical logistics operates as a critical component of the Army Medical Department and as an intensely focused dimension of total Army logistics. It continues to push logistics innovation forward as it meets the operational and economic challenges of supporting the medical readiness of today's high-tempo forces and a vast healthcare system. As programs, systems, and processes take shape, it is possible to look forward and describe a scenario for future medical logistics support.

It is 0525, Wednesday, 7 September 2007. Colonel Walter, Army Medical Service Corps, the Medical Command's Deputy Chief of Staff for Logistics, glances at the digital display on her vehicle's preprogrammed navigational system as she enters early morning traffic on the Capital Beltway: "24 Miles to Destination—ETA 29 Minutes—Drive Carefully." Her mind races through the events of the past 72 hours and the list of things she must focus on during what surely will be a long and fast-paced day ahead. Her car's mobile communication system is tuned to the Satellite News Network (SNN). The morning reporter announces that the President will address the Nation at 9:30 a.m. on the events unfolding in North Africa. A commentator follows with remarks that the President is expected to announce a major deployment of U.S. Forces to the region in response to the threat to vital U.S. and European interests.

This news confirms what Colonel Walter has anticipated since the crisis broke a few days ago. She thinks about the actions she has initiated and the follow-up that will be required. The Global Medical Logistics Operations Center (GMLOC) at Fort Detrick, Maryland, is already at its Level 2 state of readiness. An 0800 situational update is on her schedule, and she *expects the first reports on materiel readiness from the "cylinder." The GMLOC's information processing center is known affectionately in the tri-Service medical logistics community as the "oxygen cylinder" because of its distinctive shape. Using specific scenarios and worldwide, location-based environmental assessments, the GMLOC can develop tailored medical materiel packages rapidly. It also can execute requisitions based on real-time unit readiness, medical materiel assembly status, and visibility of strategically located, commercially held medical materiel assets. The GMLOC's systems are precise enough to make adjustments for the North African climate, endemic disease conditions, and enemy threats of biological and chemical weapons. Colonel Walter expects the GMLOC to analyze all of these operational factors and have the initial materiel availability report ready for the 0800 meeting.*

Colonel Walter already has scheduled a video meeting for 0900 with the 6th Joint Medical Logistics Management Center's (JMLMC's) theater response team (TRT), which is on alert for deployment. The video link-up will include the JMLMC at Fort Detrick and the G4 from the medical brigade headquarters at Fort Bragg, North Carolina. Colonel Walter has been a little concerned that this will be the first TRT mission for the team's new leader, a Navy lieutenant commander. But she knows he is a capable medical logistician and a recent graduate of the Joint Medical Logistics Operations Course. Her confidence is bolstered by the fact that the Army captain and the Army, Navy, and Air Force noncommissioned officers who will complete the five-person team also are well qualified.

Colonel Walter has several questions to ask the TRT. She especially wants to confirm that they have downloaded all pertinent GMLOC information into their "briefcases" and that their Intranet and Internet satellite links are set. She also wants to verify that the team has coordinated with the G4 so their rendezvous with the theater logistics distribution center and deployed medical logistics elements is set. Finally, she wants a read-out on yesterday's communications check between the JMLMC and the GMLOC. Colonel Walter is awed when she contemplates that, with their "briefcases" containing compact computers and telecommunications equipment, five logisticians can perform the information and communications functions needed for theater-wide medical logistics support.

Traffic seems lighter than usual as she turns onto the George Washington Memorial Parkway and checks her navigational display, which now indicates "12 Miles to Destination—ETA 17 Minutes." She knows that U.S. Forces Command is preparing the force package and begins to consider what the total medical force will look like. No doubt forward surgical teams and a couple of combat hospitals are likely to be involved. The number of units and their dispersion will determine the medical logistics component, but Colonel Walter expects that two medical logistics companies may get warning orders today. The companies likely will subdivide to support delivery of a strategically pre-positioned combat hospital, support the roll-off of medical materiel from the strategic sealift ships, and establish a theater distribution capability. Fortunately, each company's modular unit design enables it to accomplish a variety of missions effectively.

Colonel Walter knows the commanders of the medical units at Fort Bragg and Fort Hood, Texas, and is certain they are ready. Both units participated in recent exercises involving the JMLMC and the U.S. Army Medical Materiel Center Europe (USAMMCE). The linkages required among units for this operation appear to be almost identical to those of the exercises. USAMMCE provides 24-hour turnaround for predictive supply actions and specific item supply requests. This capability means that in-theater supply levels likely will not exceed 7 to 10 days of supply. Electronic connections between USAMMCE and GMLOC have been incredibly fast since the deployment of Defense Medical Logistics Standard System (DMLSS) Phase II hardware in 2005. Medical maintenance, optical fabrication, and blood distribution teams also are well prepared, thanks to recent exercises and advanced specialty training conducted on site at the unit locations and with industry counterparts.

One of the intelligence reports she read yesterday concerning a large displacement of people in the area of likely operations prompts Colonel Walter to worry about humanitarian relief. She knows the GMLOC already is calculating humanitarian supply requirements, but the situation could demand that health facilities be engineered rapidly to support a large refugee population. She anticipates a requirement for her health facilities' experts to dispatch a health systems assessment and assistance detachment quickly. It probably will become necessary to use existing civilian facilities in the area or to convert available buildings into operating facilities for U.S. or international aid organizations. She knows from participation in numerous humanitarian missions previously in her career that this could be a difficult mission, especially when military action is taking place concurrently.

Colonel Walter considers hitting the preprogrammed number on her mobile communication system for the Assistant Chief of Staff for Logistics for the eastern DOD *healthcare region, her close friend and colleague at Walter Reed Army Medical Center. But she figures it will be after noon before she can get a quick rundown of regional medical logistics actions underway to support forces that may be deployed. She knows that, from the Walter Reed hub, her colleague, in his role as the regional logistics leader, already has reviewed requirements with all DOD healthcare activities in the eastern region. Fortunately, materiel standardization programs and consolidated medical logistics services and contracts have been in place now for several years and can support the pending increased level of activity.*

Colonel Walter will find out very soon from the GMLOC if regional requirements in support of reserve component units already have been factored into the equations that GMLOC and the Defense Logistics Agency are using to ensure supply availability. Similar actions are underway in the central and western regions, so Colonel Walters likely will call the logistics leaders in those regions later today.

Again, an SNN news bulletin interrupts the normal report and indicates that certain U.S. military units have been issued warning orders for deployment. Colonel Walter's concerns are confirmed. A moment later, the audible beep on her mobile communications system discloses that a digital message is about to be displayed. Sure enough, across the small screen appear the words: "Report immediately to LOC." Fortunately, she is now in the south parking lot and only a few quick steps from the Pentagon.

Joint Medical Logistics 2010

The above scenario may appear to be futuristic. To the senior leaders of the DOD healthcare community, it is not. In fact, actions are underway now to institutionalize most of what you read. The framework for future medical logistics operations is described very effectively in the recently prepared document, *Joint Medical Logistics 2010* (JML2010). Crafted by the Services' medical logistics agencies (U.S. Army Medical Materiel Agency, Naval Medical Logistics Command, and Air Force Medical Logistics Office) with support from the Logistics Management Institute, this document defines principles and practices that will move medical logistics into the era of Focused Logistics. JML2010 concepts and programs provide a 21st century platform for worldwide medical logistics support that is based on commercial practices, increasingly sophisticated information systems and electronic commerce processes, and truly joint logistics operations.

It is dramatically evident that the underpinning required to achieve the medical logistics support envisioned in JML2010 is being designed and implemented today. Since the Desert Storm period, there has been a fundamental shift in medical materiel management from a depot-based institution to a commercially based enterprise. The inventory that we count on today to support everyday healthcare operations and to respond to contingency scenarios beyond the first few days of military operations increasingly is not in a military-operated warehouse but rather in a commercial medical materiel distribution center. Medical materiel and, to a larger extent, our total medical logistics readiness, are becoming a very sophisticated balance between the "business" and "military" dimensions of managing and delivering medical logistics support. In the race to 2010, this balance will become more precise and effective. A blending will occur, making the mix even less noticeable.

The GMLOC has been tested at Fort Detrick in recent exercises and in real-world operations with participation by the Services' medical logistics agencies. However, the essential and increasingly sophisticated management information components that will turn today's relatively "low-voltage" GMLOC into a situational analysis and information response powerhouse are being developed today. The DMLSS, the Medical Logistics Total Asset Visibility System, the Joint Medical Asset Repository, the Medical Materiel Common User Data Base, and the Commercial Asset Visibility System, all of which are being developed today as components of the DOD suite of information management initiatives, are key ingredients that will unfold in the 21st century to provide an unprecedented dimension in medical logistics capability. With the Services' joint vision and commitment to achieve this goal will come the drive to create the "oxygen cylinder," the information center for logistics support of global medical operations.

Jointness is imperative for the success of this endeavor. One critical aspect of ensuring a joint perspective in planning and delivering medical logistics support is theater-level medical logistics direction and management. Today's theater medical materiel management center (TMMMC), of which the Army has one (the 6th TMMMC, a 44th Medical Brigade unit stationed at Fort Detrick), will convert to a redesigned medical logistics management center. Medical logistics leaders envision that this center ultimately will be a jointly staffed organization and believe that a "theater response team" is a very realistic element in future operations.

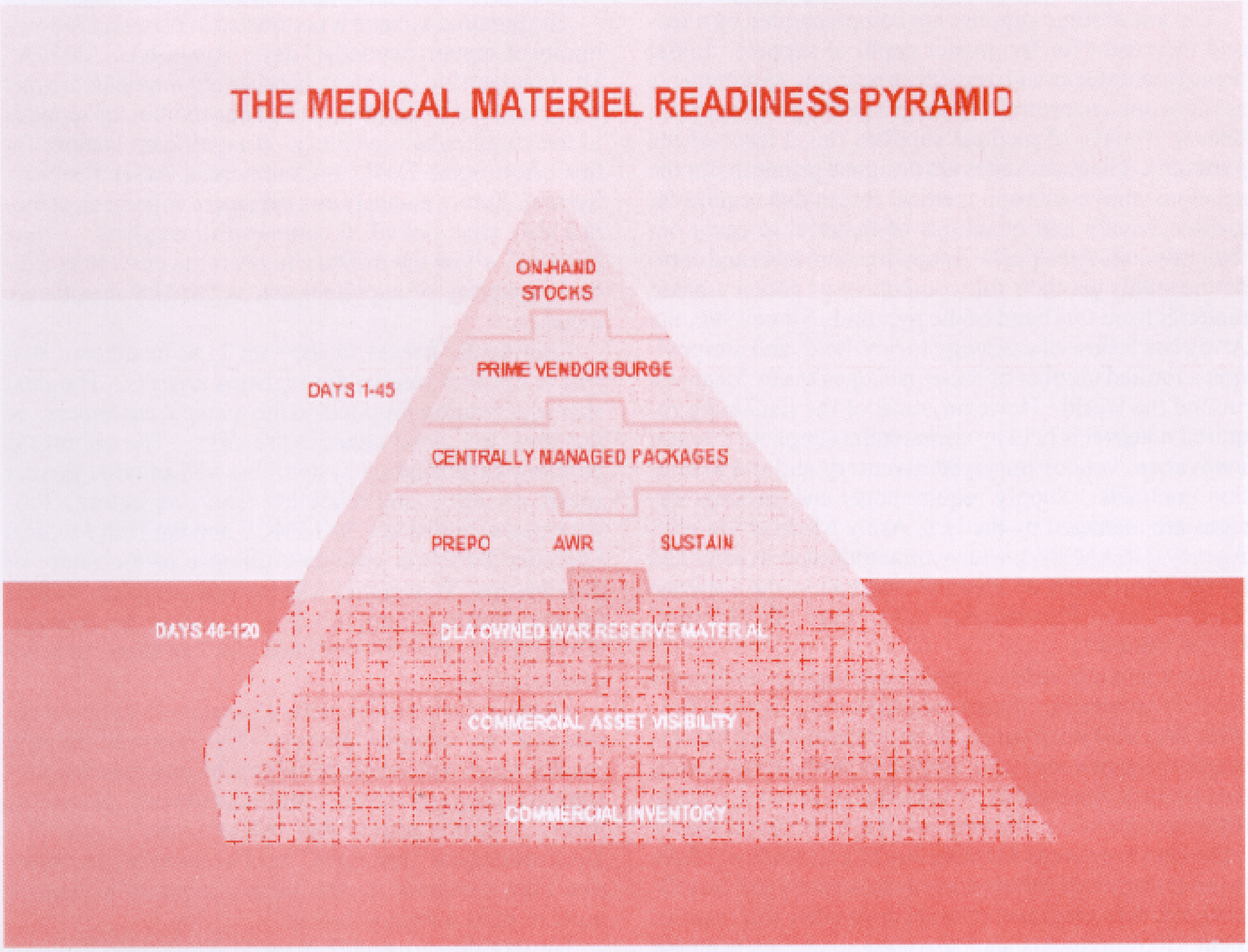
JML2010 captures the thinking, forces, and realities that are driving change and the directions and actions that medical logistics must pursue to meet the objectives and challenges of future support of medical operations. In essence, JML2010 is an organizational and cultural change process that will ensure that medical logisticians remain on the leading edge of the Revolution in Military Logistics. As with all revolutions, the old processes swept away in the change are replaced by new ones. In this case, the old depot system will be replaced by a new concept—the medical materiel readiness pyramid.

Medical Materiel Readiness Pyramid

At the core of Army medical logistics are provision of class VIII (medical) materiel to the Army and distribution of medical supplies to all forces in a theater of operations through a joint, single in-theater distributor concept. While strategic and theater management of medical materiel is intended to be a joint endeavor, in-theater distribution is a role the Services expect the Army's medical logistics battalions and companies to perform as part of the Army's theater distribution team.

In the shift from depot support to a commercially based system, a new structure for providing medical supplies has emerged. This structure takes the shape of a medical materiel readiness pyramid (below) that depicts the sources of medical supplies for current and future operations. This is clearly a revolution in progress, with its shape becoming more solid every day. In its final form, the pyramid will ensure the continuous availability of medical supplies for the first 45 days of a military operation, mixing on-hand materiel with very large portions of owned or accessible stocks held in commercial inventories. The pyramid also contains the plans and obligations required for comprehensive supply support through a conflict lasting 120 days or longer. The revolution is being shaped by the twin needs for guaranteed readiness and cost efficiency.

At the tip of the pyramid are on-hand stocks in Army units. In our divisional medical elements, these stocks are intended to support 3 to 5 days of operations and must include long-shelf-life items and potency-dated materiel. In effect, this is the unit's basic load of medical supplies. There are also operational stocks at the Army's major class VIII distribution centers, the



☐ **A new structure for providing medical supplies has emerged as medical materiel management shifts from a depot-based institution to a commercially based enterprise.**

USAMMCE, and the 16th Medical Logistics Battalion in Korea to support everyday healthcare operations in those areas of the world. However, today's on-hand inventory levels reflect our high-velocity, low-inventory, prime vendor support practices. The result is far less inventory to support contingency operations, necessitating other innovative programs to fill this immediate supply gap. In units above the division level, we are removing short-shelf-life items because of the high cost of rotating them, and we are stopping the past practices of buying and ultimately destroying costly pharmaceuticals because of potency date expiration.

The next level of the pyramid is prime vendor surge. This is the rapid infusion of the most essential items required primarily by the division's medical elements. Medical Prime Vendor contracts that we now rely upon for our everyday healthcare support have been supplemented with "surge" clauses designed to support readiness. Trauma items essential to combat casualty care in the division area are included in the surge program.

The initial surge supplies are complemented by a second increment for far greater depth of support. Initial deployment stocks and immediate resupply requirements are contained in centrally managed packages of approximately 10 days of medical supplies (level three of the pyramid). These packages are designed primarily for the echelons-above-division medical forces that require far greater density and quantities of materiel to carry out their mission. Area medical support companies and combat hospitals get their full component of potency-dated materiel from this band of the pyramid. Since 1996, the Army has followed a strategy to buy, hold, and pre-position a limited number of these packages at key locations around the world. However, most of the remaining required materiel is held by commercial suppliers through innovative, vendor-managed inventory and stock-rotation contracts. Supply requirements and package designs are managed by the U.S. Army Medical Materiel Agency (USAMMA), with contracting support provided by the Directorate of Medical Materiel at the Defense Supply Center Philadelphia. (See page 50, "Medical Prime Vendor.")

Commercially based surge and packaging capabilities not only provide significant readiness and economic benefits; they also keep our medical supplies "fresh" by incorporating new and vital drugs and medical devices as they become available in the commercial inventory. Contracting experts are weaving into these programs the requirement to rotate and replace stocks as is routinely done in the commercial sector, and manufacturers and distributing vendors are prepared to accommodate this requirement. Requirements such as rotation and replacement form the basis for effective long-term partnering with commercial suppliers.

The development of these programs, the USAMMA-DLA partnership to harness commercial capability, and the continued application of new variations of this concept ensure that all pieces of the medical supply picture are in place. Linked with the growing complement of information power, these practices ultimately will allow rapid tailoring of packages in response to specific operational requirements.

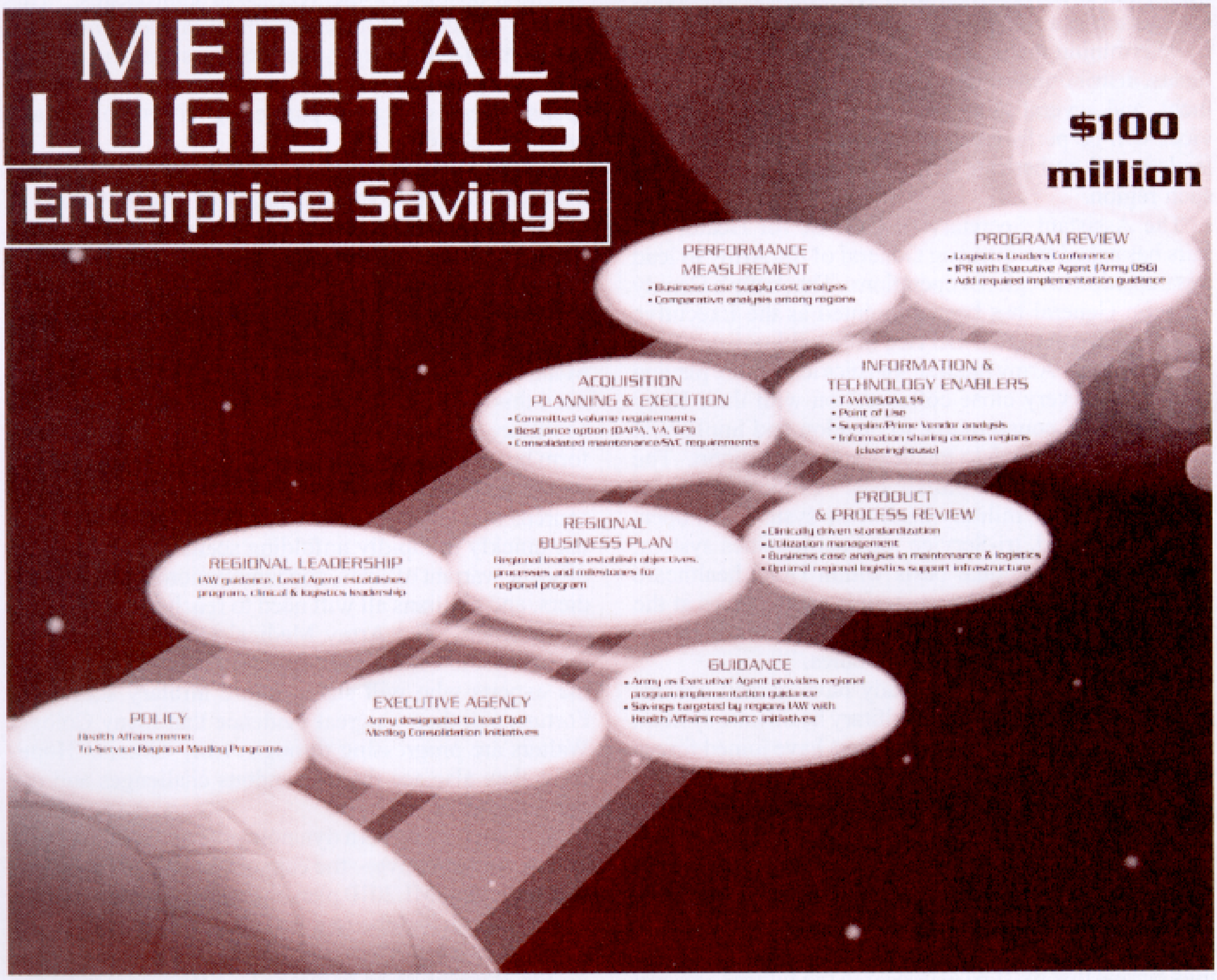
Army plans call for the availability of supplies to support 45 days of full-scale military operations. This means that the Army War Reserve materiel program also must have sufficient resources (pyramid level four). Following an intensive review of war reserve materiel requirements by the Army Deputy Chief of Staff for Logistics, new funding is projected in the 2000-2005 Program Objective Memorandum (POM). This breakthrough in resourcing, combined with the new surge and centrally managed package programs, offers exciting potential to save money and bring readiness to a historically high level.

The pyramid's shape is completed in planning for continuity of support beyond 45 days. Again, a USAMMA–DLA partnership is critical, because requirements are met based on careful assessment and observation of supplies in the commercial inventory. A significant enabler for this effort is the DMLSS Commercial Asset Visibility System. Future planners and managers will use an elaborate data base linked to commercial suppliers. These links will allow the military to chart the current and future capability of suppliers across the U.S. healthcare industry.

Contractual access to the vast U.S. healthcare system is the first step in the logistics process. The next step is delivering products to the medical customers. In this area, too, great changes are afoot. The military is building a distribution system that will provide greater speed, accuracy, and reliability than ever before. Prototypes developed at USAMMCE and the 16th Medical Logistics Battalion provide a glimpse of the future of distribution. That future will include complete visibility and control of supplies at all points in the distribution pipeline, greatly shortened pipeline times, and decreased costs.

Shaping the medical materiel readiness pyramid remains a very complex process. The fusion of military requirements with commercial capabilities requires constant learning, awareness, and adjustment. However, recent evidence proves that real progress is possible. Determining the "just right" level of materiel, an objective often espoused by the Army's logistics leaders, is more in sight than ever before.

The worldwide network of medical treatment facilities traditionally has played a key role in delivering a full spec-



☐ The Army is seeking to take $100 million out of its medical logistics costs over the next several years. This chart shows the steps in the campaign plan to reach that goal.

trum of medical logistics support. Business practices in our medical treatment facilities are tied closely to overall readiness objectives. Here, too, major change is unfolding as business practices are being redesigned around tri-Service regional programs.

Regionalizing Medical Logistics

The drive to achieve the highest state of medical logistics readiness possible is equaled by the intense demand to provide the most efficient and highest value support to the military healthcare system. Projecting a healthy force means operating a highly effective healthcare system that supports our soldiers and their families. Medical logistics support is a key component of the cost of operating our healthcare system. Increasingly, economic reality makes this effort a tougher and tougher job. Simply stated, spending too much for medical supplies or inefficient logistics services diverts essential resources that otherwise could be channeled into direct patient healthcare programs.

Medical logisticians in our hospitals and across our healthcare system continue to strive for greater efficiency and cost effectiveness, but the stakes have never been higher than they are now. In response to the new level of incentives and pressures, medical logistics support is being recast into regionally aligned business units. The fuse igniting a revolution in the medical logistics support structure for our direct patient care system has been lit. Medical logistics management processes that historically have been conducted independently at the medical treatment facility level are being shifted to the regional level. In the new regional business units, coordination and cooperation for medical logistics support are applied across a DOD healthcare region. Functions such as determining medical supply and equipment requirements, distributing supplies, maintaining medical equipment, and several other medical logistics support services will be performed regionally. Regional logistics leaders will orchestrate delivery of this support across each region.

The Assistant Secretary of Defense for Health Affairs has asked the Surgeon General of the Army to lead this transition to regional operations. The Army's Deputy Surgeon General has been appointed as the Executive Agent for Regional Tri-Service Medical Logistics Support Programs. Army medical logistics leaders are playing key roles, in very close collaboration with their Navy and Air Force counterparts, to develop and implement the regional approach to medical logistics support. The vision for this dramatic initiative is: "Clinical and logistics leaders in the military healthcare system will operate an integrated, tri-Service medical logistics system, organized on a regional basis within DOD healthcare regions to provide quality materials and services at the lowest delivered costs, and to increase the efficiency and effectiveness of clinical outcomes."

These regional efforts already have gained considerable momentum within the military healthcare system. Clinical and medical logistics leaders have joined forces to establish new product standardization processes. In some cases, they already have taken action to turn the use of multiple products across a region into a single, regionally standardized item. Thousands of dollars have been saved in these efforts. A variety of business case analyses have been completed in several regions, with actions unfolding every day. Tied to this effort are savings targets that must be achieved in the future to ensure compliance with expected supply budget levels. The Army is seeking to take $100 million out of its medical logistics costs over the next several years, a very demanding and challenging goal. The "campaign plan" to reach that goal is clearly taking shape and is embodied in the steps displayed in the chart on previous page .

Regional performance of medical logistics functions within the military healthcare system also will have an impact on logistics readiness. Tri-Service coordination of logistics support to deploying units will improve the deployability and supportability of medical units and improve DOD's coordination with its medical materiel vendors. Regionally managed standardization processes will improve the accuracy of item requirements that the Services need to support deployed organizations. This will lead to more accurate computations of immediate resupply requirements and war reserve materiel.

The full maturation of the regional medical logistics support structure will continue over the next several years and will take medical logistics into a significantly altered business posture as the year 2010 approaches. This change, which will follow Medical Prime Vendor and commercial-based support practices as the next generation of logistics support, will reduce costs, improve responsiveness, strengthen partnering with suppliers, and enhance readiness.

Medical Logistics Professionals of the Future

The future Colonel Walter will be a very skilled and sophisticated officer whose knowledge spans a broad range of military and private-sector logistics practices. She clearly will bring together tools from both sectors to respond effectively to rapidly changing military needs. Medical logisticians, like all other Army logisticians, will need this expertise to merge private sector support into a military context and into military requirements; to perform business case analyses that apply to everyday support and ensure contingency support; and to know the sources of critical information and how to integrate its use quickly in rapidly unfolding scenarios. Our future officers, warrant officers, noncommissioned officers, soldiers, and civilians all will need to reach new heights of competence. The Army Medical Department faces a critical test to continue the professional development of the experts who will shape future military successes. Fortunately, there is great evidence that many Colonel Walters are progressing through Army careers. Hopefully, they also see the tremendous challenges and opportunities that lie ahead.

Medical logistics is a dynamic process that ultimately effects one objective—the care of our soldiers and their families. The JML2010 plan, the medical materiel readiness pyramid, and the regional approach to medical logistics will have substantial impact in the years ahead. As the Revolution in Military Logistics proceeds, the words from our medical logistics battalion mottoes, "Spirit Of Support," "First Always," "Support the Healers," and "Support for Life," will echo constantly through these initiatives, keeping efforts focused on providing the best possible support to the patient care mission. **ALOG**

Colonel Stuart A. Mervis is the Surgeon General's Director of Logistics and the Deputy Chief of Staff for Logistics in the Army Medical Command. He acknowledges the editorial support provided by Roger Miller, who is a research fellow at the Logistics Management Institute.

Integrated Sustainment Maintenance

by Bruce Koedding

The Army is establishing an integrated management structure for all sustainment maintenance above the direct support level.

The intent of the Revolution in Military Logistics (RML) is to "transform Army logistics into a distribution-based system that substitutes logistics velocity for logistics mass to provide the right stuff at the right place, at the right time, and at the best value." To have a genuine revolution, there must be dramatic change within the three functional domains of the RML: Technology Application and Acquisition Agility, Force Projection, and Force Sustainment. As today's Army transitions through Army XXI to the Army After Next, many logistics modernization concepts and initiatives will need to be implemented, particularly within the functional domain of Force Sustainment.

One Army initiative supporting Force Sustainment will modernize the sustainment maintenance portion of the Army's total maintenance mission to meet the challenges of future logistics environments. This initiative is Integrated Sustainment Maintenance (ISM).

Changing Conditions Lead to ISM

The most important factor driving the need to modernize sustainment maintenance is the ongoing doctrinal shift from a forward-deployed Army to a largely continental United States (CONUS)-based, power projection Army—Force XXI. The maintenance concept for this future force is based on the need to support technologically advanced units on battlefields characterized by large operational areas and nonlinear frontlines. An additional factor is the growing need to respond to support and stability operations, such as nation-building, disaster relief, and peacekeeping missions. A flexible, responsive, and tailored sustainment maintenance system is essential to supporting the future Army.

The ISM concept emerged from a review of the current logistics systems designed to support Force XXI operations through to the Army After Next. The doctrinal shift and the experience of Operations Desert Shield and Desert Storm (ODS) demonstrated the need for a sustaining maintenance system that can respond rapidly to a full range of combat missions, from high-intensity conflicts to contingency operations such as Grenada and Panama.

The Army Logistics Integration Agency (LIA), under direction of the Office of the Deputy Chief of Staff for Logistics, Department of the Army (DA), assembled a study team in the early 1990's to develop a sustainment maintenance concept that would meet future Army needs. The development of that concept was based on the supposition that the Army will be operating low-density, high-technology weapons with reduced resources and a smaller, CONUS-based force in an era of regional conflicts requiring rapid deployment. [This article addresses the "corporate," or strategic, level of ISM. An article by Major David Funk, "Understanding Integrated Sustainment Maintenance," in the January-February 1998 issue of *Army Logistician*, examines ISM at the "operator" level.]

Current Sustainment Maintenance System

Management of the current Army sustainment maintenance structure is fragmented among multiple organizations. Within the Army Materiel Command (AMC), the Industrial Operations Command (IOC) controls depot sustainment maintenance resources, while AMC's commodity-oriented major subordinate commands (MSC's) control national maintenance management activities and national maintenance contractor resources. (However, some depot missions are realigning with their respective AMC MSC's.)

Active component sustainment maintenance resources are managed by the major Army commands (MACOM's). In CONUS, the Forces Command (FORSCOM) and the Training and Doctrine Command (TRADOC) are the principal providers of sustainment maintenance. Outside of CONUS, MACOM's include U.S. Army, Europe (USAREUR), Eighth U.S. Army (EUSA) in Korea, and U.S. Army Pacific (USARPAC). In the reserve components, both the Army National Guard (ARNG) and the U.S. Army Reserve (USAR) have important sustainment maintenance capabilities and responsibilities.

Under the Total Force concept, the Army has concentrated over 80 percent of its deployable sustainment maintenance manpower in ARNG and USAR units. However, because of historical disparities in assigning weapon systems and equipment, reserve component units often train on second-line equipment. As a result, many reserve component maintenance personnel lack the experience they need to repair the first-line equipment they are expected to support during contingency operations. ODS demonstrated that training in many reserve component units did not match their mobilization missions. DA contractors and installation directorates of logistics (DOL's), which are nondeployable assets under Army doctrine, provide much of the peacetime sustainment maintenance capability.

Lessons Learned From ODS

In many ways, ODS represents the type of operation the Army will be required to carry out in the future. While the overall coalition force mission was accomplished, ODS demonstrated the gap between the current maintenance system and the needs of the future. Here is a summary of the challenges presented by ODS.

An immediate challenge to achieving the rapid response required by ODS was the many parallel management chains involved in sustainment maintenance. This structure meant extensive coordination was needed in ODS to field the sustainment maintenance capability. A combination of active and reserve component general support (GS) maintenance units, Government civilians, and contractors was required to meet the needs of the theater commander. Once in place, some portions of this system continued to experience difficulties. The reason for these difficulties can be traced to gaps between supply, maintenance, and transportation systems and the communications and automation systems that linked them.

Another challenge was the lack of rapidly deployable sustaining maintenance capabilities. AMC personnel and contractors were used to fill the shortage, but it took time to make this happen.

A third challenge was the delay in deploying reserve component sustainment maintenance units. The delay resulted from the lack of unified control over various elements of the Army's maintenance infrastructure. Extensive coordination was needed among U.S. Central Command, AMC, FORSCOM, other MACOM's, ARNG, and USAR to determine the best way to meet the sustainment maintenance needs of the deploying forces. Full integration was never achieved during ODS.

ODS revealed shortfalls in the ability of reserve component sustainment maintenance units to maintain frontline combat systems. Many of these units did not train on first-line equipment and were not ready immediately to support the weapons systems used in ODS. There also were mismatches between the assigned peacetime missions of reserve component maintenance units and the missions they needed to carry out in ODS.

Evolving Army Doctrine

A flexible, responsive maintenance system is required to support high tech Force XXI operations on a battlefield characterized by large areas of operations and nonlinear frontlines. Only combat repairs that can be made quickly will be carried out in the battle zone. Maintenance units attached to maneuver units will make these repairs. Most field maintenance capabilities will be concentrated above the division level and located in the dispersal area. These capabilities constitute forward support maintenance.

The primary mission of forward support maintenance units is to repair broken or battle-damaged equipment and get it back to the combat units. They also provide reinforcing support to combat repair units in the battle zone and logistics area.

Sustainment maintenance is focused on reconstituting combat forces. Generally speaking, sustainment maintenance activities are located at echelons above corps and provide 40- and 50-level maintenance. They support reconstitution by repairing end items, shop replaceable units, and line replaceable units and returning them to frontline units; or by making major repairs, equivalent to overhaul, to support the supply system. These activities can be conducted in the logistics areas in the combat theater or at fixed installations outside the theater of operations.

The changes described in Force XXI doctrine focus on the combat repair and forward maintenance support portions of the system. While overarching maintenance doctrinal changes are being proposed, such as concentrating maintenance support at the division level and combining the 20- and 30-level maintenance activities, those proposals do not address the sustainment maintenance portion of the system. A sustaining maintenance system is needed to complement the changes being made to other levels of the maintenance system. Developing this complementary sustaining maintenance system is the primary goal of ISM.

Budgetary Influences

A new sustaining maintenance concept must deal with the realities of shrinking Department of Defense (DOD) budgets. If past experience is a good indicator, force reductions will hit support forces harder than combat units. The Defense Management Review Decision (DMRD) process already has taken credit for billions of dollars of savings associated with streamlining logistics activities—streamlining that often has yet to be developed or put into practice. In particular, emphasis has been placed on DMRD 927J, which calls for the Services to build and sustain seamless logistics systems.

Assumptions

Development of ISM is based on the following assumptions—

- The evolving doctrinal concepts for projection and sustainment of Force XXI operations are valid for concept development.
- Current maintenance concepts do not provide the best basis for developing logistics support systems and tools for future missions.
- Strategic planning guidance will continue to emphasize a largely CONUS-based, power projection strategy, a limited overseas force presence, and DOD participation in major regional conflicts.
- The Army will remain the proponent for all ground support operations, regardless of the mix of deployed forces.

Overview of ISM Concept

Under the ISM concept, an integrated management structure is being established for all sustainment maintenance above direct support. Sustainment maintenance managers at national, regional, and local levels will be responsible for providing all sustainment maintenance capabilities required by field units, whether in garrison or deployed to support any operational need arising from the Army's global force-projection mission. They will be responsible for setting work loads for active and reserve component sustainment maintenance units; the portions of DOL's that carry out sustainment maintenance in peacetime; Army depots; and, as contracting officers representatives, contractors carrying out maintenance activities under national maintenance contracts. They will assist reserve component sustainment maintenance units by assigning work loads for maintenance training, making mission assignments, and influencing the activation of those units.

Specific functions under the ISM concept will be performed as follows—

- The National Sustainment Maintenance Management (NSMM) Office develops and implements business policies and procedures to provide optimal sustainment maintenance support to Army organizations. Collocated at the IOC, this activity integrates Total Army sustainment maintenance management by linking national, regional, and local sustainment maintenance programs. The NSMM also supports reserve component training and contingency operations and participates in the deliberate planning process with AMC's logistics support elements (LSE's).
- MACOM control cells provide oversight of ISM operations by using ISM data to support management decisions on budget, infrastructure, and mission priorities. Their primary focus is to assess cost savings and cost avoidance, track ISM performance data, monitor inventory management, and support the budgeting process. MACOM control cells are currently operational at FORSCOM, TRADOC, the National Guard Bureau, the Office of the Chief of the Army Reserve, and USAREUR. Fielding of the final cells in EUSA and USARPAC is in progress.
- Regional and theater sustainment maintenance management (RSMM/TSMM) offices manage the execution of sustainment maintenance requirements in a designated region or theater. They oversee local sustainment maintenance operations and evaluate their performance. Two RSMM offices are operational, one in the East Region at Fort Bragg, North Carolina, and the other in the West Region at Fort Hood, Texas. The TSMM office in Europe was fielded in fiscal year 1998, and fielding of the TSMM offices in the Pacific and Korea is in progress. Upon completion, there will be five regions worldwide.
- Local sustainment maintenance management (LSMM) offices manage the workloading of multiple Army sustainment maintenance units and activities. Typically, the LSMM office will be collocated with and support the materiel maintenance officer within an installation or activity staff or, for the National Guard, at a state surface maintenance management office. A total of 35 LSMM offices, 26 in CONUS and 9 OCONUS, will be in place by the end of fiscal year 1999. Four ARNG aviation classification and repair activity depots will be incorporated under ISM and will act as LSMM offices.
- Associate maintenance activities (AMA's) par-

ticipate in ISM as work centers for designated LSMM offices. In addition to executing their local work loads, AMA's perform regional ISM and national work as assigned. AMA's report work they evacuate to other ISM sites and receive from other installations to their designated LSMM offices for control and tracking. MACOM's designate which installations they want to function as AMA's; the work centers are maintenance activities within the MACOM's existing installation infrastructure.

Wartime and Mobilization Operations

Under the ISM concept, the theater commander determines wartime requirements and transmits them through the theater support command to the deployed AMC LSE and its NSMM cell. The NSMM cell assists in determining the mix of resources needed to meet the requirements and coordinates assignment of resources to the theater of operations. Most of these resources are assigned to the theater maintenance activities located in the logistics area of the theater. As needed, the NSMM cell assists in the retrograde of unserviceable reparables by identifying sources of repair with the appropriate capacity and capability for those items.

Peacetime Operations

The NSMM Office integrates sustainment maintenance for the Total Army. It coordinates operations with both local-retail and national-wholesale maintenance providers. The primary interface at the retail level is through the RSMM/TSMM offices and their respective LSMM offices using MACOM installations' maintenance activities. The interface at the wholesale level is with the AMC MSC's, which use depot, contractor, and forward repair activity sustainment maintenance support to make major modifications or overhaul equipment to support the supply system.

The RSMM/TSMM offices coordinate all ISM management activities within their respective areas of responsibility through the LSMM offices. In addition to maintenance units that are assigned to installations, the RSMM/TSMM offices develop regional support centers to provide support more efficiently. The LSMM offices manage the daily production of ISM lines (those items selected for maintenance under ISM) at their regional centers of excellence (COE's). A COE acts as a central location where a particular ISM line is repaired for all customers within a given region. Using the COE concept, GS maintenance activities are able to maximize their repair capabilities.

A current initiative that will assist the NSMM Office and MSC's is the Maintenance Contract Data Base (MCDB). The prototype system is designed to establish visibility of Army maintenance contracts (tactical and combat equipment, wholesale and retail levels) at the national level to consolidate contract requirements, track maintenance services and costs, and maximize national- and regional-level repair capacities and capabilities. It will make information available to any authorized Internet user equipped with a commercial, Java-enabled browser. MCDB will establish a functional bridge between the traditional procurement data administrators and individual maintenance and logistics managers.

Organizational Concept

Headquarters AMC is the principal Army logistics organization, and the NSMM Office is an element of that organization. At full implementation of ISM, the NSMM Office's focus will include the Total Army-level integration of the day-to-day operations of contractors, depots, GS maintenance units, and other Government-owned facilities and activities performing sustaining maintenance operations.

Relationship With the Reserve Components

As indicated above, the NSMM Office coordinates sustainment maintenance required to support deployments and contingencies. This support includes assisting the theater support command and LSE in determining which reserve component sustainment maintenance capabilities are required and when they are needed to support the theater commander. The NSMM Office coordinates mobilization and deployment requests for active and reserve component sustainment maintenance units with FORSCOM, ARNG, and USAR.

The NSMM Office is responsible for coordinating the availability of components for maintenance training. It also recommends mission assignments and equipment allocations for active and reserve component sustainment maintenance units. It may recommend changes in the mix of active and reserve component capabilities and may suggest realignment of missions for these units to meet the Army's evolving needs.

The NSMM Office plays an active role in coordinating the maintenance training of reserve component sustainment maintenance units. It works closely with the ARNG and USAR chains of command to identify maintenance training requirements for them and to track the ability of each unit to carry out its sustainment maintenance mission. The NSMM Office assists in providing maintenance training opportunities for these units, as needed, at depots, contractor-operated maintenance facilities, DOL's, active component sustainment maintenance units, or other maintenance activities so they can fulfill their role in the integrated sustainment maintenance system.

Asset Visibility Through Automation

At the heart of GS reparable management within the ISM program is a computer system known as the Executive Management Information System (EMIS). EMIS is used at LSMM, RSMM, and NSMM offices; each participating MACOM also has EMIS. EMIS uses a relational data base to collect and consolidate data from various logistics Standard Army Management Information Systems and MACOM-unique maintenance management systems. It displays these data in a format that is easy to read and understand. EMIS allows LSMM, RSMM, and NSMM offices to monitor maintenance and supply trends and adjust production as needed. With EMIS, logistics managers can make informed decisions. In the future, this ISM automated functionality will be integrated into the Global Combat Support System-Army.

Testing and Implementation

To test the ISM concept, the Army conducted an ISM proof of principle (ISM PoP) from November 1993 through July 1994 at III Corps installations. III Corps established LSMM offices (collocated with the DOL's) at Fort Hood; Fort Carson, Colorado; and Fort Riley, Kansas, and an RSMM office at Fort Hood's 13th Corps Support Command (COSCOM). NSMM functions were simulated. Near the end of the ISM PoP, the Texas Army National Guard joined the ISM structure as a maintenance activity of the Fort Hood LSMM Office. AMC representatives assisted in establishing centralized workloading procedures at the RSMM and LSMM offices. In addition to producing significant reductions in retail acquisitions through better "repair versus buy" decisions, the ISM PoP demonstrated the potential for significant production rate improvements, reductions in repair turn-around times, and net savings through the establishment of regional repair COE's.

At the conclusion of the ISM PoP, the FORSCOM Commander, citing ISM's efficiencies and improvements, directed that the ISM PoP procedures continue under corps-managed regional repair programs (CMRRP), initially in III Corps and subsequently in the XVIII Airborne Corps.

The III Corps CMRRP bridged the gap from the end of the ISM PoP until the more comprehensive ISM-Expanded (ISM-X) demonstration. Working in an inter-MACOM environment, AMC and LIA conducted the ISM-X demonstration from July through December 1995. The purposes of this demonstration were to determine the feasibility of multi-MACOM ISM operations, establish and evaluate NSMM functions, and increase participation by ARNG units. The ISM-X demonstration expanded the ISM PoP framework by adding another FORSCOM installation, Fort Irwin, California; two TRADOC installations, Fort Sill, Oklahoma, and Fort Bliss, Texas; and two Kansas Army National Guard sites. The demonstration illustrated that ISM effectively crosses MACOM lines to produce truly integrated operations and validated ISM's potential for cost savings and cost avoidance.

After these successful field tests of the ISM concept and methodology, the Army leadership approved ISM implementation in May 1996.

ISM Business Process Improvements

Through implementation of ISM, the Army will—

- Enhance its responsiveness to the sustainment maintenance requirements generated during peacetime, contingency, and wartime conditions by integrating local, regional, and national sustainment maintenance operations under a single structure.
- Achieve economies of scale by establishing regional repair centers, where repairs for selected items within the region are consolidated at single repair facilities.
- Realize price and production rate efficiencies by introducing competition for sustainment maintenance work loads.
- Increase the visibility of Army sustainment maintenance capabilities and capacities through a developmental automated management information system.
- Reduce procurements of components and end items through improved repair versus buy decisions.
- Enhance reserve component maintenance unit proficiency through closer integration of sustainment maintenance training and synchronization of resources.

ISM will be a major step toward the Army's ability to implement a single, seamless logistics system and position the sustainment maintenance structure to meet the needs of Force XXI and on to the Army After Next.

Regardless of the thrust and direction, ISM will continue to be the sustainment maintenance component of any current or future logistics initiative in the foreseeable future. For more information on ISM, access the Army Materiel Command home page at www.amc.army.mil/des_logistics/lg-ism. **ALOG**

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Functional Domains of the RML—

- ***Technology Application and Acquisition Agility***
- ***Force Projection***
- ***Force Sustainment***

TOTAL ASSET VISIBILITY

Army Total Asset Visibility

by Cecilia Butler and Sandra Latsko

By using automatic identification technologies, the Army provides users with more accurate and up-to-date information on the logistics pipeline.

Army Total Asset Visibility (ATAV) is a program designed to achieve one of the six tenets of the Revolution in Military Logistics—total asset visibility. It also is an Army Force XXI initiative. Put very simply, ATAV is an automated capability that will improve dramatically the ability of soldiers, logisticians, and managers to obtain information on the location, quantity, condition, and movement of assets through the logistics pipeline.

As a fully-automated, near-real-time, open-architecture capability, ATAV provides complete, integrated visibility over Army assets and other logistics data. It is designed as a distributed system of multiple data bases, to which users gain telecommunications access from existing personal computers located at Army commands and activities by means of logon scripts.

A panel of judges selected the ATAV program as one of the 1995 winners of the Federal Technology Leadership Awards. Those awards recognize Federal agencies that have demonstrated extraordinary leadership in using information technology to improve service to the public, lower costs to the Government, and improve their ability to meet their mission requirements. Currently, the Army Logistics Integration Agency (LIA), which is headquartered in Alexandria, Virginia, is responsible for the development, management, and Army-wide implementation of the ATAV capability.

Why Was ATAV Developed?

In every recent major military deployment, the forces were plagued by a lack of visibility of materiel and equipment entering their theater of operations. The sheer volume of materiel moving through the logistics pipeline taxed the ability of soldiers, logisticians, and managers to track the materiel manually, maintain accurate records, and provide timely information to commanders. During Operations Desert Shield and Desert Storm, thousands of containers had to be opened, manually inventoried, resealed, and reinserted into the pipeline because of a lack of visibility of their contents. A dedicated effort has been underway since 1990 to ensure that such problems do not reoccur.

Reduced resources also contribute to the need for ATAV. The Army needs to maximize the use of all its resources before making procurements. Visibility of its existing assets is critical so that the Army will spend its dollars for the things it needs most.

Where Does ATAV Get Its Data?

The ATAV capability obtains wholesale and retail data on all classes of supply from various Standard Army Management Information Systems (STAMIS) and other source systems. ATAV data are received from the source systems through communications transfers and by uploading reconfigured data resident on logistics systems at the Army Materiel Command Logistics Support Activity (LOGSA), located at Huntsville, Alabama. The data are loaded into ATAV as they become available. To the ATAV user, access to external source systems is transparent and does not require him to perform any programming activity.

ATAV does not create any new data bases. ATAV-provided information is only as current as the information that is contained in the STAMIS. Some examples of these STAMIS include the Standard Army Retail Supply System (SARSS), Worldwide Ammunition Reporting System, Army War Reserve Deployment System, Standard Property Book System-Redesign, Commodity Command Standard System, AMC Installation Supply System, Standard Army Maintenance System-Installation/Table of Distribution and Allowance, Materiel Returns Data Base, and Logistics Intelligence File.

During fiscal year (FY) 1996, the Army began an aggressive ATAV data integrity effort. An ATAV Data Integrity Action Plan was developed. LIA chairs quarterly ATAV Data Integrity Work Group meetings with representatives from Headquarters, Department of the Army (DA), major Army commands (MACOM's), system design centers, and LOGSA. Through the efforts of this work group, ATAV data integrity has improved significantly over the past year.

Why Should ATAV Be Used?

The ATAV capability should be used by Army commands because it provides timely information from the strategic level through the tactical level in a way that is totally transparent to the user and in a format that soldiers, logisticians, and managers can readily use to support their routine operations. Managers can use ATAV information to make materiel management decisions, such as redistributing excess items or diverting materiel in transit. ATAV-related business rules and policy currently are being developed at DA level.

In addition to asset information, ATAV data sources provide unit authorization data, basis-of-issue plans, procurement information, distribution priorities, and catalog data. Users can query the ATAV capability by various means to find information on requisitions, shipments, or voyage or flight numbers.

Where Is ATAV Being Used?

The ATAV capability has been implemented successfully in much of the Army. ATAV provides visibility on Army-owned and Defense Logistics Agency (DLA) wholesale assets. ATAV shares that information with logisticians throughout the Army and the Department of Defense (DOD).

In support of the Office of the Secretary of Defense-directed Lateral Redistribution and Procurement Offset Initiative, ATAV provides asset data to all the armed services and DLA. This information is used to redistribute critical assets to meet user requirements. Managers supporting Paladin production under the Program Manager-Paladin use ATAV to determine potential production-line stoppers and the availability of assets that can be redistributed to prevent work stoppages.

ATAV-Enhanced (ATAV-E), an application using ATAV data, provides users visibility of redistributable materiel. Various reports supporting DA and MACOM requirements also have been developed in ATAV-E. Examples of these reports are the authorized stockage list (ASL) requisitioning objective dollar-value report, ASL zero balance report, and percent fill of Army prepositioned stocks report.

ATAV prototypes were successfully used in Somalia, Rwanda, and Haiti. ATAV provided commanders vital information on assets at the end of those operations. ATAV now is being used in support of Operation Joint Forge in Bosnia. During the deployment to Bosnia, ATAV was used to identify the locations of cold-weather clothing and equipment; in some instances, TAV data were used to divert equipment to forces scheduled for deployment.

ATAV-Related Technologies

The ATAV capability is supported by automatic identification technologies (AIT's), such as optical memory cards, bar coding, and radio frequency (RF) tags and readers, that provide rapid and accurate data capture, retrieval, and transmission. An RF tag can identify the contents of trucks, seavans, and air pallets and their locations. These RF tags are read automatically when queried by RF interrogators at air and sea ports of embarkation and debarkation, at other transportation nodes and choke points, and at receiving activities. This information is transmitted via satellite or land line to a regional server, thereby providing in-transit visibility. Optical memory cards, applied to multipacks at the source of supply, provide total content visibility and assist in error-free receipt processing and forward movement of required supplies. These specific AIT-related technologies are being implemented within the Army.

ATAV Support of Operation Joint Forge

Intransit visibility (ITV) is a major element of the ATAV program. As part of LIA's ATAV/ITV initiative, several AIT's have been implemented throughout the Army. In fact, three of these technologies are being used extensively to support Operation Joint Forge in Bosnia.

Optical memory cards, as a part of the Automated Manifest System, are being used to enhance receipt processing of multipacks at supply support activities (SSA's) in Hungary and Bosnia. At the depot or distribution center, data on multipack contents are stored on the card, and the card is attached to the multipack. At the SSA, the card is scanned through a reader and the data are posted to the user's supply system. This eliminates hours of manual receipt-processing time.

RF tags and interrogators are being used to enhance the visibility of pallet and container locations and contents flowing into Hungary, Croatia, and Bosnia. At the depot or distribution center, data on container and pallet contents are stored on an RF tag, and the tag is attached to the shipment. Omnidirectional interrogators, installed at key transportation nodes, read the tagged shipments as they arrive and depart those nodes. The interrogators pass those data to a regional server, where they can be accessed by users. Logisticians at a container yard, for example, can use a handheld interrogator to read tag data and determine container contents.

This technology is being implemented throughout Europe. Implementation in Korea was completed in FY 1998 and will begin within the Army Forces Command (FORSCOM) in FY 1999. When integrated with existing and emerging logistics systems, this technology will provide an infrastructure for automating source data and ensuring that ATAV data access is more timely and accurate.

Ammunition and AIT Integration

LIA has taken the lead in preparing ammunition logistics for operations in the next century. In partnership with the Military Traffic Management Command (MTMC); the Army Materiel Command; the Army Combined Arms Support Command; U.S. Army, Europe; and industry, the groundwork has been laid for applying AIT to the ammunition business process. A pilot effort was completed in fiscal year 1998 that integrates AIT into the ammunition business process and provides ATAV for class V materiel as it is transported from a continental United States (CONUS) depot through MTMC ports and on to ammunition supply points (ASP's) in Europe.

The ammo/AIT integration program will automate source data, integrate ammunition management information systems, create a baseline Army and joint AIT infrastructure and architecture, and provide asset and intransit visibility. Critical transportation and supply data will be pre-positioned in the Standard Army Ammunition System-Modified to facilitate planning for receipt operations. The Mobilization Training Management System (MTMS)-FM and associated AIT hardware will integrate Standard Depot System, MTMS, and CONUS Freight Management System functions and burn RF tags at shipping depots. RF tags will be placed on containers as they are stuffed. The tags then will be used to track containers through the transportation nodes and provide receipt data and in-the-box visibility at the receiving ASP's. In fiscal year 1999, LIA will expand the integration to remaining Tier I depots and European ASP's. Expansion to Tier II depots, ports, plants, and remaining ASP's is contingent upon availability of funds.

DOD AIT Operational Prototype

DOD is capitalizing on the successes achieved by the Army's use of AIT. A prototype hosted by the U.S. European Command will focus on four specific scenarios: unit movement, seavan, air cargo, and ammunition. Both the unit movement and air cargo scenarios will directly support Operation Joint Forge.

Key benefits resulting from the DOD AIT prototype include easier distribution of assets, which will contribute to reduced inventories; reduced receipt-processing time; improved in-the-box visibility and location of theater sustainment shipments; improved visibility of intheater truck convoy and rail movements; minimized manual data-entry tasks; increased source data accuracy; increased throughput of shipments through transportation nodes; and increased potential for interoperability with commercial vendors and shippers through the use of a commercial standard shipping level.

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ATAV is an automated capability that requires minimal resource expenditure by Army commands or activities. It is designed to be installed on and operated from existing organizational personal computers. A graphical user interface version of ATAV also is available and can be downloaded from the LIA home page. ATAV uses existing Army STAMIS for its source data. Perhaps most importantly, ATAV enables soldiers, logisticians, and managers to provide real-time or near-real-time information to commanders, allowing them to make informed decisions using the most current Army logistics management information.

For more information and details on how to implement the ATAV capability at your location, please contact an ATAV Program Office point of contact (see box above) located at the U.S. Army Logistics Integration Agency, 5001 Eisenhower Avenue, Alexandria, Virginia 22333. A VHS videotape titled "ATAV Orientation-June 1996" is available on request. **ALOG**

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2d Armored Cavalry Regiment Unit Move

by Major General Larry J. Lust
and Brigadier General Mitchell H. Stevenson

The unit's redeployment from Bosnia to Louisiana provided an opportunity to test automatic identification technologies.

How does one track roughly 2,400 soldiers from 27 troop-sized units, 2,524 vehicles, 45 helicopters, and 217 container and shop sets—coming from 7 base camps, crossing 5 international boundaries, and using highway, rail, air, inland waterway, and sea transportation—from Bosnia to the United States? In May 1998, this question was answered when the 2d Armored Cavalry Regiment (ACR) redeployed to Fort Polk, Louisiana.

The only visibility achieved on previous unit moves was from point of embarkation to point of debarkation. This type of logistics nightmare has occurred often since the Spanish-American War, as supported commanders commonly have lost both visibility and control of units in transit using existing procedures.

Background

On 7 January 1997, the Deputy Under Secretary of Defense (Logistics) and the Director for Logistics (J4), Joint Staff, established an Automatic Identification Technology (AIT) Task Force (TF). The AIT TF was established to address the lack of visibility common in unit movement and to integrate new and developing technologies to enhance in-transit visibility (ITV). AIT automates the collection and passage of information to interested users to achieve ITV. When AIT data are infused in automated information systems (AIS), the source data are more reliable and easier to perpetuate without further manual entry.

With the use of AIT, such as radio frequency (RF) tags, military shipping labels (new label), linear bar codes, two-dimensional (2D) bar codes, smart cards, and satellite tracking systems, the Department of Defense AIT TF saw a great opportunity to assist the 2d ACR redeploy to Fort Polk while resolving previous ITV problems. The objectives were to—

- Demonstrate ITV of passengers and cargo associated with unit moves using the Joint Operations Planning and Execution System (JOPES) at level 6 detail (each item of unit property book equipment).
- Automate and simplify the production of ITV source data and share them with multiple AIS, such as the Global Transportation Network (GTN), Transportation Coordinator Automated Information for Movement System II (TC–AIMS II), Worldwide Port System (WPS), and Joint Total Asset Visibility.
- Connect ITV to supported commander in chief (CINC) requirements as described in the time-phased force and deployment data (TPFDD) by inserting the unit line number (ULN) on the RF tag and smart card.

In November 1997, General Hugh Shelton, the Chairman of the Joint Chiefs of Staff, and General Wesley Clark, Commander in Chief of the U.S. European Command (EUCOM), accepted the vision of the AIT TF and pushed for an operational prototype to showcase AIT. Four different scenarios were developed. The centerpiece was the unit move of the 2d ACR from Tuzla, Bosnia, to Fort Polk. The EUCOM was designated as the lead for the unit move.

EUCOM goals for the unit move scenario for the AIT operational prototype were to—

- Integrate five AIT media (RF tags, linear bar codes, 2D bar codes, smart cards, and satellite tracking systems) into deployment processes and associated information systems in a unit movement scenario, from origins in the EUCOM area of responsibility to a U.S. destination.
- Measure the effects of AIT use on ITV, AIS, and the processes used at logistics nodes and by different transportation modes.

• Achieve ITV at JOPES level 6 detail on a unit movement from Bosnia to Fort Polk.

• Measure the effectiveness of an advanced fly-away suite of AIT and AIS designed for contingencies at austere locations in Bosnia and at established installations like Fort Polk.

• Accelerate the introduction of an AIS (TC–AIMS II) to the European theater. TC–AIMS II version 2.X was used in the operational prototype in conjunction with an enhanced JOPES interface capability, called the Joint Force Requirements Generator (JFRG II), as a single, joint translation tool.

In December 1997, Major General Mike McDuffie, the EUCOM J4, directed Lieutenant Colonel Brian Layer to spearhead this effort as the unit move scenario chief and joint coordinator for AIT and AIS integration.

USAREUR DCSLOG Challenges

On 23 March 1998, EUCOM tasked U.S. Army, Europe (USAREUR), to be the EUCOM executive agent for installing and integrating all AIT throughout the European theater. The USAREUR Deputy Chief of Staff for Logistics (DCSLOG) assumed these responsibilities and assigned them to the Logistics Automation Division (LAD). Dr. Tom Young leads the LAD branch responsible for AIT. The AIT Branch is a mixture of soldiers, Government civilians, and contractors. AIT Branch personnel have extensive experience using RF tags and satellite tracking in Europe, as well as in deployments to Somalia, Macedonia, Haiti, and Bosnia.

USAREUR DCSLOG's challenges were numerous, because a unit deployment is normally a busy time. Training on TC–AIMS II and the AIT peripherals had to be planned carefully. Equipment such as RF interrogators was erected in host-nation facilities where there were no communications or electricity. In addition to these challenges, the 2d ACR's redeployment date was accelerated by almost a month, which put a strain on the delivery of equipment from technology vendors. The Commanding General of Task Force Eagle, Major General Larry Ellis, wanted to use Bosnian rail lines to transport the cargo and rolling stock from Brcko and Lukovac, Bosnia, instead of convoying to Taszar, Hungary, to use the railheads there.

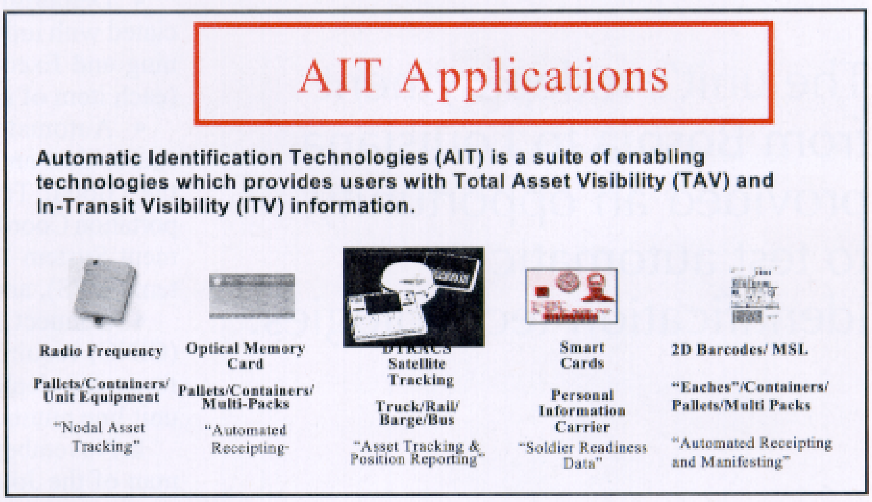
Preparing for AIT and AIS Integration

In January 1998, AIT Branch and EUCOM personnel made their first trip to Bosnia to survey the nodes to be equipped with RF interrogators. This site survey resulted in the identification of 14 new installations in Bosnia and Croatia that required instrumentation to achieve visibility from base camps through Bosnian railheads and border crossings. Most of these locations were austere and without power. In some camps, the only communication was through mobile subscriber equipment (MSE) and FM radio. The task was to instrument these locations and others at principal travel routes back through Central Europe to the United States.

The milestones (as shown below) were aggressive but achievable. Over the next several months, AIT Branch personnel coordinated continuously with Task Force Eagle; the Military Traffic Management Command (MTMC); EUCOM; the 2d ACR; the 21st Theater Army Area Command; the Program Executive Office for Standard Army Management Information Systems (Program Manager for TC–AIMS II); Brown & Root Services Corporation; and U.S. National Support Element personnel on the upcoming mission.

Equipment was tested, site preparation work completed, and power lines laid. TC–AIMS II modules needed to encompass USAREUR-unique forms and AIT data feeds were developed. Interfaces to the AIS had to be verified and tested as well. The AIS incorporated in the test were TC–AIMS II, the Global Command and Control System (GCCS), JOPES, JFRG II, the Consolidated Aerial Port System (CAPS II), and WPS. From those systems, the ITV capabilities of record were the USAREUR regional ITV server, GTN, and Joint Total Asset Visibility.

In February 1998, Stan Polonsky, Program Manager for TC–AIMS II, sent a team to Bosnia to train unit movement officers (UMO's) on the new system and provide instruction on creating deployment equipment



☐ **Automatic identification technologies used in the 2d Armored Cavalry Regiment's move.**

☐ **Unit movement officers received TC-AIMS II training, here at Camp McGovern, Bosnia.**

listings (DEL's). Four AIT Branch RF interrogator technicians (Hans Hollister, Master Sergeant James Wheeler, John Herron, and Rick Pestian) also were in Bosnia installing RF-interrogator read stations and providing training on the new system.

On 31 March 1998, the first milestone was met, with all the base camps in Bosnia and the border crossings operational, reporting to the regional ITV server, and visible in GTN. Camp Demi, the most austere base camp, was the site originally designated as the location to test a fly-away capability. It was instrumented and never experienced a problem while reporting RF tags every hour for the next 4 months.

In April and May, members of the TC–AIMS II team traveled to Bosnia to provide basic and reinforcement training to 2d ACR UMO's. In May, the TC–AIMS II personnel, with assistance from their AIT Branch partners, supervised UMO's in writing their DEL and container data to RF tags, providing the required level 6 detail that makes ITV a reality. These data then were passed to the regional ITV server, allowing anyone with Internet access to trace the location of their supplies on the Internet at http://www.dcslog.hqusareur.army.mil (then select Log.Autom.Div; AIT; RF-ITV).

Meanwhile, back in Heidelberg, Germany, other members of the AIT Branch, led by Sue Durham, were working hard to prepare smart cards that provided visibility of every individual soldier in the deployment. They received data from the 2d ACR S1 office and verified it against a data base compact disk from the Defense Manpower Data Center. Once the data were accumulated, it took only 1 day to put them all onto more than 2,400 smart cards. After the smart cards were validated, the S1 was able to rely on them to ensure the accuracy of the manifest, through every phase and mode of transportation, until the soldiers arrived at Fort Polk. There were times when the smart card team had to physically locate a particular soldier because the unit and the S1 lacked current information.

Deployment of AIT and TC–AIMS II Support

From May through mid-July 1998, TC–AIMS II and AIT Branch personnel worked closely together in Bosnia to provide assistance. This team traveled to each of the 2d ACR base camps to fix problems as they arose, including lack of Microsoft NT support on the networks in Bosnia (NT was the operating system for TC–AIMS II) and the need for modifications to the software. During this period, major crashes occurred with the networks at Comanche and Colt bases, but because of the flexibility in the TC–AIMS II and RF software, data continued to be passed via satellite, MSE local area network (LAN), and other methods.

The smart cards that were issued to the soldiers at the base camps were scanned as the buses passed through Tuzla or Camp McGovern and when the soldiers got off at Taszar. The cards were scanned again as the soldiers boarded the plane in Taszar, and finally when they debarked at Alexandria, Louisiana. AIT Branch personnel were at each of these locations to assist with the scanning process and ensure that the manifests were delivered electronically. As an example, when 100 soldiers departed by bus from Tuzla on 7 June, it took only 10 minutes to scan the cards and produce an electronic manifest with 100-percent accuracy.

The 2d ACR Unit Move Scenario

Unit DEL development. The 2d ACR's UMO's were tasked to update unit DEL's in TC–AIMS II. With this system, UMO's were able to create and amend data from their deployed locations. When their deployment plans were complete, UMO's at troop level forwarded the data through their chain of command (squadron and regiment) to the Task Force Eagle Division Transportation Officer (DTO). At each level, data were verified for accuracy by responsible officers. The DTO then forwarded the DEL to the USAREUR Office of the Deputy Chief of Staff for Operations and Plans' Movement Operations Center (MOC), where the data were verified again and edited for submission into JOPES. As movement data were transmitted to the MOC, the same data were sent simultaneously to the 27th Transportation Battalion (Movement Control), where they were used to order railcars, buses, trucks, and aircraft.

Translation of movement data to the JOPES TPFDD. The USAREUR MOC used the JFRG II to translate TC–AIMS II unit DEL's to the JOPES TPFDD. This was a significant enhancement to the TPFDD development process because, regardless of Service, the data went directly into the TPFDD using a GCCS application at the joint command level. This improved CINC TPFDD development in two important ways. First, it provided the CINC EUCOM with accurate movement requirements in less time. Second, it provided all CINC component commands with a common TPFDD translation tool. While it had been recognized that there was a legitimate need for sharing Service-specific information at the department level, it was not possible previously to provide the TPFDD with unit-level movement data that concurrently supported the CINC's planning and execution requirements

Deployment preparation at unit base camps. The 2d ACR was dispersed throughout the Sustainment Force's Multi-National Division-North Sector at seven base camps in Bosnia (Demi, Dobol, Guardian, Comanche, Eagle, Colt, and McGovern). At each location, UMO's prepared for redeployment by creating movement source data with TC–AIMS II. As redeployment plans materialized, the UMO's planned convoy and bus movements, developed container manifests, populated RF tags, and printed military shipping labels for their rolling stock and containers using TC–AIMS II and its associated peripherals. For rolling stock and containers, TC–AIMS II produced automated advance transportation control and movement documents. In addition to equipment preparation, USAREUR used the smart cards issued to each 2d ACR soldier to create manifests and track force movements.

Theater Movement Control Operations

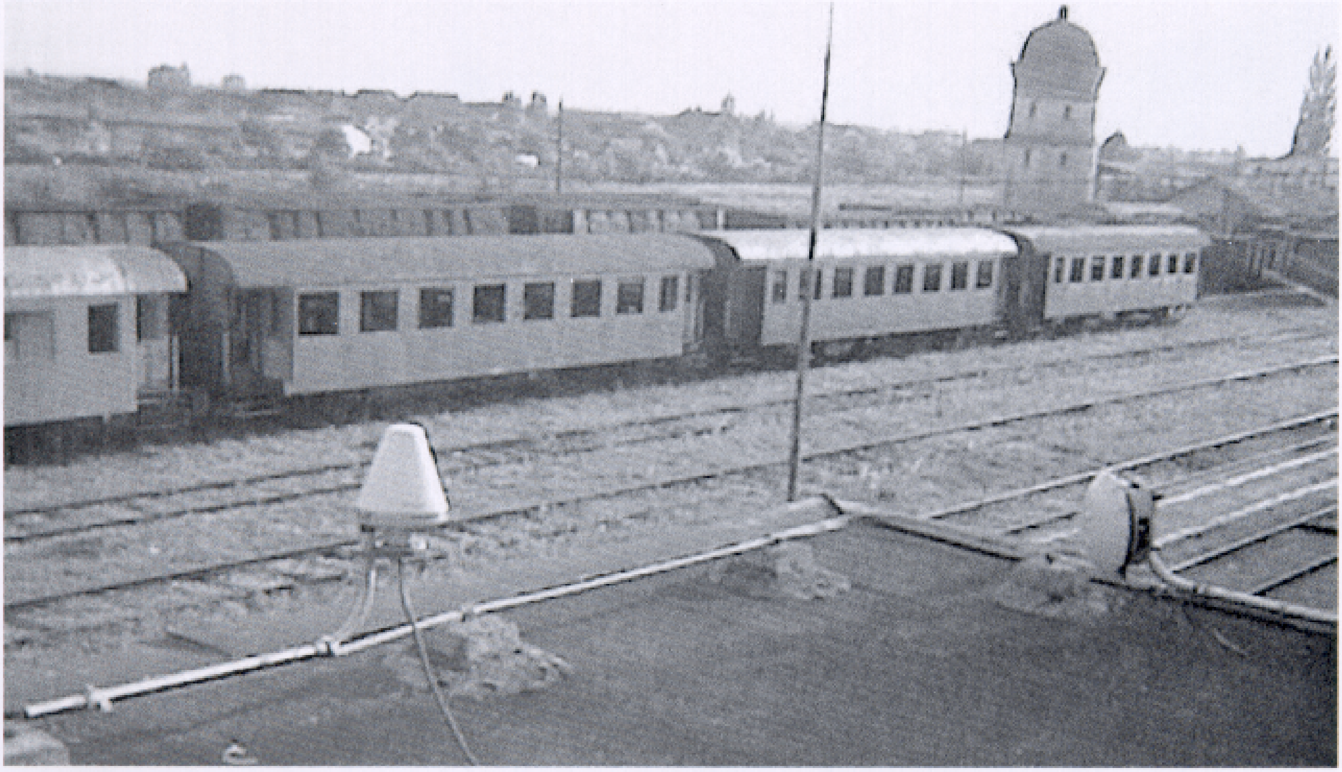
Convoy planning—base camps to Taszar. The DTO and Movement Control Team (MCT) at Tuzla electronically requested and received convoy clearances from the MCT at Slavonski Brod, Croatia, using TC–AIMS II.

Convoy movement—base camps to railhead. UMO's created soldier manifests using TC–AIMS II and smart cards and sent those data to the GTN server. Key convoys included a vehicle equipped with a Defense Tracking, Reporting, and Control Systems (DTRACS) transponder, by which commanders could monitor the convoy's departure, progress, and arrival at its destination. Convoy numbers were associated with specific transponder numbers, which correlated positional data with the convoy equipment manifest. The DTRACS transponder populated GTN with data sent via the USAREUR DTRACS server at Friedrichsfeld, Germany.

Container and artillery piece movement—base camps to railhead. The 2d ACR created RF tags for each unit equipment container and artillery piece. These items were chosen because they most frequently move outside unit convoys. The RF tags were populated using two methods. The primary method was "drag and drop," by which UMO's prepared the manifest on the TC–AIMS II laptop by copying items from a unit equipment file and pasting them to the tag manifest in a Windows environment. An alternate method used by the Regimental Headquarters Troop was to build tag manifests populated from 2D bar codes, which were pre-affixed to the actual equipment and scanned as the equipment was packed in containers.

In both cases, the manifest was created and checked in TC–AIMS II and the tag was populated with manifest information using a peripheral RF tag "write" station connected to the laptop. The containers and artillery pieces were moved to Lukovac and Brcko by supporting truck assets; they passed by RF interrogators at

☐A soldier applies a military shipping label generated by TC-AIMS II to equipment being shipped by rail.



☐ **RF interrogators were installed at the railhead at Brcko, Bosnia.**

each base camp and at the railhead. Sensitive items were trucked to Bremerhaven, Germany; interrogators along the convoy route indicated the location and progress of sensitive-item unit containers.

Bus movements—unit base camps to Taszar. Soldiers traveled from base camps to Taszar on buses. The 27th Transportation Battalion published bus schedules they had created using TC–AIMS II. Commanders verified personnel manifests using smart cards, and the manifests subsequently were forwarded by electronic mail to Task Force Eagle. When buses departed, UMO's notified Task Force Eagle telephonically, and the MCT reported the departure and arrival information electronically to GTN. Based on TC–AIMS II installation situation reports, the personnel manifest was associated with a bus number in GTN.

Rail movements to the Port of Bremerhaven. The 27th Transportation Battalion reported railcar departures and arrivals using the TC–AIMS II installation situation reports. They created actual rail manifests at the railhead by scanning bar-coded military shipping labels as unit equipment was loaded onto the railcars or by "dragging and dropping" advance transportation control and movement documents into the manifest. When the train departed, the Rail MCT electronically reported train departure, railcar information, and the transportation control and movement documents of all attached equipment to GTN using TC–AIMS II. RF interrogators along the rail route reported the progress of all unit containers and artillery pieces; this information was updated periodically in GTN through the regional ITV server. The MCT at Bremerhaven reported train arrivals to GTN using the TC–AIMS II installation situation reports, which closed out the ground movement phase of the operation.

Unit equipment at the Port of Bremerhaven and Rhine River Terminal. Once the MCT at Bremerhaven reported train arrivals at the port, the equipment was downloaded and accepted into the "strategic system" by MTMC, which scanned military shipping labels and forwarded equipment data to GTN using the WPS. WPS created the ship manifest that was reported to GTN. Helicopters from the 2d ACR were flown to Mannheim, Germany, prepared for ocean transport, and loaded onto barges at MTMC's Rhine River Terminal for movement to Rotterdam, The Netherlands.

Strategic Movements

Air movement from Taszar to Alexandria, Louisiana. Personnel of the 2d ACR reported to the Air Terminal MCT at Taszar, where personnel manifests were created using TC–AIMS II. The manifests were con-

☐ Smart cards are used to compile a manifest at Tuzla, Bosnia.

firmed using smart cards and passed through TC–AIMS II to CAPS II. CAPS II associated the manifest with a mission number, and those data were passed on to GTN. The Global Decision Support System recorded actual departures and arrivals of the air missions, which ultimately updated the data in GTN.

Unit equipment sealift from seaports of embarkation to the Port of Beaumont, Texas. MTMC posted manifest information and reported ship departures and arrivals in WPS. Those data also were visible in GTN.

United States Movements

Soldier movement from Alexandria to Fort Polk. Soldiers traveled by bus from the airport in Alexandria to Fort Polk. Manifests were closed by scanning individual smart cards. Those data, along with scheduled and planned departure and arrival information, were forwarded from the Fort Polk Installation Transportation Office (ITO)/MCT to the Army Forces Command (FORSCOM) using the TC–AIMS II installation situation reports. FORSCOM passed the data to GTN.

Unit equipment from the Port of Beaumont to Fort Polk. MTMC used WPS to scan military shipping labels as equipment was offloaded from vessels and staged in the port. Convoy manifests were created by MTMC by scanning the military shipping labels on equipment departing the port in convoys. The ITO/MCT at Fort Polk reported arrivals to FORSCOM using TC–AIMS II installation situation reports. In addition, RF interrogators at the port and Fort Polk reported unit container progress.

The First Signs of Success

The first signs of success were virtually instantaneous once the unit move began. Smart card data were being sent to GTN within an hour, level 6 data were visible on RF tags in GTN, and ITV was providing commanders with visibility of their shipments. Unit movement data were entered at the troop level, with DEL's passing through the troops' command hierarchy to the JOPES TPFDD. Troops also could amend and reproduce information in TC–AIMS II that they never could before. One squadron movement noncommissioned officer was quoted as saying, "I wish we'd deployed using TC–AIMS II. Mistakenly, we'd left some equipment behind. While we rarely used [that equipment] at Fort Polk, it would have been handy here. If we'd planned our deployment using TC–AIMS II, that equipment wouldn't have fallen through the cracks."

Lessons Learned

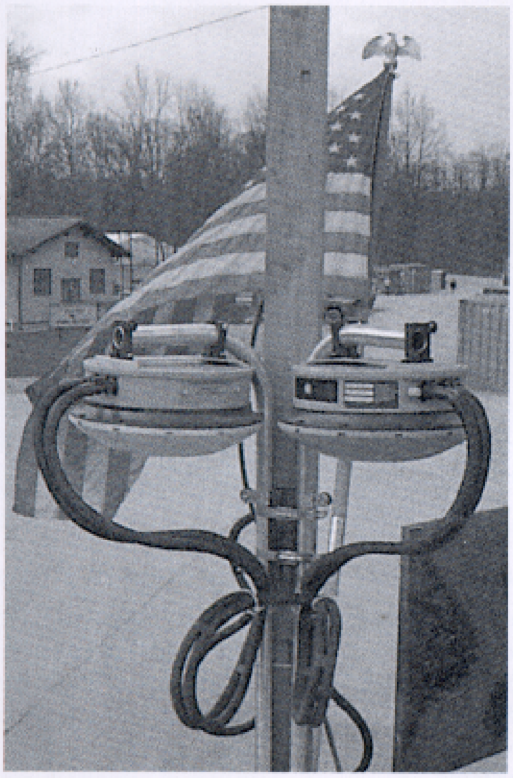
Brigadier General Samuel S. Thompson III, Commander of Fort Polk, said the smart card "has increased the efficiency in soldier accountability in the deployment process. It is an efficient way to quickly build troop lists and/or manifests, which expedites a unit's deployment/redeployment sequence . . . the smart cards made the transition from the airfield in Alexandria back to Fort Polk incredibly efficient. What seemed to take units a whole day in the past (i.e., returning troops from Saudi Arabia) is now reduced to a very few hours. Soldiers, weapons, and equipment were quickly accounted for, which allowed the soldiers to return to Fort Polk and their families with minimal delays."

Though originally intended to create manifests, the smart card provided additional benefits by helping the S1 office to automate reports and by providing additional capabilities and fields through which they were able to track such things as weapon numbers, messing entitlements, and blood types.

Though primarily used to track sensitive cargo, the DTRACS also was a success, providing 2d ACR soldiers a redundant means of communicating between Eagle Base and the Lukovac railhead.

One of the true highlights of the unit move prototype was TC–AIMS II, which did more than just build DEL's. It created military shipping labels, transferred data to the MOC, and produced 2D bar-code labels, transportation control and movement documents, DD 1750 packing lists, freight warrants, rail forms, convoy movement requests, and virtually any report requested by the user. TC–AIMS II data were input into JFRG II, providing an infinitely more efficient and effective data-entry method into JOPES than previously afforded by TC ACCIS and the Computerized Movement Planning and Status System.

Some of the strong points of the unit move were the ability to—



☐ **An RF interrogator and RF link in Tuzla scan passing equipment and containers.**

- Build two-way interfaces, through which JOPES provided requirements to JFRG II.
- Pass requirements to TC–AIMS II without ULN movement data, whereby TC–AIMS II provided the ULN's with level 6 data.
- Accept source requirements from TC–AIMS II.
- Marry source ULN cargo and personnel data and pass the merged plan back to JOPES.

"Movement officers are much more involved with and informed about their deployment when they plan it on TC–AIMS II," a 2d ACR staff officer remarked.

JFRG II enabled modifications to data in a more timely and efficient manner, on site, without having to send those modifications to FORSCOM for entry into JOPES. Perhaps most beneficial is the fact that one system supports all Services.

Conclusions

AIT worked well in contingency areas where communications and power were minimal. Camp Colt was able to switch from LAN to satellite reporting in 2 hours. Because UMO's can produce source-interactive data and AIT (2D bar codes, linear bar codes, and RF tags) in the unit area or a deployed base camp, the process of creating updates and passing data becomes faster and easier. That allows the deploying unit to concentrate on its deployment and follow-on missions.

Although using AIT requires additional unit-level training, the costs are easily justified by improved coordination, movement, and reduced frustration associated with developing source data for mass unit deployments.

The bottom line: Soldiers in the field were willing and excited, not only about going home, but about something that would make their jobs easier. Though somewhat intimidating at first, this new technology and capability quickly became integral and essential to the performance of their missions. **ALOG**

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Army Diagnostics Improvement Program

by Colonel Albert J. Hamilton

As part of its efforts to create an anticipatory logistics system, the Army is working to place embedded diagnostics and prognostics in its equipment. The payoff: increased force effectiveness and reduced operations and support costs.

The Army has initiated a program to revolutionize the maintenance and supportability of equipment—a program that will upgrade logistics functions at the same time that the tactical force is modernized. This is the Army Diagnostics Improvement Program (ADIP), which will place embedded diagnostics in Army equipment and develop anticipatory, prognostic logistics systems. The incorporation of embedded diagnostics and prognostics in Army equipment is a tenet of both Army XXI and Army After Next and will impact existing, legacy, and future weapon systems. The purpose of the ADIP is to reduce operations and support (O&S) costs while maintaining or increasing total force readiness.

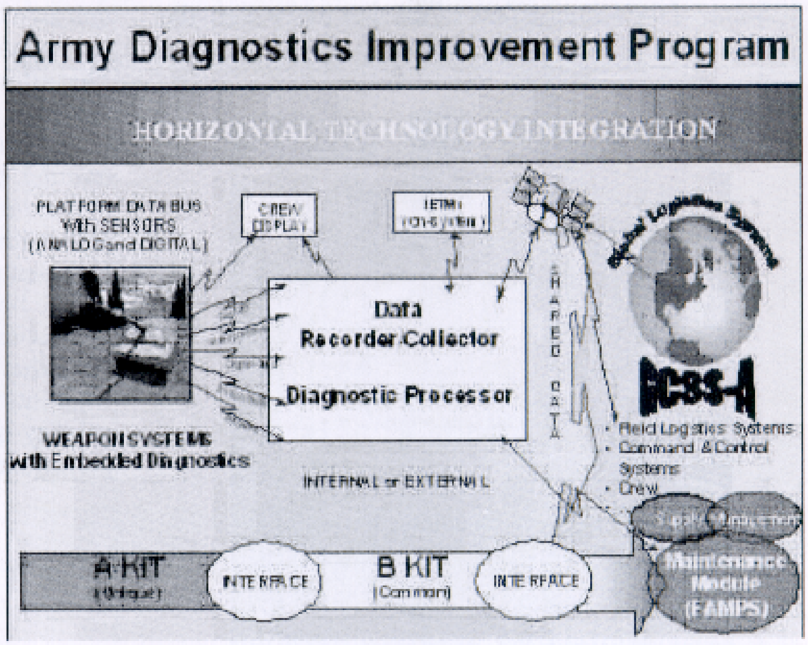
The Need for a Diagnostics Program

For a long time, the Army has wanted to reduce the cost of maintaining the force in peacetime and improving readiness for wartime, but it has not realized the full potential of diagnostics for achieving those ends. Existing diagnostic systems have raised a number of concerns: They make too many misdiagnoses, they too often report no evidence of failure, and they tend to be too labor intensive to operate. All of these factors have contributed to unacceptable O&S costs. In addition, the Army is failing to exploit the latest technology, and there is no Army-wide plan for diagnostics.

Incorporating new technology into modern weapon systems has increased the complexity of diagnostics. To meet maintenance requirements, more sophisticated test and diagnostic equipment has been developed and fielded. However, more sophisticated test equipment has resulted in more complex training for maintenance personnel and increased reliance on contractors to perform maintenance and repair missions. This increase in complexity runs counter to the Army's efforts to reduce training times and eliminate specialization.

As modern weapon systems have been developed and fielded, more system-unique test and diagnostic equipment has been fielded to support them. Despite efforts to reduce the proliferation of test equipment on the battlefield, and the associated needs for more manpower and training support, the Army now has more sophisticated system-specific testers than ever before.

Many systems developed in recent years have required various levels of built-in test (BIT) and built-in test equipment (BITE) to decrease their reliance on general-purpose test equipment. Several systems have been developed with various levels of built-in test and diagnostics equipment. However, the lack of a comprehensive diagnostics strategy limits the savings that can be achieved, and there is no linkage to future Army logistics systems.



☐ **The Army Diagnostics Improvement Program.**

Meanwhile, the use of embedded diagnostic technology in the commercial sector is increasing rapidly.

Automotive manufacturers have complete standard diagnostics strategies designed into automobiles. Since 1995, Ford vehicles have had digitally controlled drive trains that permit the use of embedded diagnostics technology. Shop test equipment automatically transmits repair data to central data bases at Ford. Information generated from the data bases is used to track and determine abnormal maintenance actions, predict parts usage, issue technical bulletins, and train mechanics. Similarly, commercial trucking companies use satellite tracking systems that relay the maintenance status of vehicles to central operations facilities, and aviation companies use on-board maintenance data recorders to track the status of systems and schedule maintenance actions. The reason for this interest in the commercial sector is the potential for cost reduction.

The Army is lagging behind commercial industry in developing and placing embedded diagnostics in its weapon systems. While some systems have achieved advanced levels of BIT and BITE, no systems, policies, or standards have been established to guide materiel developers in creating an effective embedded diagnostics program. Weapon system developers and contractors instead have adopted system-specific, stovepipe approaches that fail to capitalize on already developed technology. Furthermore, because there are no standard interfaces, weapon systems' embedded test capabilities are not able to transfer data automatically into Army automated logistics systems. The Army has failed to achieve the significant O&S cost reductions that are possible through improving diagnostics processes. Unless there is a specific program to accomplish this task, the Army will not attain these cost reductions.

The ADIP Is Established

In July 1997, a three-star-level General Officer Steering Committee (GOSC) directed that a plan for improving diagnostics in the Army be developed. The GOSC charged the Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE) to develop a focused, Army-wide, long-range plan for emplacing embedded diagnostics in Army equipment. The plan makes weapon system PM's part of an integrated product team (IPT) that is working to reduce O&S costs by maximizing the use of common embedded diagnostics and prognostics.

An approach known as horizontal technology integration was selected to develop, manage, integrate, and field components with a common architecture across families of weapon systems. Further policy guidance issued by the Vice Chief of Staff of the Army and the Army Acquisition Executive requires weapon system developers to incorporate embedded diagnostics in their systems.

The ADIP Vision

Future Army logistics systems will anticipate requirements and initiate responses before equipment failure or parts shortages occur. On-board sensors will be linked electronically to combat commanders' information and logistics systems. This will enable individual weapon systems to be monitored and resourced while they operate anywhere in the world. This logistics system will be proactive rather than reactive.

Developing an anticipatory logistics system will require that technologies (such as expert systems, neural nets, advanced sensors, and improved embedded diagnostic capabilities) be integrated into equipment design and linked by a distributed communications system. As operational sensor data are collected, variance data will be used to anticipate future failures.

Operators and crews, backed by multidiscipline, multicapable maintainers using advanced diagnostic techniques and equipment, will anticipate maintenance and logistics needs. Embedded sensors will monitor the health and status of systems continuously and provide data to enable logistics systems to anticipate support requirements.

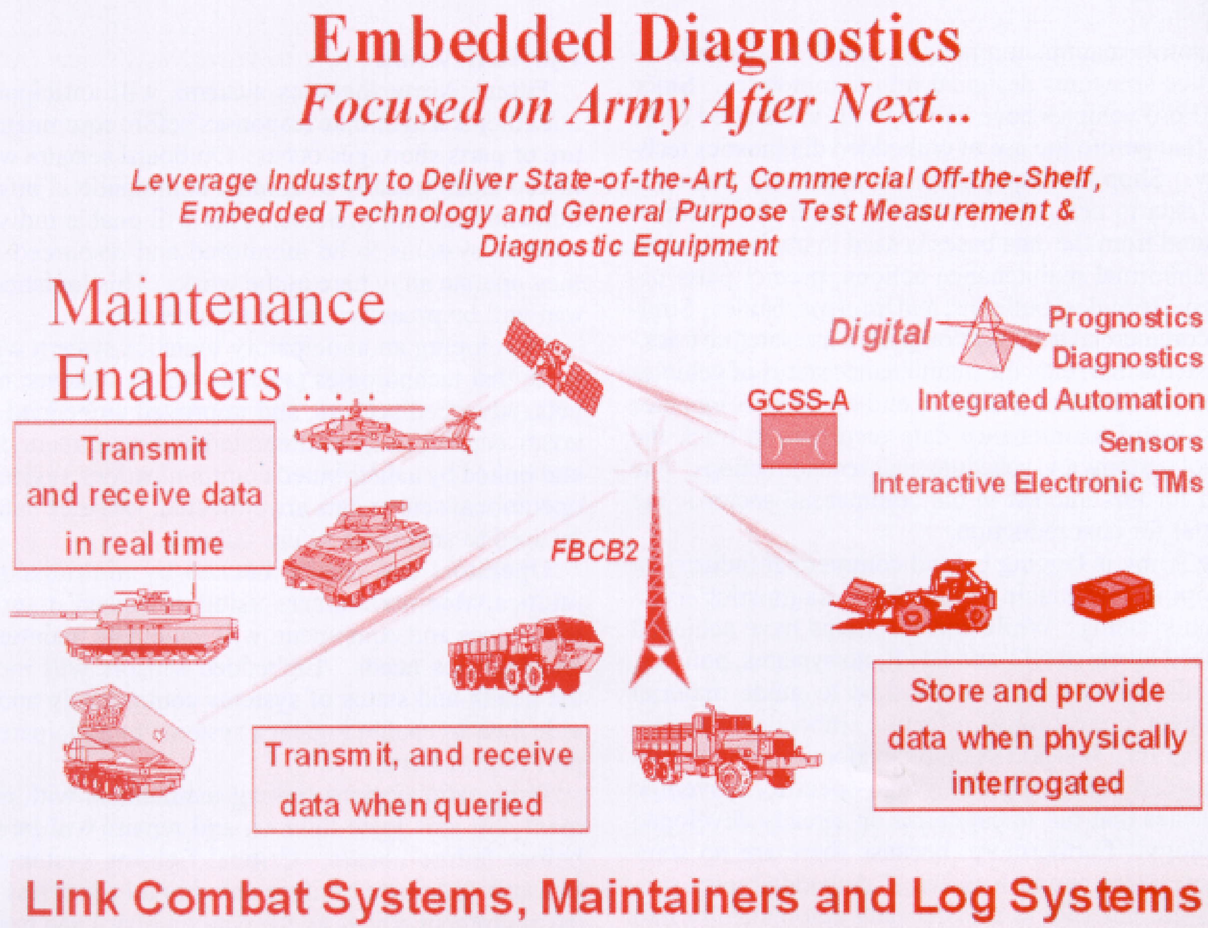
Prognostic systems linking maintainers with equipment will anticipate failures, and repairs will be made before failure occurs. Critical fighting systems will transmit anticipated failure data in real time; less critical equipment will store the data on board and transmit them when queried; and other equipment will store the data until interrogated by maintenance personnel. The need for parts and other supplies will be anticipated, and they will be delivered to the system. Linking logistics with operations will provide responsive support while reducing or eliminating the need for carrying stockpiles of parts onto the battlefield. The ADIP provides a focused plan for moving toward the common embedded diagnostics and prognostics that will make this vision a reality.

Implementing the Vision

Technology has progressed to the point that future systems will be capable of providing total system diagnostics and fault isolation in a replaceable unit. This will be accomplished through built-in programmable sensors and on-board automated equipment that detect, process, and communicate diagnostics information to logistics providers. The ADIP will—

- Emplace embedded diagnostics in Army equipment that will eliminate the need for much, if not all, external test equipment.

- Team with industry to develop advanced sensors that can be programmed to monitor and react to a variety of mechanical, thermal, or electrical conditions;



□ The Army Diagnostics Improvement Program's Vision.

provide advanced warning of incipient failure by comparing readings to normal baselines; and transmit data to automated logistics systems.

- Team with industry to develop and integrate data buses, collection devices, data recorders, processors, and output systems that will record, monitor, and process data.
- Develop hardware and software that will support predictive maintenance and prognostics by permitting repairs to be made before failure and improving fault isolation of failed parts to the lowest reparable component level. Some failures will be repaired through built-in self-repair routines that are selected by operators and system crews.
- Allow more repairs to be performed by system operators, thereby reducing the impact of any shortages in maintenance personnel.
- Save O&S resources by reducing overhead maintenance personnel, improving system diagnostics, reducing diagnostic time, eliminating the need for expensive tools and test equipment, accurately forecasting spare part requirements, minimizing parts usage through accurate diagnosis, and performing real-time system health monitoring.
- Reduce or eliminate the need for stocking parts, supplies, and equipment on the battlefield to meet unexpected failures that may prevent mission accomplishment.
- Implement expert systems that will contain algorithms to correlate the data and develop information for obtaining future requirements.

Not every system will require real-time maintenance monitoring. Systems will be categorized according to their criticality, and diagnostics, prognostics, and health monitoring will be tailored to match that criticality. The Ordnance Corps Vision XXI describes these equipment categories and the levels of maintenance information response as follows—

- Fighting systems (such as tanks, helicopters, and artillery pieces) will transmit variance data in real time.
- Support equipment (such as trucks, forklifts, and heavy engineer equipment) will store data and transmit them when queried.
- Other equipment (such as generators, heaters, and bath and laundry equipment) will store data and transfer them when interrogated by maintenance personnel.

• Equipment such as field tentage, shop equipment, and individual soldier equipment will not be digitized.

Goals and Objectives

The goals of the ADIP are to—

• Improve Army diagnostics.

• Reduce O&S costs by 20 percent.

• Integrate predictive maintenance into the Global Combat Support System-Army (GCSS–Army).

• Emplace embedded diagnostics in Army equipment.

• Reduce life-cycle costs for current and future systems.

• Reduce the proliferation of test, maintenance, and diagnostic equipment.

The program's near-term objective is to incorporate existing technologies into current Army systems to achieve immediate savings in O&S resources. These technologies will improve current Army diagnostics and will be attained by using specific weapon system managers for implementation. This will save not only dollars and improve diagnostics but also will provide data for the future development of diagnostic technology. This objective will be met by Thrust 1 of the ADIP.

The mid-term objective will be to develop technologies in areas that build on the Failure Analysis and Maintenance Planning System (FAMPS) to provide a predictive maintenance capability for current and future systems. FAMPS will be designed to become part of the Maintenance Module of GCSS-Army. This objective will be met by Thrust 2 of the ADIP.

The ADIP's long-term objective will be emplacing embedded diagnostics in Army equipment and realizing a full prognostic maintenance system. This objective will be met by Thrust 3 of the ADIP.

The ADIP Campaign Plan

A program master plan has been prepared and staffed to initiate the ADIP. The plan requires the development of hardware, software, interfaces, communications, and architecture for all Army systems. Using the horizontal technology insertion approach will require joint developments by the PM's of both weapon systems and host platforms and by the PM for Embedded Diagnostics Technology. IPT's will integrate and interface system-specific components (A-kits) with common equipment (B-kits) that will be installed on host platforms. This clear and focused diagnostics strategy is critical to the Army's implementation of a flexible and responsive logistics system in support of Army Vision 2010.

The strategy also encompasses a paradigm shift from today's reactive maintenance to an anticipatory, proactive maintenance approach. This prognostic-based thinking involves not just how we maintain on the battlefield, but how we think and design for maintenance. This approach is a holistic one that involves all organizations, from initial designers to end users.

Technologies are available now that make use of existing equipment. As new embedded diagnostics are developed under this program, additional technologies and capabilities will be spun off to further improve diagnostics and reduce costs. These spin-off technologies will be implemented by identified candidate systems, working through the horizontal technology insertion approach and IPT's in combination with platform system managers. These programs will serve as continuous improvement processes and real-time test beds feeding the developmental program. Future weapon systems and legacy systems will benefit from these efforts as upgrades or modifications extend life cycles and improve performance.

The Army cannot afford to wait until the ADIP is fully implemented to begin realizing its benefits. Therefore, the ADIP strategy also is designed to address current diagnostic problems with existing and legacy systems. This strategy will begin saving O&S costs immediately and will create a source of funds for additional improvements to diagnostics. The program is intended to become self-funding eventually, after initial investments, by generating O&S savings that can be reinvested to generate additional savings. The horizontal technology insertion approach will produce solutions that will achieve diagnostic improvements for specific systems that can be applied across multiple systems, without recurring costs of developing the technology for each system.

ADIP's Implementation Thrusts

The ADIP strategy consists of three interrelated and interdependent thrusts that will be developed concurrently.

Thrust 1: Immediate insertion. This thrust consists of a series of projects that will improve diagnostics on existing and legacy systems and reduce O&S costs. Projects in Thrust 1 are sponsored under ADIP but will include specific improvements to existing weapons that are expected to remain in the Army inventory for the foreseeable future and even for the Army After Next. These systems are expected to continue to be viable weapons for the Army, and it is not feasible, affordable, or necessary to replace them. However, they will be modified, improved, and upgraded to add new capabilities.

Diagnostic improvements may be inserted as these weapons are modernized, at the same time as other planned improvements are made. In other cases, diagnostic improvements may be accomplished by replacing antiquated test equipment or converting to interactive electronic technical manuals. Moving toward digitization by applying standard data buses will facilitate incorporation of embedded diagnostics.

Examples of projects to be accomplished in Thrust 1 include the following—

- Redeveloping, rehosting, and replicating test program sets will eliminate or reduce reliance on outdated and expensive test equipment. This will increase the work-load capacity and efficiency of newer standard test equipment, such as the electronic repair shelter and other components of the integrated family of test equipment. Replacing antiquated test equipment with more capable and sophisticated standard test equipment will reduce support costs and improve diagnostic processes.
- Developing and emplacing maintenance data recorders on Army helicopters will give maintenance personnel and crews access to system health and diagnostics data.
- Developing, producing, and fielding interactive electronic technical manuals for equipment will improve diagnostics processes.
- Installing digital controls and data buses on engines and systems will allow data to be recorded and processed on board and downloaded to other processors.

Thrust 2: Development of an anticipatory maintenance system. An anticipatory maintenance system will be developed through an evolutionary approach that will move from today's reactive maintenance to a predictive maintenance system for Force XXI and an anticipatory logistics systems for the Army After Next. The development of FAMPS will lead to automation of organizational maintenance activities and will be the stepping stone to anticipatory maintenance.

FAMPS is being developed as the maintenance system focal point for planning and employing maintenance support for today's Army, Force XXI, and the Army After Next. It will be a seamless combination of software tools, data bases, and interfaces: anticipatory maintenance system, prognostic analysis system, maintenance shop scheduler, information-handling and report-generating system, and higher- and lower-echelon maintenance communications interface. For the maintenance community, FAMPS combines current and future technology improvements and modernization efforts. The anticipatory maintenance system will be developed, over time, from an initial system primarily supporting tracked and wheeled vehicles with trend analyses to a system supporting all Army weapon systems with artificial neural networks.

FAMPS expands on investments made in on-system test equipment, interactive electronic technical manuals, and systems that combine advances in electronic document delivery with personal computer-based test instrument technology. The initial development of this anticipatory maintenance system is being accomplished with development and fielding of a prototype FAMPS to units of the 3d Brigade, 1st Armored Division, at Fort Riley, Kansas. These initial efforts require that a computer workstation be fielded to test units so they can host the FAMPS software. As the GCSS–Army is fielded, the hardware requirement for FAMPS will be eliminated and its software functions and capabilities will be integrated into the GCSS–Army's Maintenance Module. The program is incremental so that the Army will reap a return on its investment almost immediately and will continue to do so as it progresses through Force XXI and into the Army After Next.

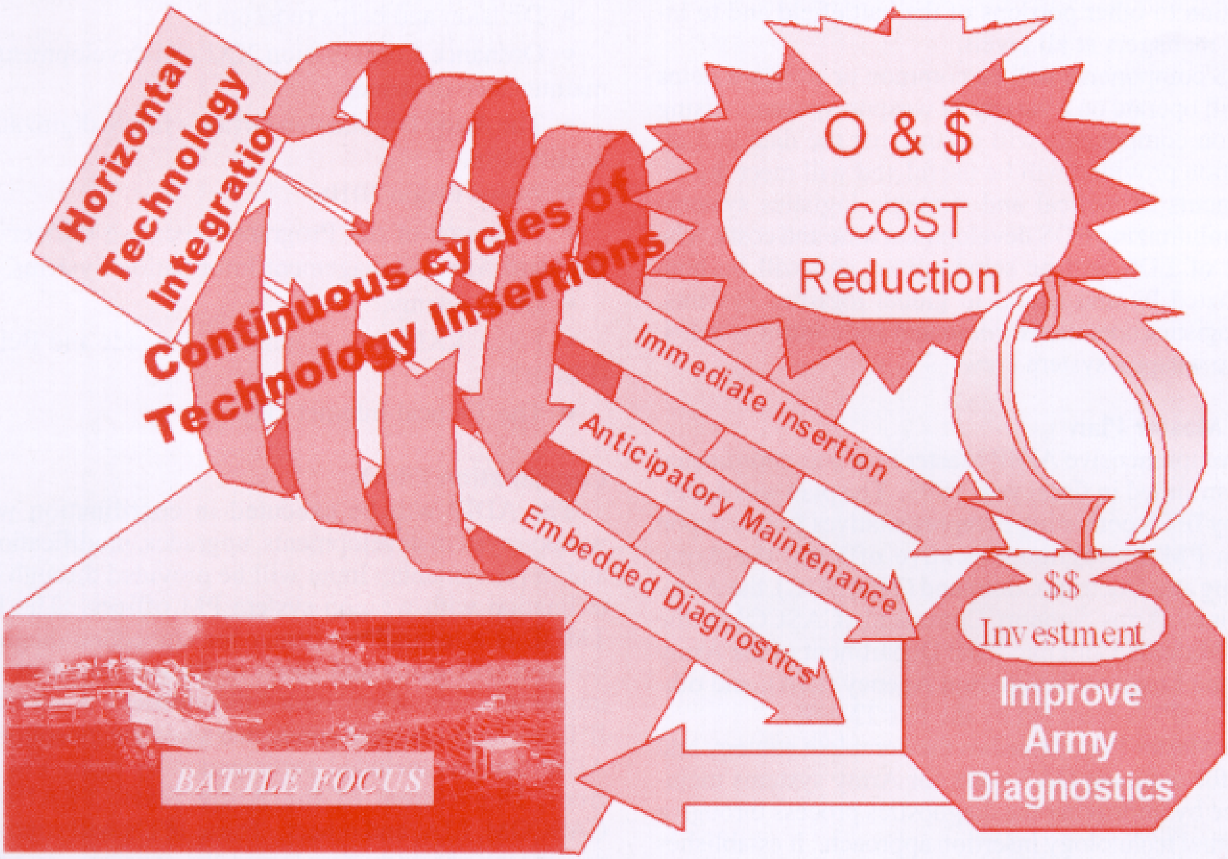
Ultimately, prognostic logistics systems will anticipate failures and other logistics needs and provide timely notification that will eliminate the need to stockpile parts and reduce the downtime created by waiting for parts. Anticipatory maintenance and logistics systems will monitor the health and use of weapon systems remotely from embedded hardware and software and apprise operational and maintenance personnel of system conditions.

Predictive systems will anticipate failures before they occur and requisition the materiel and support needed to avoid the failure. Prognostic maintenance processes will be linked to both logistics support and tactical operations organizations. Commanders will make operational decisions with accurate assessments of equipment capabilities to complete specific missions. Maintenance planners will be able to prioritize maintenance tasks to improve mission readiness and the probability of success. Crews and maintainers will perform anticipated repairs before the mission begins in order to avoid equipment failures and repairs during the mission. Thrust 2 will develop the tools necessary to achieve these goals.

Thrust 3: Embedded diagnostics for future systems. Technologies needed to satisfy the requirements for the embedded diagnostics system (EDS) for future weapons will be defined and developed under Thrust 3. EDS will revolutionize maintenance on Army weapon systems. It will be a comprehensive and inclusive system that will harvest data generated by embedded sensors on weapon systems; collect, store, and process the data using interactive procedures; and transfer information that will be shared by multiple users. EDS will be fully integrated and will make possible the anticipatory maintenance developed in Thrust 2.

EDS will be emplaced on Army equipment and will provide a complete maintenance and diagnostics capability for the crew and supporting field maintenance units. In addition, EDS will provide logistics data for all levels, from equipment operators to global logistics data bases and command and control systems. Sensors and other devices that are integrated into each weapon system will continuously detect and provide signals and

ADIP Campaign Plan



☐ **The Army Diagnostics Improvement Program is following a three-part (or thrust) strategy using horizontal technology integration.**

data that will be collected through interfaces and stored on onboard digital devices. Onboard processors will receive these signals and, using advanced interactive procedures, will provide interactive instructions and information to the weapon system, the crew, field commanders, and field-level logistics elements. Data also will be transmitted to centralized data bases in theater and in the continental United States to provide visibility of weapon system status to all levels. In addition to providing continuous data on the status of individual weapon systems, EDS will provide prognostic failure data on components, mission accomplishment profiles, fault isolation information, and even some level of self-healing capability.

Components of EDS include—

• Suites of advanced programmable sensors that will detect and collect measurements and information from all components and subsystems of the weapon system.

• Interface devices that will transfer data from sensors and other weapon system components to an automated data collection and storage device.

• Data collection and storage devices that will provide the system with the capability to obtain, store, and retain massive quantities of data.

• Processors mounted on board the weapon system that will have the speed and capacity to process massive amounts of information through the collection and storage devices.

• On-board output devices that will provide the crew with specific status information, prognostics, and maintenance instructions via a display. In addition, the crew will be able to interact with EDS through a keyboard or keypad or by voice command. Through EDS and the output devices, the crew will have the capability to repair their system without calling for maintenance personnel.

• External interfaces that will provide output continuously to local field commanders.

• Maintenance procedures, interactive electronic technical manuals, and other software products that will use data and information interactively to evaluate system performance, provide status, produce instructions, and feed other data systems.

• Centralized data-receiving systems that will receive, further process, disseminate, and transfer information to other portions of the battlefield and to logistics managers at all levels.

EDS components will be common or standard items that will operate on a variety of weapon systems. Using common components will ensure that the data and information provided will be useful and will meet the requirements of tactical and strategic logistics systems while minimizing EDS development time and costs. The output of EDS will be standardized and will be both anticipated by and useful to global logistics systems, field logistics operations, command and control systems, and the weapon system crew.

ADIP Master Plan

A comprehensive ADIP Master Plan was coordinated and distributed in fiscal year 1998. The plan was developed by IPT's consisting of representatives from weapon system PM's, program executive officers, the Army Training and Doctrine Command (TRADOC), the Army Combined Arms Support Command (CASCOM), the Army Materiel Command, the Department of the Army Staff, the Logistics Integration Agency (LIA), and others. The IPT's were led by the PM TMDE.

The Master Plan describes the complete strategy and goals for reducing O&S costs for Army systems maintenance by improving the diagnostics process through a horizontal technology insertion approach. It establishes the roadmap for building on today's systems, guiding tomorrow's technology, and inserting technology at points of opportunity to achieve the vision of the Army After Next.

This plan will lead to developing the embedded diagnostics architecture for weapon system developers and address life-cycle costs during systems design and upgrades. It outlines specific responsibilities for implementing this program. The plan recognizes that emplacing embedded diagnostics in all Army equipment is a significant undertaking that requires an organized transition from today's systems to tomorrow's technology while simultaneously reducing O&S costs in the near term. The Master Plan is a living document and will be updated periodically to incorporate the latest developments.

Related Initiatives

The ADIP cannot and will not work in a vacuum. It will work under the guidance of the Army's Director for Information Systems for Command, Control, Communications, and Computers so it fully complies with the Army Technical Architecture and the Common Operating Environment. It also will be coordinated with all other programs working on related initiatives, including—

• TRADOC military occupational specialty consolidation.

• Division and corps redesign.

• Ordnance Corps Vision XXI and development of maintenance doctrines.

• The Army Digitization Office's future digitization architecture.

• Army Vision 2010.

• Programs of the Program Executive Officer for Standard Army Management Information Systems.

• GCSS–Army.

• Force XXI Battle Command, Brigade and Below (FBCB2).

• The Tactical Internet (TI).

Coordination Efforts

The ADIP will be executed in coordination with weapon system developments, upgrades, modifications, and improvements. Input will be provided through coordination with weapon system PM offices. The PM TMDE is a technology center for embedded diagnostics and will guide and assist in the development and implementation of embedded diagnostics. A series of IPT meetings has been conducted since the inception of ADIP that has included participation by many PM offices, Department of the Army Staff, TRADOC, CASCOM, LIA, and others. These IPT's will continue as a means of jointly developing the program. In addition, PM TMDE representatives will participate on IPT's of weapon systems to assist in developing and integrating embedded diagnostics.

PM TMDE maintains an ADIP web page at http://armyhti.sed.redstone.army.mil. This page contains the latest ADIP Master Plan and numerous briefings and other presentations that have been developed in support of the program. The web page is regularly updated with new information. **ALOG**

Colonel Albert J. Hamilton is the Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE). He was assisted in the writing of this article by Steve Martin, who is a system staff engineer in the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition; Pat Stevens, who is a project engineer at PM TMDE; and Jack Conway of Analytical Services, Inc.

Keeping Track Of Your Shipments Using Automatic Identification Technology

by Sergeant First Class Angel L. Luciano Gonzalez and Hans Hollister

According to a September 1992 General Accounting Office report, $2.7 billion worth of spare parts went unused during Operation Desert Storm. The Army estimated that if an effective method of tracking the location and content of cargo containers had existed, the Department of Defense (DOD) would have saved approximately $2 billion. This led to the development of a standard automated system that would provide in-transit visibility to support worldwide operations; hence, automatic identification technology (AIT) was implemented.

AIT Components

The objective of AIT is to provide a common view of total asset visibility (TAV) with minimal human intervention. AIT encompasses the radio frequency (RF) tag, the optical memory card (OMC), the Defense Transportation Reporting and Control System (DTRACS), and the smart card.

Radio frequency tag. The RF tag is used to gain TAV over supplies and equipment moving through the transportation pipeline. Once the shipment information is loaded, the tag is placed on the shipping container. The information loaded onto the tag includes, among other things, the container number, the transportation control number (TCN) or document number, the unit identification code and name of the receiving unit, and the national stock number (NSN), quantity, and a brief description of each item in the container.

☐ An RF tag containing information about the container and its contents is attached to each container before it is shipped.

Optical memory card. Both the theater distribution centers (TDC's) and the Kaiserslautern Industrial Center (KIC) of the 21st Theater Army Area Command (TAACOM) use the OMC to store shipment data. Distribution centers equipped with the Automated Manifest System (AMS) store shipment data on the OMC during the process called "burning the RF tag." Burning the RF tag is simply embedding the shipment data into the OMC and the RF tag by using an interrogator or an RF tag docking station. Once the supply support activity receives the shipment, users upload the data into their Standard Army Retail Supply System computers and quickly process the shipment for distribution to their customers.

Defense Transportation Reporting and Control System. The 37th Transportation Command (part of the 21st TAACOM) successfully uses DTRACS to track its convoys. The system provides the commander with vehicle visibility and communications between the dispatcher and driver. Using satellite telemetry, dispatchers and movement control personnel can locate their vehicles on a digital map in near-real-time and, as necessary, divert convoys to new locations. DTRACS also has proven itself to be an effective tool in movement control operations by providing feedback on road conditions, accidents, and local political demonstrations, thereby allowing alternate routes to be used.

Smart card. The smart card, originally known as the MARC (multitechnology access reader) card, is a personal information carrier that provides the user instant access to soldier readiness data. In redeployment of the 2d Armored Cavalry Regiment from Bosnia to Fort Polk, Louisiana, the data received from the unit's S1 section were verified against a data base on compact disk from the Defense Manpower Data Center and loaded into 2,400 smart cards. This part of the process was completed in only 1 day. Once verified, the smart cards were used throughout every phase of the unit move scenario to keep track of the individual soldiers. It provided the user with the tools to complete in hours tasks that once took weeks.

□ **The Automated Manifest System is used to enter data onto the optical memory card.**

How AIT Works

RF interrogators are installed at border crossings, railheads, bridges, and base camps in the European theater. These are known as "choke" sites. As the RF tag passes by an RF interrogator, all the shipment information contained on the RF tag is collected and sent to the RF retriever. Once received by the RF retriever, this information is transmitted to the in-transit visibility (ITV) server located in Mannheim, Germany. By accessing the ITV server, the supply service activities' operators and item managers are able to track and locate their shipments.

During support of Operation Joint Endeavor, U.S. Army, Europe (USAREUR), used AIT to command and control over 1,000 miles of supply convoy routes to Hungary, Croatia, and Bosnia-Herzegovina. Since then,

TAG = 30853

LICENSE PLATE

LEAD TCN: SW31238098D667XXX **CONTAINER**: QL667

POE: DOV **POD**: TZL

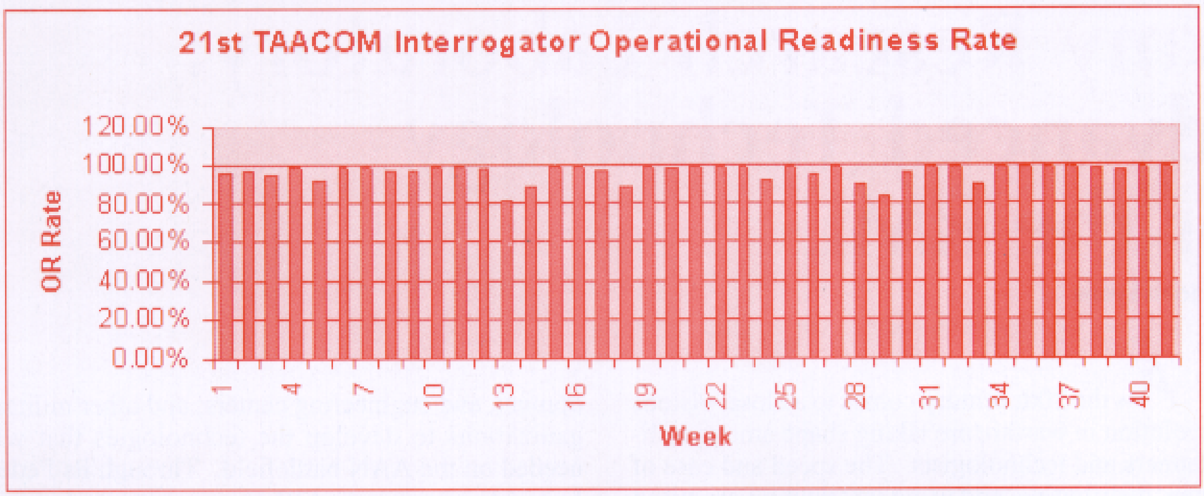
CONSIGNEE: WK4GEY **CONSIGNOR**: SW3123

HAZMAT: X TP: 1G

FREE TEXT: WGT 08805 CUBE 0462

EVENTS DTG	SITE	EVENT STATUS
16-APR-98 13:50:00	GUARDIAN BASE TSO GATE BH	CHOKE
16-APR-98 13:20:00	GUARDIAN BASE TSO GATE BH	CHOKE
16-APR-98 08:20:00	GUARDIAN BASE MAIN GATE BH	CHOKE
16-APR-98 07:57:00	2D LSB ATMTC/H-159 TUZLA	CHOKE
11-APR-98 20:05:00	RAMSTEIN HOLDING YARD	CHOKE
11-APR-98 01:09:00	DOVER DEPARTURE/ARRIVAL APRON	CHOKE
09-APR-98 12:10:00	DOVER TRUCK ARRIVAL DOCK	CHOKE
08-APR-98 16:48:00	NEW CUMBERLAND DDSP GATE	CHOKE
08-APR-98 09:32:01	NEW CUMBERLAND AMS BURN -	SUSQUE WRITE

□ **Data obtained through the Internet indicate pertinent container identifying information and the date and time that the container passed each interrogator site, from the time the information was embedded into the RF tag to the time of the report.**



☐ **The OR rate for 21st TAACOM for a recent 40-week period was nearly 97 percent.**

the original number of "choke" sites has grown from 7 to 96 to support USAREUR. Nineteen of these sites provide the visibility of assets throughout the theater.

Automated Manifest System

The KIC and the TDC's write information about shipments onto the RF tags using the AMS illustrated below. The mission of the TDC is to receive, sort, and redistribute classes II, III (packaged), IV, VII and IX items to over 90 DOD customers throughout the U. S. European Command area of responsibility, while providing quality, unparalleled customer satisfaction, and dependable, on-time logistics service. The mission of the KIC is to provide theater-level general and direct support, supply, and maintenance to units throughout the theater; reception, staging, onward movement, and integration support; support to contingency operations; and defense of its assigned area of responsibility. AMS is a fully integrated AIT platform consisting of the OMC, RF tag, and bar code-scanning capabilities.

Internet Access

The USAREUR regional ITV/RF query data base may be accessed through the Internet. This data base enables operators to gain visibility of their shipments by using any of the following key data elements: TCN or document number, NSN, RF tag number, or the container/pallet number. Below are some examples of the information provided by the ITV/RF query data base.

21st TAACOM's Trend

With the theater infrastructure increasing so rapidly, senior theater logisticians saw the need to know the reliability of all RF interrogators located throughout the theater. In response, the USAREUR Logistics Automation Division in the office of the Deputy Chief of Staff for Logistics (DCSLOG) developed an operational readiness (OR) report that lets the senior theater logisticians know which systems are up or down on a daily, weekly, and monthly basis. Reasons for systems down time are included in the report. Since the first OR report on 23 October 1997, the OR rate, which was originally 82 percent, now meets the USAREUR DCSLOG standard of 95 percent.

AIT provides visibility of "what's in the box and where it is," as well as TAV for support transactions throughout the theater. This system provides a level of visibility never before experienced by logistics managers. **ALOG**

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Hans Hollister works for System Resources Corporation as the project manager for Automatic Identification Technology.

Army Research Laboratory: Advanced Technology for the RML

by Dr. John Lyons

As the 20th century comes to a close, visions of a revolution in warfare are taking shape among military planners and technologists. The speed and ease of gathering, distributing, and using information promised by the digital battlefield have created unprecedented possibilities for providing and sharing accurate and detailed knowledge about battlefield events as they happen. Rapidly advancing technology, coupled with the end of the Cold War and other events of the late 20th century, have resulted in a changing Army with new roles and missions that are being addressed by Joint Vision 2010 and the Army After Next (AAN). That Army will be a smaller, lighter, full-spectrum force that can perform missions across the entire range of operations effectively on very short notice. Such a force must be able to get to its mission site quickly with what it needs to do the job.

The Army realizes that its logistics system must function differently in the 21st century environment. Bold changes must be made because the speed of future battlefield operations will not permit us to rely on a long, slow logistics tail. The same technologies being developed to digitize the battlefield also will integrate logistics as part of the force as never before. Real-time situational understanding of combat requirements and logistics capabilities, combined with the embedded decision support systems that orchestrate those capabilities, will transform the current supply-based system into a focused, distribution-based system. The 21st century logistician will be able to think in terms of hours rather than days when planning logistics support and will be able to supply the force with what it needs when it needs it.

The Army Research Laboratory (ARL) has played a vital role in developing logistics technologies in the past and is in a position to play an even larger part in the coming Revolution in Military Logistics (RML). ARL's mission is to provide the Army with the key technologies and analytical support needed to ensure supremacy in future land warfare. Its basic research program is the driving force in reaching the Army's long-term warfighting goals.

To that end, ARL works with the Army Materiel Command's subordinate commands; research, development, and engineering centers; and other military organizations to develop the technologies that will be needed on the AAN battlefield. Through its Federated Laboratory concept, ARL's scientists and engineers work with outside researchers from industry and the academic world to take advantage of the private sector's dominance in the development of microelectronics and digital communications. ARL works closely with the Army Training and Doctrine Command to develop the Army's future requirements and the doctrine that will allow the AAN to apply evolving technical capabilities to the battlefield. ARL maintains centers of excellence in several technological areas through agreements with a number of universities. Finally, ARL scientists and engineers are collocated at two National Aeronautics and Space Administration (NASA) research centers, where they perform joint research in the areas of vehicle propulsion and structures.

With programs in the information sciences, sensors, human engineering, weapons, materials, vehicle propulsion, computing, and analysis, ARL has an important role in the RML. Basic research in these areas will provide the underpinnings for the AAN and will address the challenge in two ways: make the process more efficient, and reduce demand for logistics support. The latter includes lighter, durable, and more fuel-efficient systems; smarter, more accurate munitions; improved power sources; and more efficient maintenance techniques. Here is a brief look at some technologies ARL is working on that will benefit logistics.

Information Science and Technology

ARL's integrated battlefield visualization and information processing research program will enhance situational awareness by providing the commander with the ability to visualize battlefield terrain, atmospheric conditions, information from sensors, and deployment of military units. Researchers are working on advanced processing and collaborative technologies that will be able to sort through the tremendous amount of information gathered from the battlefield and make the right information available rapidly to commanders and staffs. This will include terrain, target, and weather data as well as logistics information and evolving and recently stored information on battlefield events. This technology will allow commanders and staffs to collaborate and to benefit from knowledge provided not only from within the tactical operations center but from other experts at dispersed locations. And they will gain this knowledge at AAN speeds that enhance their ability to adapt to ever-changing battlefield situations.

On the battlefield, soldiers will need to exchange a huge volume of information over a constrained communications network. Information distribution technology will maximize combat network radio throughput by exchanging data in their most general form, sending only necessary data, and exchanging those data efficiently. ARL is developing algorithms and model-based techniques to smooth and regulate the flow of information.

Artificial intelligence programs show great promise for helping the future logistician. ARL, in collaboration with the Army Ordnance Center and School, has already developed and introduced the Tank Engine Diagnostic (TED) program. TED is a diagnostic expert system designed to help M1 Abrams tank mechanics find and fix problems in the tank's turbine engine. It can not only diagnose system faults but also order spare parts, provide instructions on how to perform required repairs, perform tests to ensure that repairs correct the problem, maintain maintenance records, and provide an on-line tutorial on engine maintenance procedures. The system is being transitioned to the Army Armament Research, Development, and Engineering Center, where it will continue to be enhanced.

ARL has developed prototypes of the Forward Area Language Converter (FALCon), which lets a user with no foreign language training convert a foreign language document into an approximate English translation. With FALCon, U.S. forces can assess the military significance of documents captured in the field and decide whether or not to pass them to a linguist for full translation and analysis. Several prototype FALCon systems have been used in Bosnia since May 1997 to help V Corps intelligence and special operations forces evaluate documents written in Serbian or Croatian. Other languages FALCon can handle include French, Italian, Spanish, and German. There are plans to downsize FALCon, perhaps to the point where it could be worn by a soldier. Work also is underway to integrate into FALCon the Navy's Multi-Lingual Interview System, a voice-operated dialog assistant that relies on phrases tailored for specific functions like medical care, mine clearing, or force protection.

Sensors and Electronics

ARL is developing acoustic sensors and other low-cost battlefield sensor technologies that can provide significant new capabilities, such as non-line-of-sight target detection for individual soldiers and passive targeting sensors for various munitions. These technologies show promise as a means of helping to reduce the cost of battlefield sensing.

Research in acoustic physiological sensing is yielding advances in detecting heartbeats, breath rates, and other physiological indicators of a soldier's performance and condition on the battlefield. ARL is continuing to pursue leading-edge research in global positioning systems support for munitions through the Low-Cost Competent Munitions and the Guided Multiple Launch Rocket System programs.

Also under development are sensors for the individual soldier that will consume significantly less power, as well as technologies that will make large system sensors available in smaller packages. These sensors work with hardware and algorithm applications that can be structured to stop processing when they receive a result that is good enough, thus making smaller hardware and lower power requirements possible.

The development of improved energy storage components for command, control, communications, computers, and intelligence; smart munitions; and Army vehicles remains a high priority. ARL has supported the development of high-performance rechargeable batteries for communications applications by identifying candidate low-temperature organic electrolytes. New high-voltage electrolytes were developed for electrochemical capacitors to potentially double their energy density, making them useful for assisted engine starting, electric drive vehicles, and burst communications.

Human Engineering

Human engineering researchers at ARL have a long and productive history of developing and demonstrating advanced technologies that provide new and productive capabilities to Army logisticians. Over the years, these efforts have included prototyping the first forward area ammunition supply vehicle as well as exploring and demonstrating the application of robotics technology to combat service support operations. ARL built and demonstrated the world's largest prototype materiel-handling robot and conducted a 2-year, comprehensive human performance review of the Army class IX (repair parts) system for the Deputy Chief of Staff for Logistics. ARL provided leadership for the first automated interface for transferring tank ammunition from a resupply vehicle to a tank and also helped to focus efforts on modernizing the ammunition supply system. Human engineering researchers developed the first logistics decision-support tool to include artificial intelligence planning technologies; led the technical development efforts on the Total Distribution Advanced Technical Demonstration and the Joint Logistics Advanced Concept Technical Demonstration; fielded and supported more than 20 logistics anchor desks (LAD's) to three commanders in chief (CINC's); and, using the LAD, provided significantly increased operational capability during Operation Joint Endeavor in Bosnia.

Currently, human engineering researchers are investigating ways of harnessing the rapid growth in data visualization technologies to create departmental logistics situational awareness and decision support applications. They also are looking at ways of applying cognitive systems engineering to influence the design of coordination tools in order to increase staff productivity and measure the effect of automated coordination technologies on logistics business processes. And researchers are expanding MANPRINT (manpower integration) tools to model and predict logistics unit effectiveness and adapting commercial-site operations software to provide decision support for setting up and operating logistics sites.

Materials and Weapons

ARL's ongoing research in advanced materials and weapons is generating several technologies that will reduce logistics burdens in future deployments. Lightweight armor systems are one example. ARL's terminal effects experts and materials scientists are collaborating to develop high mass-efficiency, multifunctional, passive armors, such as composite integrated structural armor and encapsulated ceramic armor, and novel active and energetic armor systems, such as active protection and smart armor. These armor technologies will support the development of ground vehicles that are significantly lighter than current systems while maintaining or enhancing protection.

ARL's advanced weapons concepts team is supporting the development of an ultralight towed howitzer that will provide fire support to airborne and other rapid-deployment forces. ARL scientists also are developing new munitions technologies that, when coupled with lightweight, high-performance materials such as organic-matrix composites and titanium alloy, will result in lightweight weapons and munitions that have improved accuracy. The composite 155-millimeter artillery shell, the lightweight 81-millimeter mortar system, and the low-cost, improved accuracy 2.75-inch rocket technology development programs all are designed to support Army light forces at reduced system weights and with reduced ammunition supplies.

Vehicle Structures and Propulsion

ARL's wave rotor technology has the potential to increase the power and fuel efficiency of gas turbine engines significantly while operating within current limitations on material temperatures. The performance enhancements will have far-reaching implications on battlefield logistics in the AAN. ARL has teamed with the NASA Lewis Research Center in Cleveland, Ohio, to advance this very promising technology.

Wave rotor technology accomplishes the thermodynamic processes performed by compressors and turbines, but without the encumbrance of mechanical parts. Other wave rotor benefits include efficient performance at low rotor speeds (four to five times slower than modern compressors) and the improved dynamic stability of the engine compression system. Recently completed engine-cycle analyses show that wave rotor topping will decrease the specific fuel consumption of a turboshaft helicopter engine by 22 percent while increasing its specific power by 15 percent. More impressively, this performance enhancement is maintained as the engine shifts between full power and idle, which translates directly into substantial fuel savings.

ARL and the Lewis Research Center are engaged in a cooperative effort to develop unique gas turbine engine concept called the semiclosed cycle, compact turbine engine. This concept features a closed-loop and an open-loop gas turbine cycle operating in parallel, with recuperation taking place in the high-pressure, closed-loop portion of the cycle, along with reburning of a significant portion of the exhaust. Engines based on this concept are expected to be half the weight and volume of conventional recuperated engines but will maintain low fuel consumption. Other advantages include reduced inlet and exhaust flow (meaning a reduced signature on the battlefield) and low levels of pollutants.

ARL has a cooperative program with Bell Helicopter Textron that seeks to reduce maintenance downtime and extend the service life of rotorcraft. The objective of the program is to increase the certainty and timeliness of crack detection in critical components by using diagnostic programs developed in-house and elsewhere. Full success will result in a 50-percent decrease in crack-detection thresholds. This will extend useful flight times and reduce unneeded maintenance.

These are some of the Army Research Laboratory's projects that will improve logistics for the AAN. By developing and inserting the latest technology across the board, our changing Army will be provided with the support it needs to succeed in any contingency. **ALOG**

Dr. John Lyons is the Director of the Army Research Laboratory, Adelphi, Maryland.

RAPID FORCE PROJECTION

Acquisition and Logistics for the Army After Next

by Lieutenant Colonel Allen Forte

Changes in the acquisition process are needed to support the logistics requirements of the Army After Next and the concept for deploying critical technologies in the future.

Army After Next (AAN) is our Army's effort to reshape its forces to deal with the missions and threats of 2025 and beyond. Through wargaming and experimentation, the Army will identify the factors that will be most important for the future of warfare. AAN will not define specific systems or force organizations. Rather, it will point toward critical future technologies and new operational concepts that likely will be the most successful.

The wargames conducted to date have started to define an outline for the AAN battle force, the element of the future force that will use advanced technology, tactics, and doctrine to revolutionize the way the Army deploys and swiftly establishes dominance in any theater of operations. The findings point to mobility and speed of maneuver as the most important factors contributing to battlefield success in 2025.

The AAN battle force will need to be extremely maneuverable, capable of deploying directly from the continental United States (CONUS) onto the battlefield, and capable of using terrain for advantage in tactical engagements while relying on air mobility to move across the battlefield. Maintaining dominance in maneuver, lethality, and information will require a battle force that fights in three dimensions reaching into the atmosphere and space. That force will need a robust and seamless command, control, communications, computer, intelligence, sensors, and reconnaissance (C4ISR) systems network to keep its units linked and aware and to keep its actions coordinated. The force also will require precision weapons and long-range firepower to mass effects at the point of decision.

That emerging picture of the AAN battle force presents some significant challenges for the acquisition and logistics communities. In the AAN spring wargame, held at the Army War College in April 1998, players tested logistics issues involved in supporting the AAN force. They identified four critical factors that must be addressed for AAN to succeed—

- Streamline and speed force closure.
- Lighten the force.
- Reduce fuel and energy consumption.
- Provide for soldier support.

Streamline and Speed Force Closure

Force closure for AAN forces is complicated by the fact that, in 2025, the Army still will use large numbers of Army XXI and legacy forces that are harder to deploy and have very large support requirements. AAN forces will require the support of follow-on Army XXI forces to secure areas cleared of enemy troops. To support the total force of the future, the Army must ensure that there are sufficient deployment platforms available to transport both AAN and Army XXI forces. The AAN forces will need to use these platforms for tactical mobility in theater, but the rest of the force will have a competing need to mobilize in support of the AAN force. For these older forces that will not be self-deployable, the Army must look at the possibility of establishing intermediate staging bases and must find ways to enhance force deployability.

Lighten the Force

Strategic lift issues highlight the need to lighten the force to make it more transportable. That need applies not only to reducing the weight of individual platforms but also to lightening the support structure by reducing required personnel and supplies. A lighter logistics burden must be designed into new systems from the start.

Two major contributors to system weight are fuel and ammunition. Eighty percent of Army transportation assets currently are dedicated to moving those commodities. As a result, efforts to reduce these burdens are critical. Additionally, the Army must work to make its systems "ultra-reliable" in order to reduce the level of support needed in theater. Systems that can operate longer in a combat environment and easily perform forward repair will reduce the amount of support forces and equipment needed in theater.

Reduce Fuel and Energy Consumption

Reduced fuel and energy consumption rates are critical for AAN forces. The concept of operations for AAN combines rapid, long-distance maneuver with a large sensor and communications network. Such a force will be very energy intensive. The Army therefore must find ways to make its systems more energy efficient to reduce weight and extend performance. Given the likelihood of increased fossil-fuel costs in 2025, the Army should look to alternative fuels to power future systems.

Provide for Soldier Support

The final issue is soldier support. Items like mail, pay, and special holiday meals still will need to reach the soldier regardless of how AAN forces operate. The logistics burden associated with these important items will not disappear and must be accounted for in the design of the new force. Further, AAN forces operating far from support bases will require organic capabilities to deal with casualties (both medical care and body retrieval), enemy prisoners of war and refugees, and the religious needs of the troops. While these latter concerns are partially organizational matters, their impact on logistics also must be addressed.

Army Acquisition Today

Responding to the bold vision of AAN is no small task, but the Army acquisition community already is actively pursuing measures to address many aspects of that challenge. There are several ongoing efforts to reform our acquisition process and procedures, and many address AAN priorities.

Just as the Army in 2025 will be composed of upgraded elements of the force currently in the field and in development, as well as the new, advanced systems, so the Army's efforts to reduce costs and the logistics burden must address each of those elements. Among the efforts affecting our current systems are the Modernization Through Spares program and the Operations and Support Cost Reduction program. These programs and others like them make use of both new and existing technology to reduce sustainment costs as existing components and parts are replaced with superior ones.

The acquisition community also has undertaken several efforts that address the acquisition of systems currently in development and those planned for the future. As part of the Army's effort to control the burgeoning costs of advanced systems, program managers have been asked to assume responsibility for the total life-cycle costs of their programs. Therefore, as they make tradeoffs for cost and capability, program managers must take into account issues related to every part of a program's life, from the research and development phase through production and fielding to the sustainment phase. Among those many variables, logistics issues and constraints figure prominently.

Another example of the acquisition community's response would be adopting the concept of spiral development. In that process, one-time development efforts, ending with a full operational test, are abandoned in favor of a more flexible, iterative process of design, test, and redesign. Still other efforts, such as Prime Vendor Support, are aimed at contracting life-cycle support to a single vendor in order to consolidate responsibilities and generate savings.

Another forward-thinking program that will have far-reaching impacts on both our current programs (major modifications and programs in development) and our AAN systems is the Horizontal Technology Integration (HTI) program, which integrates common technology into multiple platforms. Using common components, subsystems, and even single parts can produce savings in several areas. Those savings begin with sharing of the "overhead" costs of development, rather than pursuing partially or wholly redundant separate development efforts on a given technology. By aggregating the demand for a given commodity from multiple platforms through a single Army agency, our bargaining position with industry is improved. The Army saves again by purchasing larger numbers of a given item, driving the item's price down.

The biggest savings stemming from the use of common parts comes after a platform or system is fielded. The more common parts are used, the fewer varieties of parts must be stocked, tracked, and managed in the sustainment phase of a program's life cycle. That saves dollars. Moreover, the greater the commonality in hardware, the greater will be the potential for commonality in software, again providing a savings to the Army.

There also are benefits to the soldier in training and in maintaining the materiel he uses. By using standardization and common components, training is simplified and therefore less expensive. Soldiers become more versatile, as training for one system can prepare them to use others. The same is true for the men and women who maintain our systems. Fewer parts and less variation make systems easier to diagnose and repair. The less time our platforms spend in repair, the more valuable they are to the soldier in the field.

Army Acquisition Tomorrow

As successful as our acquisition reform efforts have been, it is clear that they alone will not be enough to make the AAN battle force a reality. There are two main constraints on the effort to acquire such a force: budget and logistics. We must push forward with our efforts and identify additional initiatives that will take us the rest of the way.

The realities of the geopolitical and fiscal environments imply that, barring significant shifts, the research, development, and acquisition budget probably will not increase to help pay for these new systems. It also is true that highly advanced AAN systems will be more expensive to develop and acquire than those in the current force or under development. Therefore, the Army must not create an AAN force composed of one-for-one follow-ons or replacements for platforms currently in the field, or even those of the near future. The Army simply cannot afford such a force.

The second critical constraint is logistics. The requirements for deploying and sustaining our forces continue to limit their ability to respond to crisis. A major portion of our current logistics effort is spent on transportation of fuel and ammunition alone. The AAN operational concept dictates that the speed of initial deployment will eliminate the need to use staging areas or intermediate logistics points. In some cases, forces will deploy directly into a tactical environment. Therefore, the AAN force must be light, mobile, and capable of extended operations with limited support and resupply. Platforms and systems that need little maintenance and are able to interchange and repair systems in the field will help to achieve that capability. For these reasons, the logistics aspect of design is critical to the success of the AAN effort.

There are two efforts that the acquisition community could pursue in conjunction with the rest of the Army to solve the logistics challenges of AAN and to make the new force affordable. The first is to establish concrete targets and goals for acquisition to reduce the logistics burden. The second is to take a new approach to acquisition that demands modularity, commonality, and an open architecture for all AAN systems. These efforts can mean the difference between success and failure under the constraints we have identified.

Acquisition Goals for Logistics

First, the Army needs to set specific goals for reducing the weight of systems and their support tail, for reducing fuel and power consumption, and for achieving ultra-reliability. Establishing realistic targets in these three areas, and ensuring that AAN platforms conform to them, will go a long way toward mitigating the logistics issues identified in the AAN spring wargame.

Reducing the weight of the force can be accomplished in two ways: by reducing the weight of individual platforms, and by reducing the total size of the force and associated support that must be deployed. The Army should establish maximum weight limits for AAN platforms to ensure that they can achieve the tremendous scope of maneuverability envisioned for the AAN battle force. Examples might include ground vehicles weighing not more than 20 tons when combat-loaded and air vehicles that are self-deployable with their associated ground vehicles. Ammunition weight also must be reduced. New materials and multifunctional subsystems can help to reach these goals. Similarly, a weight limit established for the whole force would allow for design trade-offs between platforms to address logistics concerns.

Goals for reducing fuel consumption should include both targets for fuel efficiency and targets for eliminating fossil-fuel usage on AAN platforms. Possible goals could include mandating 100 to 200 percent improvement in platform fuel efficiency for next-generation systems, establishing a maximum percentage for fuel as a component of total platform weight, and requiring new systems to examine alternatives to fossil fuels as their first option for a power source.

Targets for reducing the total power needs of a system are of equal importance. The power demands (both for functioning and cooling) of C4ISR systems are a major challenge confronting many platform program managers. The C4ISR systems envisioned for AAN will place an even greater burden on platforms if steps are not taken now to reduce power requirements. AAN platforms could be required to use multifunction displays and multifunction sensor suites to reduce duplicative components that contribute to the power load. Use of automated power management technology to shift power away from idle subsystems to those in active use can reduce overall requirements further.

The final area where concrete goals are needed is system and platform reliability. The logistics community already has identified ultrareliability as a critical component for the AAN battle force. The acquisition community must find ways to make it a reality. That effort can start with improving mean-time-between-failures goals (on the order of 100 to 200 percent) for all systems. That would pay real operational dividends for a force expected to function far from traditional support for extended periods.

To make these goals attainable, the Army must commit investment and personnel resources to research into the appropriate underlying technologies. Just as priority for Force XXI has been given to key information technologies that provide our forces with mental agility, AAN offers an opportunity to provide our soldiers with reliable weapon systems and transportation platforms; that will give them the physical agility to take maximum advantage of information dominance.

HTI From the Start

To meet the ambitious goals set out in the AAN concepts of operation developed by the Army Training and Doctrine Command (TRADOC), the Army must change the kinds of systems it will acquire in the future. To field a force composed of small, hard-hitting, fast-moving units, the Army must acquire lighter, faster, more mobile, more lethal systems that need less support in deployment. To do that, the Army must make "HTI from the beginning" its approach for acquiring AAN systems.

This would be quite a step forward from trying to take horizontal advantage of new technologies on existing platforms, as the Army actively encourages now. Designing the entire AAN force at the same time, with commonality and modularity as the guiding principles, gives the Army the opportunity to make trade-offs across the force and to acquire AAN systems as affordably as possible. TRADOC must further their principles of horizontal requirements integration to enable their partners in the science and technology and acquisition communities to respond.

Such an approach must be based on a concept of building integrated forces, not individual platforms or subsystems. By introducing commonality to a greater extent than ever before, we can achieve success and stay within the tight bounds of our budget and logistics constraints. This approach, along with making tough decisions about the few systems we will be able to acquire, is our best chance to meet the weight and power targets needed for the AAN to function as envisioned. This unprecedented level of integration is new territory for the Army and will require a great deal of work and cooperation in the years ahead if we are to achieve our goals for AAN. But it will be a wise investment, providing tremendous savings and cost reductions in the life-cycle costs of a technologically advanced AAN force.

Pursuing HTI from the earliest development stages of the AAN battle force could mean fewer types of platforms, weapons, and sensors, thus creating a modular force. For example, it may be possible to develop only one new antitank missile for use by dismounted infantry and by vehicles, or a single, integrated combat system consisting of a ground vehicle to engage the enemy and an air vehicle to transport it and give it fire support. The platforms themselves could be modular, capable of being reconfigured to use a mix of weapons and sensors depending on mission needs. Multifunctional and multirole systems and platforms are critical if an AAN battle force is to be affordable.

The Road Ahead

There will be many challenges ahead in reaching our AAN goals. Acquiring the AAN represents a totally new requirement for a system designed to acquire a different kind of force structure. Our current management structure and patterns of communication may no longer be the most effective for developing the required capabilities. Consequently, it may become necessary to examine new organizational structures that better address changing acquisition priorities.

Our established division of labor by battlefield operating systems might need to be superseded by a more integrated approach, such as a program executive officer-level organization capable of combining responsibility for issues concerning all levels of combat operations, logistics, information, and personnel and training. Such an organization would be uniquely positioned to oversee the development of a whole force and to ensure that key standards, from open architecture to maximum horizontal commonality, are fully embraced.

Because of the AAN's need to operate independently in the field, and because that force will have to be totally integrated to move, shoot, and communicate effectively on the battlefield, it must be developed as a whole. From a management perspective, it follows that AAN battle force systems should be managed by a single organization. The Program Executive Officer (PEO) for Command, Control, and Communications manages all of the pieces of the Army Battle Command System, including digitization. Similarly, a PEO for the Battle Force, or PEO AAN, would bring together the management of what have been considered separate and independent elements into a single management package, thereby unifying both the authority and the responsibility for its successful execution.

As has been mentioned earlier, this is no easy task. We can be successful only if all of the Army contributes. No one organization can make it happen by itself. Further, such changes may not be possible all at once. What is clear, however, is that the Army must make quantum strides in bringing the requirements, technology, acquisition, and logistics communities closer together if we are to produce the platforms and systems needed to make AAN a reality for our soldiers on tomorrow's battlefield. **ALOG**

Lieutenant Colonel Allen Forte is the lead coordinator for Horizontal Technology Integration and director for future operations in the Office of Systems Integration in the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition. He thanks Andrew P. Stifel and Joseph M. Kelly, Jr., for their help in writing this article.

Advanced Intratheater Airlift

by Mark J. O'Konski and David Payne

Army XXI is a power projection force delivering to the warfighting commander in chief the dominant maneuver capability called for in Joint Vision 2010. This capability, in turn, depends on agile focused logistics provided by the dynamic distribution-based system that is key to the Revolution in Military Logistics (RML). This article describes the challenge presented by the dominant maneuver of powerful land-power strike forces and their subsequent sustainment through distribution-based, focused logistics. The Army must reach deep, move fast, and sustain on the run, and this demands an efficient, capable, projectable, and maneuverable intermodal distribution system. Aviation is a key component of modern intermodal distribution systems, and the need for advanced intratheater air transport is critical. But the Army faces the risk of experiencing a shortfall in both the quantity and capability of projected air assets for the first two decades of the 21st century.

An Evolution of Thought

As the dust of the Cold War settled, strategic thinkers considered the emerging dynamics of the post-Cold War world. Other futurists were contemplating the significance of the fledgling information age, the new technologies it brought, and the impact it would have on the global society and the global economy. As these two lines of thought converged, it became apparent that a Revolution in Military Affairs (RMA) was underway—a revolution that would transform the way wars are fought and won. Nations and armies that exploited the opportunities presented by the RMA would dominate the battlefields and crises of the next century, but those who ignored the RMA would fail famously. The Army, along with the rest of the Department of Defense, wasted no time in evaluating this promised revolution and began a series of studies and projects that have produced revolutionary new approaches to force design and employment.

The Army After Next (AAN) project produced intriguing and powerful operational concepts that called for self-mobile, air-mechanized battle forces to operate independently for a number of weeks hundreds of miles inside an opponent's territory. The Army logistics community articulated the RML vision to support these battle forces as well as to add economy and efficiency to the projection and support of the more numerous and more conventional forces of the digitized Army XXI.

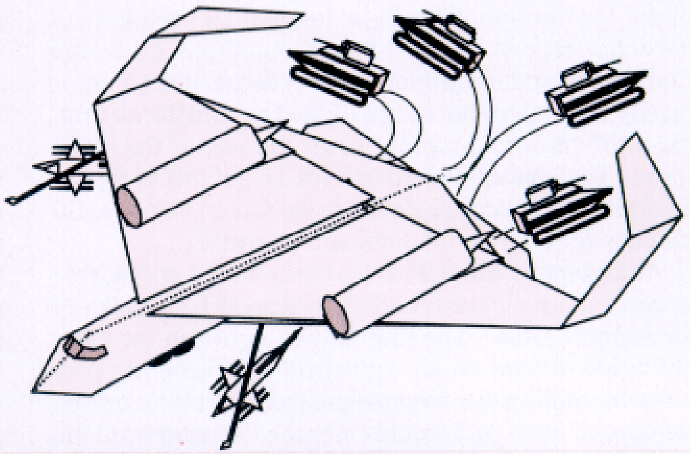
Operationally, these battle forces performed magnificently in war game after war game. The support concepts appeared to be effective and, for the most part, doable. The only devil was in a few of the technical details. Most troublesome was the inability of high-performance armored vehicles to operate without fuel resupply for weeks at a time. The RML support concepts proposed a dynamic, distribution-based logistics system that could be projected rapidly and operated efficiently to provide the widely distributed battle forces with uninterrupted fuel and ammunition supplies. However, the biggest concern and showstopper was the cost of this high-tech force package.

Strategic thinkers at the Army Training and Doctrine Command (TRADOC) and in the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition (SARDA), among others in the futures research community, are beginning to see an interesting opportunity. Much of the AAN battle force dominance can be achieved much sooner by leveraging the technologies and systems we have today or those that soon will emerge from the labs.

The Strike Force Concept

The strike force concept presented by TRADOC and refined by SARDA proposes to use tactical airlift to achieve an early form of dominant maneuver. The current concept is to use existing airlift technologies or those that will soon enter service, such as the C–130J transport. However, there may be great advantages to developing an intratheater airlifter that exploits current and emerging aviation technologies to increase theater airlift capabilities.

For comparison, imagine a mission that calls for a joint air-ground strike force to seize an airstrip 200 miles from the current friendly position and then calls for the strike force to conduct combat operations to capture or destroy opposing forces within a 50-mile radius of the airstrip. This scenario is representative of the high-end challenges of the early 21st century, combining the "need for speed" seen in Operation Just Cause with a significant armor threat, as seen in Operation Desert Storm. The airstrip is either an existing facility or terrain suitable for unimproved-field landings and takeoffs. The alternative airlift platforms are the C–130J, the CH–47 improved cargo helicopter (ICH), and a hypothetical state-of-the-art airlifter we'll call the C–2000.



☐ **C-2000 next generation intratheater airlifter**

Future Airlift Possibilities

The C–2000, as depicted at right, has several unique features that enhance its tactical airlift capability. It uses a blended wing-body design and a C-wing configuration with overblown wings to further enhance short takeoff performance. The blended wing-body would provide a wider cargo bay to support simultaneous parallel loading and unloading of four 15-ton light armored vehicles. This would allow the four vehicles to roll off the aircraft within a minute of landing. Two RAH–66 Comanche recon-attack helicopters would be carried as under-wing loads on the lead C–2000's. These lead aircraft also would carry a small number of another theorized system—a two-soldier, 10-ton ground fighter, used along with the Comanches to seize and hold the airstrip long enough for the full insertion of the strike force. These teams then would move into a force reconnaissance and security role. Tactical air support fighters and gunship versions of the C–2000 also would support the joint strike force, and together they could initially suppress opposition at the target airstrip and the immediate vicinity.

For comparison (see chart below), a C–130J would carry the Comanches internally, which could cause an unacceptable time delay at the target. The Comanches could fly to the objective on their own, but this would require refueling in the target area. They also would complicate strike timing since they are slower than the C–130's. Both of these alternatives incur a possibly unacceptable time delay. In the case of the CH–47 ICH option, Comanches and other helicopters would fly out with CH–47 ICH. They would need to refuel at the objective, which may not be supportable tactically. Comparative air-ground strike force performance of each aircraft option is shown in the table below.

To complete the scenario, the lead C–2000 airlifters would carry two Comanches under the wing along with four ground fighter vehicles. This leaves some unused lift capacity that could enhance slightly the performance

Payload Systems Per Aircraft Per Strike Brigade							
Weapons System	Qty Rqd	CH-47 ICH		C-130J		C-2000	
		Per A/C	Sorties	Per A/C	Sorties	Per A/C	Sorties
RAH-66	8	1	8	4	2	2	4
Grd Fighter	16	2	8	2	8	4	4
Scout Veh	20	1	20	2	10	4	5
Carrier Veh	20	1	20	2	10	4	5
Fire Spt Veh	4	0.5	8	2	2	4	1
MTV (w/d)	20	0.5	40	2	10	6	3.33
PLS (w/d)	20	0.25	80	1	20	2	10
TOTAL			184		62		32
A/C Comp. Sz.			92		31		16
Initial Time On Tgt (hrs)			2		1		0.5
Closure Time (hrs)			6		3		1.5
Resupply Time (hrs)			4		2		1

☐ **Comparison of the air-ground strike performance of three aircraft.**

of the lead assault aircraft, or it could be used to haul needed weapons or sustainment supplies. Once the Comanches and the ground fighters dominated approximately a 10-kilometer radius of land around the airstrip, the airlifters would rapidly insert the rest of the strike force. The concept would call for 16 aircraft to fly out en masse and insert the entire strike force in close to 30 minutes for a 200-mile dominant maneuver.

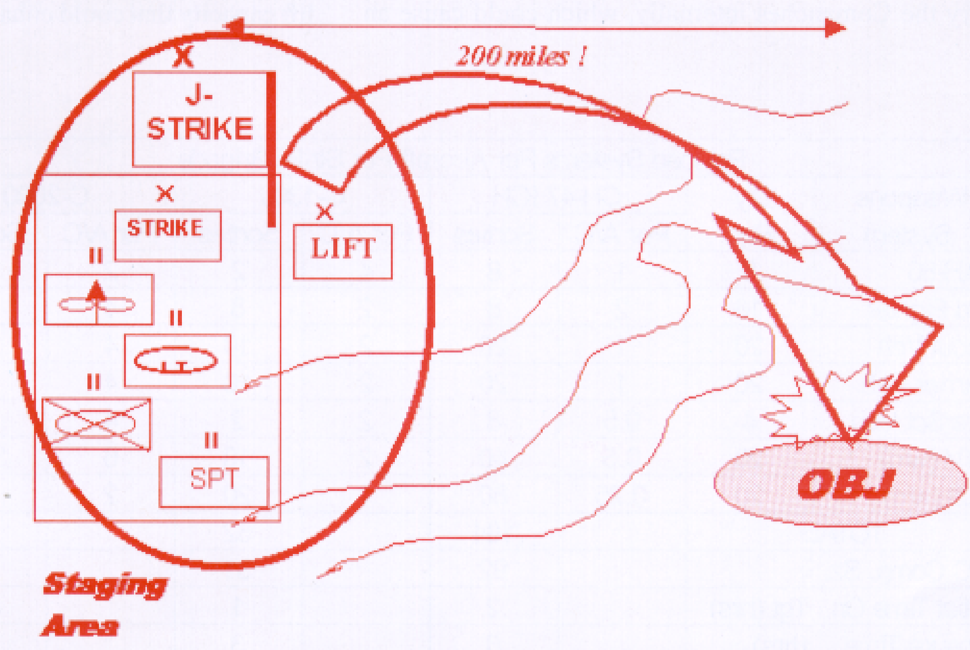
Additionally, the ICH helicopters would not be able to carry the palletized loading system (PLS) trucks of the support force. The PLS sorties shown in the chart are based instead on an equivalent lift capability provided by additional 5-ton medium tactical vehicle trucks. As shown, the ICH's would carry the Comanches to the objective area, thus conserving fuel for the attack helicopters. If the Comanches self-deployed, eight fewer ICH sorties would be required. Even so, it is clear that this 200-mile strike mission should not be conducted using ICH lift.

The greater speed and carrying capacity and the reduced unloading times proposed for the C–2000 allow it to close the strike force in half the time of a C–130J-equipped force. The limited items that the ICH could deliver take three times as long to close in the battle area. Time-on-target and closure time estimates shown on the chart are based on air speed and loading and unloading time of aircraft. The blended wing-body postulated for the C–2000 allows simultaneous loading or unloading of at least three vehicles, and assumes loading and unloading speed is part of C–2000 design. This shortens loading and unloading time to less than 10 minutes versus the 30 minutes assumed for the C–130J.

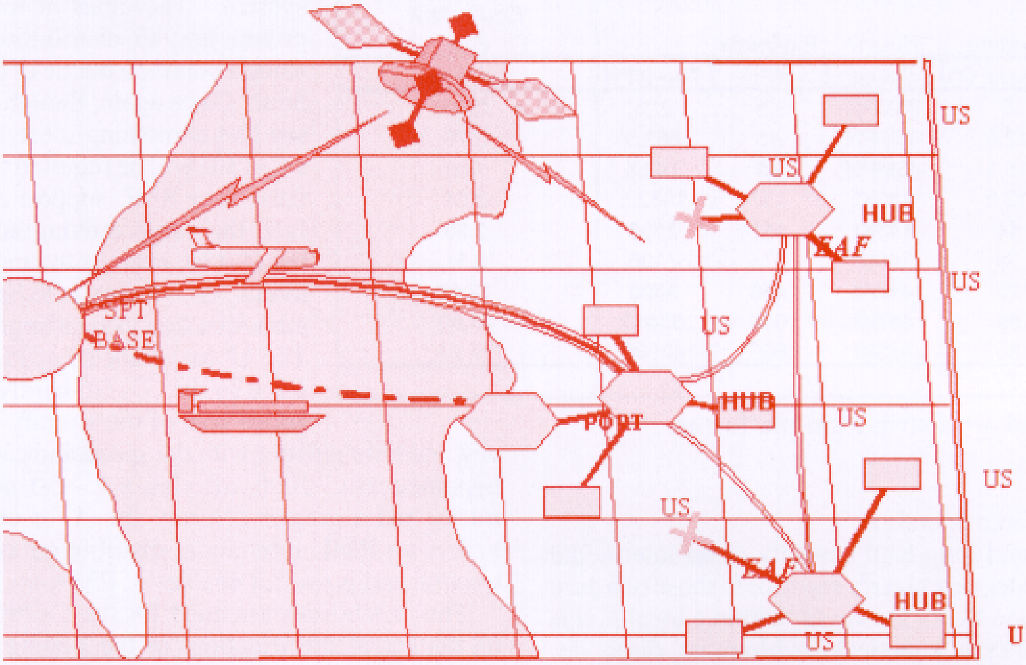
Resupply times are based on the time required for aircraft to reload selected support vehicles; fly back to the staging area; unload, resupply, and reload support vehicles; and fly back to the area of operations. Alternatively, aircraft can return empty, load cargo, and return to the area of operations and transfer cargo to support vehicles. This provides a two-lift sustainable strike capability, with combat forces coming in on the first lift and tactical support forces coming in shortly behind the combat forces. The time estimate for either option remains roughly the same and would depend on the scenario.

Flying the support vehicles back would reduce the sustainment payload for the return trip; however, the dedicated airlift fleet sizes still would support this option, which might enhance force security between refuel-rearm cycles or help the support vehicles to keep pace with the fast-moving strike force. The primary inefficiency is higher aircraft fuel use, since the aircraft fleet size is based on tactical needs to close the strike force quickly. Note that a three-lift strike concept also could be an option. The first wave would seize and hold the airstrip, the second wave would deliver the rest of the combat force, and the third wave would deliver the support force loaded with initial sustainment. The C–2000 could exploit this option with approximately 10 aircraft, deliver the same initial time-on-target, experience the same combat force closure times, and accomplish total force closure within 1.5 hours.

Operating tactical airlifters and light armored vehicles in the near vicinity of heavy opposing armored forces will require some doctrinal adjustments. One key to the strike force concept is that technology soon will support advanced hit avoidance for vehicles, which effectively provides virtual armor to these lighter vehicles as well as to the aircraft. Additionally, state-of-the-art weapons technology soon will provide precision, over-the-horizon, direct fire weapons and missiles. Finally,



☐ **Joint RMA strike force using advanced intratheater airlift.**

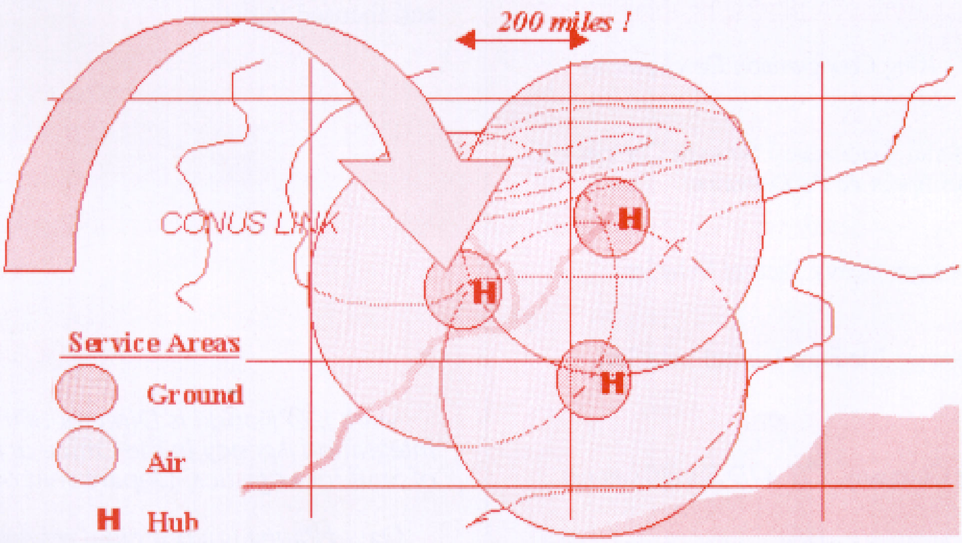


☐ **Focused distribution-based logistics–an agile dynamic distribution network.**

the strike force commander will have to fight in a manner that exploits the decisive overmatch of his weapon systems but avoids losing that advantage in close-combat attrition fire fights with the heavier opposing armored forces.

Strike Force Sustainment

The second key enabler of the strike force concept is the sustainment of the strike forces during a significant, high-OPTEMPO operation, likely lasting several days. A key concept of the RML comes into play here. The RML calls for a dynamic, projectable, and maneuverable, distribution-based logistics system. This will allow the theater support command to reach out to the strike forces and provide uncurtailed sustainment. This is one example of how the RML will empower commanders with logistics. The figure above depicts the global reach of RML distribution-based logistics, and the figure below shows the tactical side of the distribution-based logistics network in reaching out to support



☐ **A theater intermodel distribution network.**

	System	Hourly	Payloads		Equivalent PLS
System	Payload (T)	Speed	MPH	Ton-MPH	Systems
MTV	5	45MPH	45	225	0.30
HEMTT	12.5	45MPH	45	562.5	0.76
PLS	**16.5**	**45MPH**	**45**	**742.5**	**1.00**
CH-47D	12.5	143Kt	157	1962.5	2.64
ICH	**14**	**143Kt**	**157**	**2198**	**2.96**
C-130H	19	340Kt	374	7106	9.57
C-130J	**20**	**410Kt**	**450**	**9000**	**12.12**
"C-2000"	**65**	**467Kt**	**514**	**33410**	**45.00**
C-17	85	455Kt	500	42500	57.24

☐ **Ground and air distribution platforms.**

a joint strike force operation.

The speed and long-haul capacity of an intermodal distribution system are clearly superior to those of a pure truck distribution fleet. However, within a local radius of about 50 miles in a tactical environment, direct delivery by aircraft is neither practical nor efficient. That is why RML distribution-based logistics stresses the need for an integrated, intermodal, air-ground distribution system. The chart at left compares ground and air distribution platforms, using a common metric of ton-miles per hour. Once again, though, it is easy to see that something more capable than a C–130J will be required to implement these new RML support concepts. In fact, the cargo moving advantages of the C–130, even of the most modern J model, do not appear to be much more attractive than using a larger truck fleet. The 12-to-1 tradeoff of PLS trucks offered by the C–130J hardly justifies the added cost of the aircraft. However, a new medium airlifter with the speed and capacity of the hypothetical C–2000, offering a 45-to-1 offset of PLS trucks and a greater delivery speed for crucial cargo, makes an RML intermodal distribution system an attractive and powerful enabler of RMA-style warfare.

The capabilities assumed for the C–2000 are based on the actual specifications of the Boeing YC–14 medium airlifter prototype. This technology demonstrator was flown in the late 1970's. So the actual C–2000, which incorporates 20 more years of aeronautical engineering advancement, could provide even greater benefits for RML distribution-based logistics and the sustainment of globally projected Army forces. As Boeing proved in its recent 777 program, modern engineering, leveraging simulation, computer-assisted design and computer-assisted manufacturing (CAD-CAM), advanced flexible manufacturing, and optimized supply chains can cut aircraft design and production time by more than half. So the opportunity is there if the United States chooses to acquire such an advanced intratheater airlifter and, with it, the power of dominant maneuver and focused logistics. **ALOG**

Websites

The following websites provide more information on intratheater airlift:

http://www-tradoc.army.mil/dcsdoc/aan.htm
(Deputy Chief of Staff for Doctrine, Army Training and Doctrine Command, *Army After Next Insights: Beyond Knowledge and Speed*, 1998 briefing)

http://aero.stanford.edu/reports/nonplanarwings/Configuration.html
(Kroo, Ilan, *C–Wing Configuration Development*)

http://lmasc.com/c-130j/technical.htm
(Lockheed Martin Aeronautical Systems Company, *C–130J Hercules Specs & Performance)*

http://www.tacom.army.mil/dsa/pm_htv/
(Program Manager Heavy Tactical Vehicles)

http://www.tacom.army.mil/dsa/pm_mtv/
(Program Manager Medium Tactical Vehicles)

http://www.boeing.com/rotorcraft/military/ch47d/ch47dspec.htm
(The Boeing Company, *CH–47D Specifications)*

http://www.hqmc.usmc.mil/factfile.nsf/7e931335d515626a8525628100676e0c/0992276ba1b2f2b68525626e00494022?OpenDocument
(United States Marine Corps Fact File, *KC–130 Hercules*)

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Technology Initiatives for RSOI

by Dr. Derek Povah

Reception, staging, onward movement, and integration are the keys to a successful deployment. The author looks into the future and envisions how Information Age technology will improve the process.

It is early spring in the year 2000. Force XXI transforms itself into the Army After Next and deploys for war.

C Minus 6

Lieutenant Colonel Westover, the G3 operations officer for the 3d Infantry Division (Mechanized), briefly studied the execute order. It had been expected. On the tactical operations center's (TOC's) overhead monitor, Cable News Network (CNN) was reporting the third consecutive violation of the United Nations accord in as many days. Westover quickly surveyed the friendly situation board and asked Sergeant Major Colby, the TOC's operations noncommissioned officer in charge, to prepare the division's execute order for Major General Dalford's release. The division ready brigade was on the step and would get the nod.

Major Snell, the TOC's G4 representative, followed Westover out of the headquarters building to the waiting high-mobility, multipurpose, wheeled vehicle (HMMWV), which would carry him to the division commander's mobile command post. General Dalford kept the tempo of training high in the 3d Infantry Division, and Westover would have to find the G3, Colonel Rawlings, in the Bradley command vehicle out in the southeast Georgia scrub of Fort Stewart. As he passed the billeting area of the division's 2d (Spartan) Brigade, a shiver went up his spine.

He had seen and done all of this before. In the late summer of 1990, Westover had been a mechanized infantry company commander in the Spartan Brigade. He had experienced the "hurry up and wait" roller coaster ride as America's Army ponderously deployed for the first Gulf War. In 1990, the Army's continental United States (CONUS)-based heavy forces had to get in line in order to get to the fight. By the winter of 1998, Westover was back in the Spartan Brigade as a battalion commander and deployed his unit to Kuwait during Operation Vigilant Warrior. Lessons learned in that major test of military resolve led to improvements in the entire reception, staging, onward movement, and integration (RSOI) process. Those improvements would be evident throughout the 3d Infantry Division during this first crisis of the new millenium.

From the back seat of the HMMWV, Major Snell broke the spell. "Sir. Before you go in to brief the G3, here's the latest class VII major end items readiness report Sergeant Major Colby and I have cranked out of the Automated Battlebook System. Shows us everything on the ground in Kuwait at Camp Doha Army Prepo Stocks 5 [APS–5]. Gives us 'To Accompany Troops and Not Authorized for Prepo' data, as well as telling us where the equipment shortages are by UIC [unit identification code]." Westover was very familiar with the Automated Battlebook System. It was installed on his laptop. He was gratified to see Major Snell using a system that Westover himself saw as a breakthrough system for Army force deployment.

C Minus 5

Half a world away, Chief Warrant Officer (WO–3) Bodeen, the property book officer for APS–5 (Kuwait), entered the shade of the class IX repair parts warehouse and headed for a cluster of desks in the back corner. It was hotter inside the warehouse than it was outside. Two civilian technical representatives were huddled over a printer as it spit out page after page of data. One was Tom Cramwell, a retired Quartermaster Corps sergeant major and supervisor of the civilian contractors who maintain the APS–5 equipment set at Camp Doha. The other was Jon Johansen, a 23-year-old computer wizard from Northern Virginia-based Stanley Associates, a transportation and logistics information technology firm.

"Okay Jon," said Chief Bodeen, "you got that ad hoc query that the site commander wanted? You've been telling me since I got here how this Army War Reserve Deployment System [AWRDS] of yours can look into the soul of every one of the containers I own. The colonel [the commander of Combat Equipment Group–Southwest Asia (CEG–SWA)] needs to see the count on spare Bradley alternators in our prescribed load list."

Johansen replied with confidence. "Yo Chief, that was easy. Got it listed as a straight count by container, and also have a printout by UIC. What Tom and I are working on now is the update to last month's readiness report. I've been telling you, Chief, AWRDS kicks!"

Chief Bodeen looked at his maintenance lead man and grinned. "What's it looking like, Tom?" "Well, Chief," answered Cramwell, "you know we blew an engine on that Abrams last night. And we got three Bradleys we're finishing up overhaul on. I've gotten Jon here to pump that into AWRDS real-time and propagate it back to the site commander's boss at Combat Equipment Group–Asia in Charleston [South Carolina]."

Chief Bodeen nodded with satisfaction and turned to pull some bottled water out of the straining refrigerator. As he did so, he thought about his numerous late-night skull sessions with Cramwell and Johansen. He had been a skeptic at first. Johansen had an uphill battle in convincing the "old" quartermaster that the AWRDS was up to the task of managing his entire inventory.

Army War Reserve Deployment System

The Army War Reserve Deployment System is a deployable, Windows-based, automated information system developed for the Army Industrial Operations Command (IOC) at Rock Island Arsenal, Illinois. AWRDS maintains accountability, tracks inventory, and monitors the transfer of pre-positioned stocks from IOC's subordinate command, the Army War Reserve Support Command (also located at Rock Island Arsenal), to using units.

AWRDS enables APS site managers to track and efficiently transfer equipment to warfighting units using state-of-the-art bar-code technology. Real-time data are maintained through client server networking and updated remotely through data replication.

AWRDS has the following features —

- *Windows-based, open system using standard query language (SQL).*
- *Worldwide data transfer and replication capabilities.*
- *Detailed, accurate, easy-to-maintain equipment records.*
- *Robust report generation and query capabilities.*
- *Plotting module, with templated cargo location display.*
- *Standard Army Management Information Systems (STAMIS) interfaces with the Standard Property Book System-Redesign (SPBS–R), the Unit Level Logistics System-Ground (ULLS–G), and the Standard Army Retail Supply System (SARSS).*
- *User-friendly, easy-to-learn operation.*
- *Client server system with real-time data updates.*
- *Portable, stand-alone capability with data replication.*
- *Logistics applications for marking and reading of symbols (LOGMARS) technology applications.*
- *Equipment readiness reporting and historical maintenance data tracking capabilities.*
- *Worldwide Port System interface.*
- *Associated equipment (primary and secondary load information).*
- *Capability to support materiel reconstitution at remote deployment sites.*

"Take a break, guys," the Chief said as he handed cold water bottles to his two tech reps. At that, the APS–5 (Kuwait) site commander came striding up. "What do you mean, take a break? We can take a 5-minute break when we get the 2d Brigade out of here and rolling up to their tactical assembly area. In the meantime, Tom, get those Bradleys up. Jon, I need to see roll-ups of class V ammo, automated stockage list, and class VIII medical. Chief, in 3 days the advance party gets here with the logistics support element. Two days after that, the 1st Battalion, 64th Armor Regiment, begins their draw. The AWRDS is going to generate the issue receipts for us. We've got to be good, guys. We practice these draws every quarter. This time it's for real."

C Minus 4

At Fort McPherson in Atlanta, Georgia, a video teleconference was in session in the office of the Army Forces Command (FORSCOM) G3 plans officer, Lieutenant Colonel Gagnon. Also present were Major Lauren Sanders, a transportation officer assigned to the G4 of Third Army (the planning headquarters for Southwest Asia deployments), and Brad Polen, a GS-14 in the FORSCOM G4 who now was wearing his Army Central Command (ARCENT) APS–3 (Afloat)/APS–5 hat. Other participants include key personnel at IOC, Combat Equipment Group–Asia, and the Military Traffic Management Command's (MTMC's) Deployment Support Command in Fort Eustis, Virginia. Colonel Westover and Major Snell in the 3d Infantry Division TOC also were participating, as was the CEG–SWA commander at APS–5 in Kuwait.

"Now, how's your class VII major end item readiness looking out there, Kuwait?" inquired Major Sanders. All eyes were on their respective computer monitors. Using commercial off-the-shelf groupware, Colonel Gagnon, the meeting's host, was sharing the Automated Battlebook System for all to see.

"You have the cursor, Kuwait," Gagnon offered. The CEG–SWA commander, in Kuwait, then generated an Automated Battlebook System query that was visible via the Internet on every participant's computer monitor simultaneously.

Automated Battlebook System

The Automated Battlebook System (ABS) is a logistics planning tool that gives the warfighter a Windows-based, user-friendly interface with the AWRDS data base. ABS *furnishes the warfighter with real-time access to critical planning information about Army pre-positioned stocks worldwide, both afloat and land based. Using ABS for predeployment planning, the warfighter can produce accurate and flexible plans tailored to meet assigned missions. ABS is a critical component of the RSOI process.*

With the shared cursor, the CEG–SWA commander pointed out the problem. "This Abrams is still hard down. And we have one Bradley that we are still nursing. The Bradley should be no problem, but I'm concerned about the Abrams."

The Combat Equipment Group–Asia representative spoke up. "We have an M1A2 [Abrams] inbound to Charleston from depot. Should be here in time to mount out via C-17 from Charleston Air Force Base and arrive with the main body."

From Rock Island, the Army War Reserve Support Command representative chimed in, "We've got total asset visibility on it. The latest expected time of arrival in Charleston, based on its radio frequency tag signature, is 0300 tomorrow morning."

"Let's shift gears here," interjected Lieutenant Colonel Gagnon. "Lieutenant Colonel Westover. Any problems on your end?"

"Well, I'll tell you," responded Westover, "the training package that FORSCOM G4 and G3 put together for our unit movement officers is a lifesaver. From all indications, the Beyond Computer Based Training package we got last month really drove the value of the Automated Battlebook System home."

Beyond Computer Based Training

Beyond Computer Based Training (BCBT) is a concept being studied jointly by FORSCOM and the Army War Reserve Support Command. When coupled with the ABS, BCBT will leverage the technology advantage envisioned by the Revolution in Military Logistics by embedding integrated instruction techniques into the existing ABS tool.

BCBT will incorporate currently available, commercial, multimedia technology to provide ABS users with a learning tool that will be self-paced, portable, customized, available upon demand, and able to provide immediate feedback. The training tool will have a built-in structure for classroom training and will lend itself to network technology for distance learning. The goal is to mitigate the challenge of perishable training by providing the soldier who has little or no prior system training with the ability to use ABS as though he had attended formal classroom training.

The embedded integrated instruction techniques that comprise BCBT will have the following major components: super text, overlay, and progress tracer.

Super text is a "hypertext" help package that provides information about the ABS by means of video, audio, and animated graphics. For example, clicking on highlighted (or hypertext) portions of the "Draw Procedures for APS–5" would initiate a video and audio clip of an actual, previous vehicle draw at that site. This would orient the soldier to the lay of the ground and diminish the normal confusion inherent to such an operation.

Overlay combines two on-line help techniques: context-sensitive help and on-line tutorials, or wizards. Overlay will provide specific help in maneuvering through the ABS screen or module. In addition to identifying the key hot spots, or functions, the wizards will offer self-paced, step-by-step instruction by superimposing the help directly onto the ABS application screen as the soldier is using it.

Progress tracer has an array of menus that allow the trainee to test his knowledge in a particular area of the ABS. By selecting a menu, the soldier will create a test that demonstrates his proficiency with ABS in that area. This will be accomplished by blocking libraries of questions into functional areas and using random selection to formulate the test. The questions themselves will have no data attached, but they will require the soldier to perform the required ABS function to derive the correct answer, similar to an interactive quiz. The individual soldier's rate of progress in learning to use the ABS will be tracked to determine the type and difficulty of follow-on tests he needs.

C Minus 3

It was 2200, and the two friends were taking a break for the first time in many hours. As battalion staff officers, First Lieutenant Baxter, the S3A, and First Lieutenant Paulson, the S4A/unit movement officer, were critical players in the RSOI process for the "Desert Rogues" of the 1st Battalion, 64th Armor Regiment, 2d (Spartan) Brigade. The following day, they would fly out of Hunter Army Airfield in Georgia as part of the advance party.

"What's the latest on that deadlined Abrams?" asked Lieutenant Baxter. "The '3' is concerned about being one M1A2 short of a full complement."

"I was just up on the Battleweb," replied Lieutenant Paulson. "Still down. Major Snell at the division TOC tells me that a spare arrived in Charleston early this morning. If needed, it'll go out tomorrow via C-17, at about the same time we are departing Hunter." [Battleweb provides the warfighter with secure, direct access to ABS via an Internet browser and permits immediate worldwide distribution of ABS user information and enhancements.]

"Boy! This is something they didn't teach us at OCS [Officer Candidate School]. As the battalion training officer, I have to tell you that the last couple of months really prepared us for this," said Baxter.

"The National Training Center [NTC] work-up helped us iron out the kinks. The fact that the NTC has its own battlebook within ABS is a big plus for me as the unit movement officer, now that we are doing it for real," said Paulson. "The Beyond Computer Based Training package that TRADOC put on last month really iced my ability to use ABS. But last week's Virtual Deployment simulation was even better."

"You can thank Lieutenant Colonel Westover at division G3 for that tomorrow. He scheduled it all. You and he are on the same stick, aren't you?" Baxter asked. "Yeah. I got to know him on the Virtual Deployment exercise," replied Paulson.

Virtual Deployment

The Virtual Deployment concept is an extension of BCBT that is being studied by the FORSCOM G3 and G4, as well as the Army War Reserve Support Command. It will simulate an actual unit deployment, placing the warfighter participant in a realistic scenario involving movement of his unit from the "fort to the port." The warfighter will be faced with the problems, surprises, and complications one might face in an actual deployment.

The Virtual Deployment model, as envisioned, will be networked among various deployment nodes such as FORSCOM and its subordinate warfighter units; the Army War Reserve Support Command; the outside CONUS Army pre-positioned sites; MTMC's Deployment Support Command; and the Army National Guard and Army Reserve. Key players in the RSOI process, at their dispersed locations, will be able to conduct a command post exercise of the entire deployment operation in detail, with each person playing his own role.

System interfaces will allow the ABS to run concurrently with other deployment and planning systems, such as the Worldwide Port System, Port Simulation (PORTSIM), Integrated Computerized Deployment System (ICODES), and Transportation Coordinators Automated Information for Movements System II (TCAIMS II), using the Global Transportation Network. Advanced simulation models that now exist—such as the Global Deployment Analysis System (GDAS), the Force Projection Model, and the Strategic Sealift Rate Model—will be integrated into the overall Virtual Deployment architecture, creating a level of realism and action that is not possible any other way short of an actual deployment.

The initial Virtual Deployment model will simulate the deployment of a battalion-sized unit from its installation to its port of embarkation. Model development will be based on the deployment (business) process defined through a function integration analysis. The Virtual Deployment development principles will include the following—

- *Deployment realism based in an environment that creates a time-pressured situation.*
- *High fidelity to the deployment process, to include visual fidelity.*
- *Freedom of choice.*
- *Realistic "fog and friction" of operations created using probabilistic functions.*
- *High "playability" and easy to learn.*
- *Focused on normal training deficiencies.*
- *Individualized (Socratic) after-action reviews.*
- *Complete on-line deployment reference library.*

C Minus 2 and C Minus 1

As they boarded the Civil Reserve Air Fleet 747 at Hunter Army Airfield, Lieutenant Colonel Westover said to Major Snell, "I want you sitting next to me on this flight. I need access to your laptop. Overnight, the 1st and 3d Brigades got the call-up. They will be drawing the two brigades' worth of equipment at APS–5 (Qatar), in Doha, Qatar. As soon as the 2d Brigade draws its gear in Kuwait, we'll be flying to Qatar as the advance party for drawing the division base there."

Once airborne, Major Snell accessed the Battleweb site via airfone. The latest data in the ABS for APS–5 (Kuwait) showed that the deadlined Abrams tank was back on line and ready for action. The Abrams that had been shipped to Charleston still would come in handy as a sustainment vehicle. Other queries of the ABS convinced Westover that everything was on track in Kuwait. However, there were significant maintenance problems in Qatar. Although one of the Qatar brigade sets and the division base set were nearly pristine, equipment for a battalion task force had been issued out of the second brigade set for an exercise the previous month. On-site maintenance crews still were struggling with a few persistent problems.

A quick, real-time assessment of the readiness problem in Qatar was possible due to the Battleweb and the ABS. While airborne over the Atlantic Ocean, Westover determined to make a strong recommendation (via secure communication) to the division G3, Colonel Rawlings, still back at Fort Stewart, that the 1st Brigade draw from Qatar. He further recommended that the 3d Brigade draw from APS–3. The remaining Qatar set was still available, at a lessened readiness condition, to serve as division sustainment stocks.

C Day

Lieutenant Colonel Westover watched the advance party of the 3d Infantry Division (Mechanized) execute the equipment draw, alongside the CEG–SWA commander at APS–5 (Kuwait).

C Plus 95: Lessons Learned

The armored vehicles were drawn up in a sheltering V-shape in the desert. Inside the V, bleachers faced a huge sand table. Lieutenant Colonel Westover had been the master of ceremonies for a series of after-action debriefs that constituted the 3d Infantry Division's lessons learned for this relatively quick and very violent operation. Today's briefing would be dedicated specifically to RSOI issues. It was still his stage, but after a brief executive summary for Major General Dalford, the division commander, Westover could sit down. Major Snell, the division G4 unit movement officer, would conduct the detailed briefing.

While he waited for his boss, Colonel Rawlings, to escort the general into the impromptu amphitheater, Westover scanned the crowd. He remembered back to the video teleconference that had kicked off many of the subsequent RSOI actions. Most of the players in that important electronic gathering were garrison types, some of them civilians. They were all here, flown in to take part in this lessons learned exercise: Lieutenant Colonel Gagnon, FORSCOM G3 Plans; Major Sanders, Third Army G4; Brad Polen, FORSCOM G4; the commanders of Combat Equipment Group–Asia and CEG–SWA; and representatives from the Army War Reserve Support Command and MTMC's Deployment Support Command. The National Guard Bureau and the U. S. Army Reserve Command also sent representatives.

General Dalford felt that the main reason this operation had been so successful was the speed and flawlessness of the deployment. He wanted that captured. America's Army was now an imminently deployable heavy "expeditionary" force, and it was important to keep it that way.

"Ladies and gentlemen, the commanding general," Westover announced as Colonel Rawlings escorted General Dalford to his seat. "Seats, please. Proceed," commanded the general.

"Major General Dalford. Ladies and gentlemen," began Lieutenant Colonel Westover. "Many in this audience participated in the first Gulf War in 1991. Some of us were around for Operation Vigilant Warrior. We'd all have to agree that the progress toward achieving Force XXI, and now the Army After Next, is largely due to the Revolution in Military Affairs that sprang from the lessons learned review conducted at an amphitheater such as this following Operation Desert Storm.

"In a moment, I will turn the floor over to Major Snell from the 3d Infantry Division's G4 shop to give a detailed after-action report and lessons learned regarding reception, staging, onward movement, and integration as they apply to the recently concluded deployment and subsequent combat operations. Major Snell will undoubtedly make reference to the Revolution in Military Logistics, which we have all witnessed brought to fruition.

"Allow me to touch on a few key topics regarding RSOI from the perspective of G3 Operations. RSOI and its enabling tool set—the Army War Reserve Deployment System data base, along with its warfighter corollary, the Automated Battlebook System—allowed us to deploy an entire division in just over 6 days from receipt of the execute order. The Automated Battlebook System and the Internet-enabled Battleweb gave us real-time visibility into the Army prepo stocks, land based and afloat, that were available to us. This capability allowed the division commander to make a crucial recommendation to the ARCENT commander—and the CINC [commander in chief]—regarding unit set availability and combat sustainment.

"The key—as it always is and will remain—is training. Let me remind you all that we have tightly integrated the Automated Battlebook System into our National Training Center deployments. Furthermore, we have endeavored to support excellent distance learning initiatives such as Beyond Computer Based Training and Virtual Deployment to enhance the Automated Battlebook System's utility for the deploying warfighter and to mitigate the challenge of perishable training.

"Lieutenants Baxter and Paulson from the 1st Battalion, 64th Infantry, Spartan Brigade, please stand up. These gents reminded me that we still have a training shortfall from a full realization of the utter importance that the reception, staging, onward movement, and integration process has for deploying and fighting the Army After Next. As Lieutenant Baxter said to me the other day, 'Sir, they don't teach us this at OCS.'

"Based on that observation, Major General Dalford has ordered a thorough review of the division's mission-essential training list. We intend to pass along via the proper training mechanism a recommendation that RSOI and the Automated Battlebook System be added to the curriculum at OCS—and at the Infantry Officer Advanced Course, Leavenworth, and any other school that teaches the Army warfighter trade. Reception, staging, onward movement, and integration are what gets us to the fight. The Automated Battlebook System is the enabling tool.

"Thank you, General. Major Snell . . ." **ALOG**

Dr. Derek Povah works in the Plans and Operations Branch, Power Projection Logistics Division, Office of the Deputy Chief of Staff for Logistics, Army Forces Command, at Fort McPherson, Georgia.

High-Speed Sealift: Deployment Support for the Future

by Owen Spivey

A test of a high-speed Australian ferry could be a preview of the improved strategic deployment needed by the Army After Next.

Engineers from the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA), located at Newport News, Virginia, recently participated in an evaluation of the feasibility of using commercial high-speed sealift (HSS) during future deployments. The evaluation was conducted by the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) in cooperation with the U.S. Transportation Command (USTRANSCOM), the Maritime Administration (MARAD), the Navy's Military Sealift Command, the Army's Office of the Deputy Chief of Staff for Operations and Plans, the Naval Surface Warfare Center (NSWC) Carderock Division, and the Logistics Management Institute (LMI). CCDoTT, acting under the direction of USTRANSCOM and MARAD, was responsible for planning, coordinating, and executing the fiscal year 1998 HSS evaluation. Here is a brief summary of MTMCTEA's participation and the future military potential of HSS.

Need for Improved Strategic Deployment

The Army Training and Doctrine Command (TRADOC) is conducting broad studies, projecting to the year 2025, to frame issues vital to the Army's development after 2010. These studies and accompanying wargames show that the Army's present firepower-centered approach may introduce unnecessary future risks, since a future enemy will have time to harden his infrastructure against our firepower, learn to lessen the effects of our firepower by deception, and husband its military strength in preparation for our expected military assault.

A recent example of this was Iraq's dispersal and hoarding of Scud missiles during Operation Desert Storm. Pre-Desert Storm estimates indicated that Iraq possessed only 18 launchers. However, those estimates later were increased to 225. Even though Iraq's Scuds were more of a political than a military threat, a significant percentage of sorties by U.S. F-15E fighters was diverted from strikes on Iraqi infrastructure to "Scud chasing."

As we tighten our purse strings and shrink our military force, battlefield economics will not allow the Army After Next (AAN) to be diverted in such ways. Future conflicts will place greater emphasis on rapid deployment, reduced logistics requirements, precise and directed lethality, joint battlefield integration, and rapid information distribution. HSS is a futuristic concept that may provide one means of attaining such goals, but several things must fall into place in order to realize its potential.

The military must partner with commercial industry to leverage state-of-the-art technology such as HSS for military use to meet the aggressive demands of the AAN. To achieve rapid strategic deployment, the Department of Defense continues to investigate several commercial HSS vessels for possible future military deployment. For example, on 20 July 1998, the Danish high-speed ferry *Cat-Link V* set a speed record for crossing the Atlantic Ocean of 2 days, 20 hours, and 9 minutes at an average speed of 40 knots—the first Atlantic crossing in under 3 days. The HSS technology demonstrated by this vessel is gaining visibility and popularity in the United States; it represents an expanding market of the future. The objective of MTMCTEA and our partners is to determine whether existing and emerging HSS technologies have a viable military application that can solve future strategic mobility and logistics problems.

A Candidate From Australia

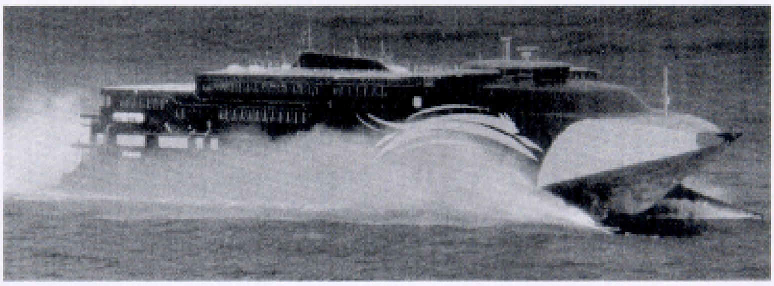
Just what is it that makes HSS so special? The vessel used in the fiscal year 1998 evaluation, the INCAT 046 *CAT*, was designed and built by INCAT, Inc., of Australia. It is a combined passenger and vehicle high-speed ferry originally designed for commercial freight and passenger service across the Bass Strait between Australia and Tasmania, the longest nonstop, open-sea, fast ferry route in the world (227 miles). With a surface-piercing catamaran hull 91 meters long and a beam of 23 meters, the *CAT* is capable of cruising at 43 knots (50 miles per hour) with a rated load of 900 passengers and 240 privately owned vehicles.

The ship's transom-mounted waterjet propulsors are driven by four 9,500-horsepower diesel engines. By using vectored thrust from her propulsors, the *CAT* is capable of precise maneuvering and docking without using tugboats. In addition, it has demonstrated the ability to perform a "crashback" (that is, coming to a dead stop) from 46 knots in just a third of a mile. This is amazing for a vessel of this size, especially when compared to a modern aircraft carrier that requires approximately 2 miles to stop. With these credentials, the *CAT* was sure to warrant a closer look.

Testing HHS Technology

After completing a season of passenger runs in Australia, Bay Ferries of Canada, Inc., purchased the *CAT* for commercial service between Bar Harbor, Maine, and Yarmouth, Nova Scotia. The *CAT* departed Hobart, Australia, on 26 April 1998 and arrived in Yarmouth on 20 May. This voyage provided an excellent chance to place instruments on the *CAT* to recover transportability data; these data would allow engineers to characterize the on-board environment that in-transit military equipment would be required to endure.

Before departing Hobart, a representative from NSWC Carderock installed wave-height instrumentation and engineering data recorders provided by MTMCTEA to measure acceleration levels at various cargo stowage locations on the vessel. The recovery of data from those instruments, as well as a military vehicle load evaluation, originally were scheduled for Fort Eustis, Virginia, on 18 May, but transit delays in Tahiti and the Panama Canal forced the cancellation of those activities. So the NSWC Carderock representative recovered the test instrumentation at Yarmouth for data reduction and evaluation. The data are being evaluated by Carderock and MTMCTEA in order to develop future HSS response models and vehicle restraint load factors to be used in designing future military systems and HSS applications.



The military vehicle loading was scheduled to validate the *CAT*'s ability to load and transport military vehicles and to demonstrate its potential military applications to a military audience. Although the transit delay cancelled the loading, LMI and MTMCTEA felt strongly that there was valuable information to be gained from such a test. Therefore, LMI coordinated with the ship's owners and the Maine Army National Guard (MANG) to perform a vehicle load and transit exercise during a normal commercial operation. The MANG cooperated by providing seven military vehicles (four high-mobility, multipurpose, wheeled vehicle [HMMWV] ambulances, two HMMWV softtops, and a 5-ton truck), along with the appropriate soldier sup-

☐ The Australian INCAT 046 CAT at rest (left) and underway (above).

All photos courtesy of Bay Ferries, Inc.

port. MTMCTEA sent three engineer-analysts to participate in the loading; they brought experience in transportability engineering, operational exercises, and shipload planning. As planned, the shiploading and transit between Bar Harbor and Yarmouth was performed on 9 June. The vehicles were successfully loaded and restrained during the transit, demonstrating the viability of loading light vehicles aboard this commercial ferry.

The purpose of this evaluation, the first of many planned, was to evaluate the potential of existing HSS technology for present and future military applications. Based on our personal observations and instrumentation analysis, we concluded that—

- The vessel can be used as a viable intratheater tactical marine transport.
- Stronger decks and larger tiedown provisions would be needed to secure larger military vehicles and equipment.
- A redesign in deck heights would be desirable as well. Available deck height on the majority of the vehicle decks is only 77 to 84 inches.
- ISO sockets and electrical outlets (for ISO containers) would be desirable. Currently, there are no ISO sockets on the ship.
- The vessel would require an integral loading ramp for use in unimproved ports or in-stream logistics-over-the-shore operations.

The *CAT* clearly demonstrated the future potential of HSS, and it could lead to bigger and better things if expanded.

Moving Beyond the *CAT*

By using composite materials, new drag-reducing hull forms, digital controls, and improved engines with increased fuel efficiency, it may be possible to build a high-speed strategic sealift vessel capable of transporting vehicles and materiel at speeds in excess of 60 knots up to sea state 7. If such a vessel included a troop-berthing area, the reduced transit time could be used for preparation, training, and vehicle maintenance. Complete force packages could be delivered directly to the theater, reducing reception, staging, onward movement, and integration requirements. This would dramatically reduce the time required to transport troops and equipment from "fort to foxhole."

The viability of designing and building a tactical HSS vessel today is a reality. By combining existing HSS technology with passive sensors, composite materials, and a reduced radar cross-section, a high-speed (45 knots plus) tactical marine transport can be built to deliver small force packages within a theater of operations (a maritime equivalent of the Air Force's C-130 transport). An example of such a scenario would be loading a small force package at Ad Dammam, Saudi Arabia, in the afternoon, departing after dusk, and arriving in the Strait of Hormuz by dawn, regardless of sea state. Both natural and man-made obstacles could be avoided by using passive means such as global positioning system navigation and downlinked data from the Joint Surveillance Target Attack Radar System, unmanned aerial vehicles, and space-based reconnaissance. In keeping with the AAN philosophy, all of these options should be considered seriously.

Clearly, the INCAT *CAT* evaluation is a good example of "thinking outside the box" to explore potential AAN applications. A joint working group representing potential military sealift users was able to partner with industry to evaluate emerging commercial technology for future military applications. In fact, MTMCTEA was able to forge several key relationships. For example, MTMCTEA and LMI worked together to establish the viability of loading military vehicles aboard the *CAT*; MTMCTEA and NSWC Carderock coordinated vessel test instrumentation and data collection to describe the dynamics of the transportation environment; and MTMCTEA, LMI, and the MANG jointly validated the capability to load and transport military vehicles aboard the *CAT*.

MTMCTEA continues to work with LMI, TRANSCOM, NSWC Carderock, MARAD, and other interested parties to establish transportability engineering criteria for emerging HSS vessel designs, as well as to provide HSS analysis results to future AAN analyses and simulations. As always, MTMCTEA's goal is to optimize force projection by turning today's visions into tomorrow's reality. **ALOG**

Owen Spivey is on the staff of the Military Traffic Management Command Transportation Engineering Agency in Newport News, Virginia.

He acknowledges John Newman of MTMCTEA, Matt Difiore of LMI, Martin Dipper of NSWC Carderock, and the Maine Army National Guard for their exceptional support in the successful completion of this evaluation and John T.H. Germanos for his guidance in writing this article.

ADEQUATE LOGISTICS FOOTPRINT

Adequate Logistics Footprint

by Roger Houck

Footprint: A tread, a trace, an impression; a detectable, targetable presence, representative of relative size. An adequate logistics footprint is one of the key tenets of the Revolution in Military Logistics (RML).

The logistics footprint must be the "right size" to support Force XXI and, later, the Army After Next (AAN) in a wide range of contingencies—from urban warfare to a Desert Storm-type of engagement. The efficiencies achieved by the RML will drive the reductions in support requirements and dramatically increase the capability and agility of Force XXI and the AAN.

Logistics support in the next century will be provided under different conditions requiring real-time situational understanding and improved command and control capabilities. The enablers for these capabilities include distribution-based logistics, total asset visibility, and a seamless logistics system. Distribution-based logistics will be a major factor in reducing the large, redundant, supply-based footprint to a smaller but adequate one. Replacing logistics mass with logistics velocity will eliminate huge inventory stockpiles and ensure the tailored, rapid delivery of support packages when and where they are needed. Also, by incorporating modern technology in weapon and information systems and adopting best business practices, the Army will reduce the amount of materiel continually present in the theater.

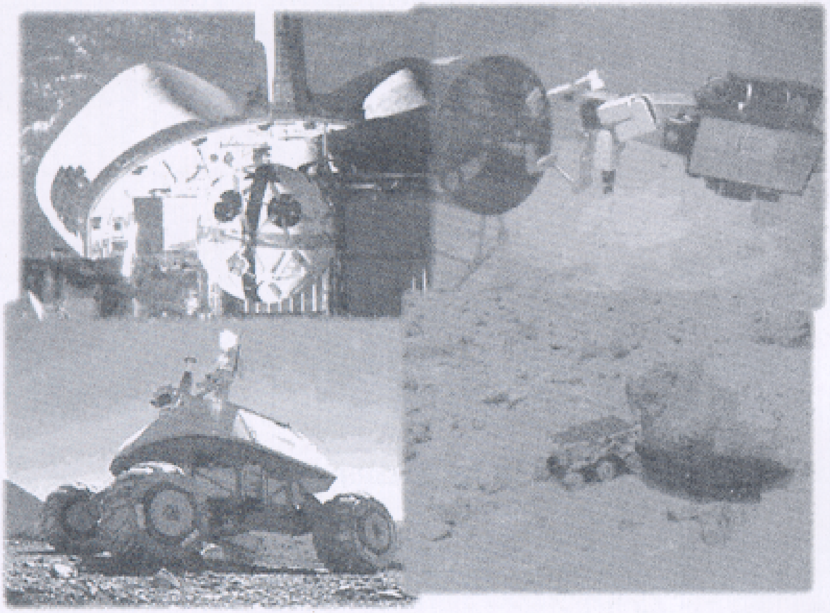
Creating an adequate logistics footprint involves more than structural change. It also involves the development and focus of concepts, ideas, and materiel. The Army Training and Doctrine Command is using a series of wargames to bring together senior defense policymakers to participate in scenario-driven exercises and discuss critical strategic and operational issues that will shape the Army. Product improvements and block materiel replacements will change the way the Army develops, tests, acquires, and maintains equipment. There will be increased reliance on split-based operations to reduce the logistics footprint in the theater of operations. The number and type of weapon systems needed by land forces in the battlespace to hold and dominate terrain will change, and so will the operational and tactical logistics requirements.

Resupply, maintenance, and other combat service support functions will be accomplished in completely different ways or in the relative safety of a rear-area or continental United States location. It is this relocation of functions that offers the greatest potential for reducing the logistics footprint in the tactical and operational battlespace.

Modularity and new commercial best practices will be leveraged to minimize the logistics footprint without sacrificing capability. Smart simple design, a commercial industry best practice, has reduced the costs, assembly and manufacture cycle times, and number of parts in commercial systems and increased the serviceability of these systems. Army acquisition programs must emulate smart simple design or similar initiatives to improve manufacture, assembly, and serviceability. Weapon systems or major end items that have fewer parts and thus are easier to repair and maintain will require lower levels of inventory and fewer maintenance personnel to support them. Use of this methodology for Army weapon systems could reduce logistics demands and contribute to an adequate logistics footprint.

Other potential contributors to a responsive and efficient logistics footprint include robotics, unmanned vehicles, intelligent agents, diagnostics and prognostics, smart/brilliant munitions, real-time communications, and fuel and energy efficiencies. Advanced robotics technologies will replace people in missions such as reconnaissance, materiel movement, and transport. The use of unmanned transporters may range from aerial vehicles to tanks. These concepts are of specific interest and investment for Army XXI and, once insights, issues, and concepts emerge and sufficiently mature, will impact the AAN.

Sensors, advanced information technology, diagnostics, and prognostics alone could have tremendous impacts throughout the Army logistics system and are key components of the RML. The incorporation of prognostics in digitized weapon systems will drive the numbers of weapon systems, materiel, and maintainers required in the battlespace. The ability to predict system failures before they occur will improve repair leadtimes and prevent failures during mission-critical op-



☐ **Advanced robotics technology will play a major role in future military operations, particularly in the areas of transportation, reconnaissance, materials handling, and, possibly, fighting.**

erations. Parts that diagnose themselves and requisition their own replacements or needed components will reduce the number of soldiers involved in the supply process. Assured communications and telemaintenance applications will allow the expertise, but not necessarily the expert, to travel. The increased speed of repair and the enhanced capabilities will reduce the number of weapon systems required for adequate lethality on the battlefield and in inventory.

This lethality will be achieved through the use of smart munitions and lighter, ultra-reliable weapon systems as opposed to the mountains of ammunition employed in the past. One-to-one kill ratios mean lower ammunition support requirements and fewer weapon systems needed to complete fire support missions. The incorporation of advanced materials, biomimetics (materials that mimic the properties of those found in nature), manufacturing technologies, and design methodologies will result in lighter, ultra-reliable systems. All of these will have an impact on the logistics footprint.

Finally, fuel most likely will continue to be a significant part of the support burden faced by Army logisticians. But with fewer, lighter weapon systems and the advances in hybrid systems, this requirement also will decline significantly.

Adequate logistics footprint, as an RML tenet, is not just about *reduction*. It is about balancing the right size, the right amount, and the right knowledge to do the job in supporting 21st century operations. It is the result of a reduced logistics demand, more lethally efficient weapons, information technologies that focus directly on the warfighter, a seamless logistics system that allows for streamlining redundant support functions and organizations, and a transformation from a supply-based to a distribution-based logistics system.

This is an exciting period of change, a revolution, for the Army and the way it supports itself and how it partners with industry. The Army will be supported by the best innovations American industry has to offer. The technologies, best practices, doctrine, and anticipatory nature of the seamless logistics system probably will allow for significant changes in the logistics forces in the next century. Our logistics footprint must be the "right size" to perform any Army mission. Not only should it be streamlined and efficient, the logistics footprint also must be *adequate* to provide the soldier with the best support to enable our forces of the 21st century to win the Nation's wars. **ALOG**

Roger Houck is a logistics management analyst at the Logistics Integration Agency, Office of the Deputy Chief of Staff for Logistics, Department of the Army.

Contractors on the Battlefield: Risks on the Road Ahead?

by Eric A. Orsini and Lieutenant Colonel Gary T. Bublitz

The Army is moving toward increased reliance on contractors for battlefield support. The authors suggest some issues that need to be examined as we proceed with this initiative.

Contractor support for the Army is not a new concept; it has been used many times in the past. In Operation Desert Storm, 76 U.S. contractors deployed with 969 personnel to provide maintenance, technical assistance, and equipment support. Contractor personnel deployed almost at the same time as the first U.S. troops and provided support mainly at echelons above corps. Some contractor field service representatives and contact teams were used in the corps and division area, and a few went into Iraq and Kuwait with combat elements.

The Army now is considering institutionalizing contracts and using contractors on the battlefield as support for routine functions of military operations. In fact, two test programs currently are in development—Apache Prime Vendor Support and Paladin Fleet Management. If successful, these contractor support programs may lead to many more and force a change in our culture while presenting new and unique challenges.

Although many believe that contractor support in routine logistics functions can save the needed dollars to fund future modernization, there still are no empirical data to prove or disprove this assertion. Contractors argue that when all costs are compared equally, contractor support can be significantly cheaper than using the force structure. For the purposes of this article, we will assume that a degree of savings can be achieved by using contractor support within the scope of industry best business practices.

Assuming that there will be increased contractor support, the purpose of this article is to explore some of the inherent risks associated with the expanded use and presence of contractors on the battlefield. The goal is to fuel a continued dialog across the Army and Department of Defense (DOD) to ensure a full and thorough airing of the issues and the identification of risks.

Our definition of risk includes one or all of the following: a degradation to mission accomplishment, an increase in the time needed to complete the mission, or an increased threat of loss of life. The last obviously is the most severe, and one for which the American people have little tolerance.

How Are We Fixed for War?

Today U.S. military forces enjoy the reputation of being the best trained, best resourced, and most capable military of any nation in the world. They earned this distinction by standing the test in a multitude of operations on the battlefield, in the peacekeeping arena, and in providing humanitarian assistance. One main reason for this success is that unit readiness is monitored constantly by commanders, senior leaders, and Congress. This monitoring includes assessments of personnel, training, and equipment, as well as subjective evaluations by unit commanders on their units' ability to accomplish the mission. Additionally, relevant and vigorous training at centers such as the National Training Center, at Fort Irwin, California, and the Joint Readiness Training Center, at Fort Polk, Louisiana, ensure combat effectiveness.

In contrast, there is no system currently in place to monitor contractor readiness. If there were such a system, who would monitor it? Would it be monitored by the Chief of Staff of the Army in his unit readiness review, or by the Chairman of the Joint Chiefs of Staff in his operational readiness review? Would Congress scrutinize industry readiness reports as they do the military's, or would industry's financial bottom line drive contractor readiness?

In order to reduce risk, contractor support must be tested and evaluated in ongoing operations and training events on a continuous basis, and contractors must undergo the same rigorous scrutiny by Congress and senior military leaders that our military faces daily. To have anything less will severely limit our leaders' ability to answer the question: How are we fixed for war?

Will Contractor Support Be There When Needed?

Anytime a discussion of contractors on the battlefield comes up, so does the question of whether or not contractors will be there when needed. Many cite the famous tree-cutting incident in Korea in August 1976 as an indication of how civilian support on the battlefield may work. That incident caused an increase in the alert status to Defense Readiness Condition (DEFCON)-3, and as a result hundreds of Department of the Army (DA) civilians who had replaced military depot maintenance and supply workers requested immediate transportation out of Korea.

The issue facing us is not whether large defense contractors will continue to service the contract, but whether or not they will be able to keep their employees on the battlefield when and where needed. Moreover, if subcontractors are performing for a parent contractor, will the subcontractor be as reliable as the primary contractor?

Unfortunately, there are no easy answers. The situation, ultimately, will always determine the outcome. Therefore, a clear understanding must exist between the contractor and the Government to ensure that the contractor will be held accountable for service regardless of the threat level and that the contractor has adequately trained personnel available to meet all contingencies.

Will the Commander Maintain Flexibility?

Flexibility is one of the principles defined in Joint Publication 4-0, Logistic Support of Joint Operations, as essential for effective logistics performance. It is defined as adapting logistics structures and procedures to changing situations, missions, and concepts. Contract support will be guided by a contract—a legal document outlining a statement of work (SOW) and expectations. If mission requirements change, the SOW may need changes if it is not written in sufficiently broad terminology. If changes to the SOW are made, the contract may require modification—and many times this will carry associated changes in cost.

The contract also can limit command and control flexibility if it becomes the controlling factor. Consequently, the contracting officer's representative (COR) is assigned the task of working with field commanders and contractors to interpret, implement, and modify contracts as required by the mission. This process reduces flexibility and may jeopardize mission execution.

Commanders have enough to worry about in fighting a war; they do not need to be concerned about contracting. They need the flexibility to do what is needed, when it is needed, and to the degree it is needed. To have any less flexibility increases risk significantly.

Consequently, the art and science of writing contracts will become extremely critical to ensuring flexibility, sustainability, and survivability on the battlefield. Every commander and logistician, from the field commander down, must be familiar and knowledgeable about the contract process, and the COR must be able to adapt to constantly changing situations.

Who Will Protect the Contract Employees?

Most military personnel are classified as combatants and can be relied upon to assist and augment the fighting force, as well as to provide self-protection and defend equipment and terrain. This was demonstrated time and time again in World War II, the Korean War, and the Vietnam War. History shows us how, in World War II, clerks and technicians replaced infantry who were killed and combat service support personnel were reclassified to combat arms to make up for casualties. Logisticians always have been the "infantry in reserve," and in many cases they have provided force protection for rear area headquarters and lines of communication. Contractor personnel, on the other hand, currently are classified as noncombatants and as such can carry a weapon only for self-protection, and then only with the express approval of the theater commander. This means that additional force structure will be required to protect contractor personnel, even if those personnel are former military. This additional force structure will become especially critical in a scenario with asymmetrical (chemical, biological, or nuclear) threats or when contract personnel are directly supporting the warfighter and moving with lead combat elements. The cost of this force protection also must be calculated in the cost equation when comparing contractor support to using the existing force structure.

The bottom line remains that force structure will be required to provide force protection for all civilians working in the theater of operations, whether in rear areas, on forward lines, or in forward-deployed task forces.

Military Career Progression and Contractors

Apache Prime Vendor Support and other fleet management concepts currently suggest that contractor support will be available from the factory to the foxhole. This means that contractor support will be the primary source of support. There will be no force structure backup or military stockpiles of repair parts. The contractor will control and own all supplies until requisitioned by the military unit. This supports the velocity management concept and, together with total asset visibility, gives the logistician the ability to deliver the right quantity at the right time and in the right place.

Until now, the Army has had force structure to maintain, requisition, supply, and transport supplies and repair parts on the battlefield and a stockpile to support anticipated needs. However, the cost to maintain this mountain of stocks no longer can be afforded, and contractor support is looked at as an answer. Although we find no fault in this logic, it does create a void in the career progression path of logistics officers and noncommissioned officers (NCO's).

With contractors responsible for providing supplies on the battlefield, there will be no trained force structure capable of handling this function. Gone are the problem-solving opportunities so critical in preparing senior logistics officers and NCO's. Gone are the hands-on training and real-world opportunities that gave most logisticians today the sound foundation to handle senior-level logistics decisions. If contractor support is implemented for most or all of the Army's current weapon systems, senior logisticians in the future will have significant shortfalls in their professional development.

Strategic Vision or Cost Savings Goal?

Every soldier understands what is meant by "commander's intent." It is a part of every operation order and provides a guide for the desired end state of the mission. Unfortunately, in the matter of doctrine and policy for contractors on the battlefield, the desired end state is unclear. No one can articulate clearly if the intent is for all of the Army's current weapon systems to be supported by contractors, or if only future weapon systems will be contractor supported. Nor can anyone predict where on the battlefield contractors will operate or what they will be doing. This is because no one has clearly articulated the "commander's intent." Instead, the driving factor is the goal of saving costs to fund future modernization. Although saving money is a very worthwhile goal, it does not provide a vision of the desired end state.

This lack of vision is not because the commander forgot to give one, but because it is almost impossible to conceptualize. This is no small task, given the fact that current doctrine must cover how the current Army of Excellence fights, how the digitized divisions of Force XXI will fight, and how the Army After Next will fight. No small task indeed, but it is nonetheless essential if we are to forge ahead to ensure that the world-class fighting force of the 21st century is supported by nothing less than a world-class logistics force.

As we have pointed out previously, contractor support has been a part of military operations in the past, and it will be part of operations in the future. The key is to find the right mix of contractor support and force structure (active and reserve components and DA civilian) and the right jobs for each, and to do so with an acceptable amount of risk. The old adage, "more is better," may not apply to contractor support, especially when the factory-to-foxhole concept may create hundreds of stovepipe contractor support systems.

Recent efforts in the Department of the Army, such as multifunctional integrated process teams studying various competitive sourcing alternatives, policy memorandums, doctrine, and functionally oriented regulations, appear to be the answer to getting a firm handle on the issue. But are they? The issue is clearly bigger than any functional area, bigger than any Service, and perhaps even bigger than DOD itself.

The functional proponents who have driven these efforts thus far are to be commended. Now it's time to establish a single DA proponent who will solicit input, not only from Army functional proponents, but also from the Army service component commands of the geographic warfighting commanders in chief (CINC's). This would provide the needed emphasis to solidify a strategic vision and the desired end state. After all, it is the CINC who will be responsible for prosecuting any warfight, and it is the CINC who will make the ultimate decision on the battlefield.

Without a doubt, further discussion, evaluation, and exploration of these issues and alternative solutions are necessary. The time to act is now, not after we have established contacts and reclassified force structure.

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Supporting the 21st Century Warrior

by Lieutenant Colonel Brian C. Keller

The battalion forward R3 (rearm-refuel-repair) point had just relocated to keep pace with the rapidly advancing combat force. The first priority was to fix the M1A4 CYBORG advanced battle tank that B Company had left behind. Pre-war propaganda had touted the ability of the tank's energetic armor to defeat tandem warheads, and battle experience had validated the armadillo-styled composite CYBORG (ceramic-boron-graphite) skin. However, some of the tank's internal electronics had not fared well when attacked by enemy millimeter-wave weapons.

As senior systems mechanic, Sergeant First Class (SFC) Miller removed what had become known affectionately as the FunGun from his utility belt and mated it to the belly button of the M1A4. The FunGun was tethered to his belt, making the FunGun method of troubleshooting similar to a doctor checking a patient's heart with a stethoscope. By tapping into the electronic heart of the weapon system, the mechanic immediately could identify failure points and components throughout the entire system. The face shield on his full-coverage helmet provided a heads-up display of those troublespots. From his Batbelt, as the utility belt had become known, a calculator-sized device provided SFC Miller with electronic access to all maintenance technical manuals. Repair procedures, required tools and parts, and estimated repair times all could be scrolled onto his heads-up display.

Initial diagnoses told SFC Miller that redundant components eliminated the need to repair the thyrotron and that the synthetic regeneration expert implant (SEXI) device had reproduced two brain cards that had been fried by millimeter-wave bursts. However, there were indications that the electronic control unit of the fire control system needed Miller's attention. After isolating the problem, he began the repair. His final action would be conducting system checks using the FunGun.

Simultaneously, troops from the liquid creation section (LCS) were using the pelletized lubricant, oil, and petroleum (PLOP) system to prepare replenishment liquids for the tank. This breakthrough system allows the soldier to drop different, aspirin-sized pellets into a base liquid to create the type of liquid fuel, oil, transmission fluid, or hydraulic fluid he needs. Petroleum, oils, and lubricants management, planning, and distribution had been improved immensely by this system.

Meanwhile, the ammunition handlers brought up a replenishment basic load for the M1A4 using the multipurpose Bullfrog. Mattel Corporation based Bullfrog on their Transformer toys that became popular in the late 1980's. By reconfiguration and use of assorted attachments, the Bullfrog could function as a bulldozer, forklift, grader, crane, explosive ordnance disposal excavator, and short-distance tow truck. It worked so well that it had replaced several items of equipment and enabled the Army to consolidate several military occupational specialties.

Employing their training in accordance with current doctrine, the R3 team used the latest tools to return the tank to combat readiness in a record 57 minutes. The world of combat service support (CSS) had come a long way since SFC Miller first joined the Army in 1990.

Given the pace of developments in science and technology, the above scenario may not be that far from reality. Weapon system capabilities are improving at a staggering rate; the 21st century warrior will be well equipped and well armed. As the scenario illustrates, to maximize the operational effectiveness of tomorrow's soldier, CSS tools also must move into the 21st century.

However, we must not restrict our efforts to apply new technology to high-profile CSS systems. There are tremendous gains to be made at the lower end of the technology spectrum, particularly in the area of soldier support equipment. Soldier support equipment is defined as "materiel and services that directly support the soldier individually or collectively in a tactical or operational environment." Specifically, soldier support equipment falls into four categories: field feeding equipment, field service equipment, shelters, and airdrop equipment. This article will discuss the first three.

The criticality of soldier support equipment to the individual soldier demands that these items receive equal consideration for modernization. However, many soldier support items were fielded in the 1950's and have not been improved since. Available technology and legitimate soldier needs make this an opportune time to maximize investment in this area. With today's high operational and personnel tempo, soldier support equipment plays an increasingly important role. Soldiers today are deployed in a field environment between 138 and 160 days a year. In 1997, the Army averaged 31,221 soldiers deployed a day in over 79 countries. For a relatively small investment, there is a great opportunity to provide the soldier modern items of equipment that directly increase combat effectiveness, enhance safety, and improve quality of life during deployments.

Field Feeding Equipment

Modern burner unit. The old adage that an army marches on its stomach still holds true. Unfortunately, the U.S. Army's field feeding equipment is approaching the age of the adage. The M2 burner that provides the heat source for all field kitchens was fielded in 1959. The M2 is a gasoline-burning item that, when used, puts soldiers at serious risk. Between October 1980 and July 1997, there were over 90 reported accidents involving the M2 burner, resulting in over 65 injuries and 2 fatalities. The modern burner unit (MBU) will replace the M2 burner and will prevent these types of accidents.

The MBU is more fuel efficient and reliable than the M2 burner. Its 30 percent increase in fuel efficiency will save over $100,000 per 800,000 hours of use. With approximately 53,000 burners in use Army-wide, the MBU's fuel efficiency starts paying off quickly. Furthermore, the MBU is twice as reliable as the M2 burner. During reliability testing, the MBU operated for over 300 hours without a failure.

The MBU's advantages over the M2 include ease of operation and increased safety. Gone are the days of 3 stations set 50 feet apart just to prep the burner, of carrying a lit burner into a kitchen and angling it into the range, and of using a dedicated burner person. The MBU employs an electronic ignition, is push-button operated, and can be fueled in place with JP8 fuel. Not only is safety greatly improved, but hours of preparation time for every meal also are reduced.

☐ Modern burner unit.

The MBU begins fielding in the first quarter of fiscal year 1999. Currently, only force package (FP) 1 units (the priority units for deployment) and active FP 2 units are funded to receive the MBU.

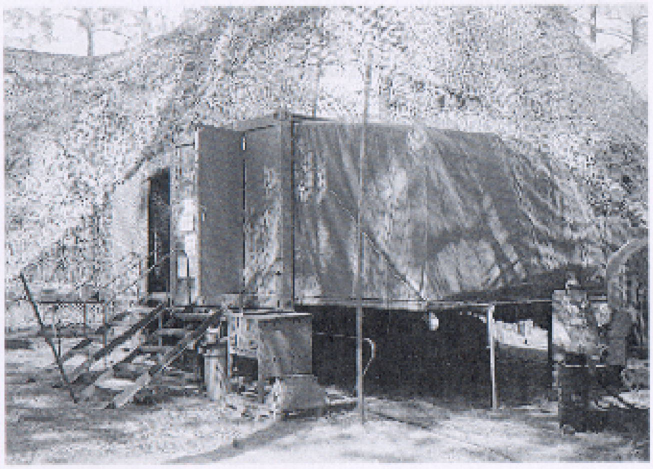
Improved mobile kitchen trailer. The mobile kitchen trailer (MKT), the most common field kitchen in use, was fielded in 1975. While it continues to serve soldiers well, the MKT has no electrical power, no lighting, no ventilation, no cold-weather operating provisions, and insufficient storage and refrigeration. Furthermore, not all MKT's will be replaced by the new containerized kitchen; many will remain in service for years to come.

The mobile kitchen trailer-improved (MKT–I) program will add greater capabilities to those MKT's remaining in service. A commercial ice chest will replace the current military standard ice chest; the ultimate objective is to add a refrigerator using the latest commercially available technology. With the fielding of the MBU, a 2-kilowatt generator will be added to the MKT for power. Fluorescent lighting will replace the current gasoline-burning lanterns. A ventilation system will be added to improve temperature distribution and air circulation and to assist in expelling exhaust. Cotton duck fabric will be replaced with vinyl-coated polyester. More durable can openers and a new griddle top with a higher lip also will be provided. Finally, a cold weather kit, including floor mats and fabric skirts extending to the ground, will be added to block cold air and insulate the floor. Under current plans, only Fort Lee, Virginia; Fort Hood, Texas; the Joint Readiness Training Center at Fort Polk, Louisiana; the National Training Center at Fort Irwin, California; and two Army Reserve units will be provided one of the MKT–I suite of improvements.

☐ Mobile kitchen trailer-improved

Containerized kitchen. The containerized kitchen (CK) is a new mobile field kitchen that provides a flexible, efficient, rapidly deployable food service capability for increased, consolidated meal preparation. One CK is capable of replacing two MKT's and can support over 550 soldiers with 3 hot meals per day.

The CK consists of a combination of existing military standard kitchen equipment and commercial com-



☐ **Containerized kitchen.**

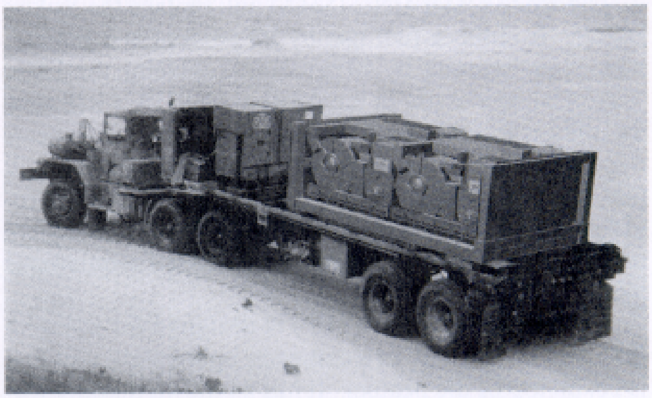
ponents integrated into an expandable 20-foot container mounted on a tactical trailer. The CK contains 33 cubic feet of refrigerated storage space and will be able to store 50 gallons of potable water. It can be transported by the palletized loading system (PLS). Units will begin receiving the CK late in fiscal year 1999.

Food sanitation center. The food sanitation center (FSC) is replacing the immersion heater and garbage can system for sanitizing food service equipment in the field. The FSC is housed in a TEMPER (tent, expandable, modular, personnel) and includes sinks with MBU's, drying and storage racks, drain tables, and worktables. Funding gaps have prevented continuous fielding of the FSC, but production and distribution should begin again in fiscal year 1999. Fieldings to FP 1 units will not be completed until fiscal year 2010.

Field Service Equipment

Laundry advanced system. The M85 field laundry will be replaced soon by the laundry advanced system (LADS). One LADS will replace four M85's. Currently, four M85's require 24,000 gallons of water a day to operate and generate nearly 20,000 gallons of wastewater daily that must be removed. Given a water supply cost of 3 cents a gallon and vendor costs of approximately $150 to remove 1,000 gallons of wastewater, the daily cost of operating four M85 exceeds $3,000. By comparison, the LADS requires less than 600 gallons of water initially and generates only 20 gallons of wastewater per day. Reduced water requirements alone will save over $2,000 during every day of LADS operation.

The LADS consists of laundry processing and water recycling equipment and a 30-kilowatt tactical quiet generator mounted on a 30-foot M871 trailer. The LADS has two 200-pound-capacity drums and is capable of

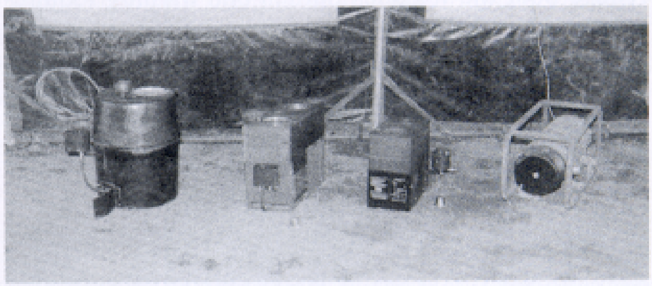


☐ **Laundry advanced system.**

processing laundry for 500 soldiers a day. It uses the latest technology to wash and dry clothes in the same drum. Dirty clothes are placed in the drum and removed clean and dry at the end of the cycle. The reliability of the LADS also far exceeds that of the M85. In addition, the number of vehicles, trailers, and personnel required to process laundry will be reduced by 75 percent with the arrival of the LADS. FP 1 and 2 units are due to receive the LADS by fiscal year 2003; other fieldings will occur through fiscal year 2013.

Family of space heaters. The family of space heaters (FOSH) will replace the Army's current field heaters, including the M1941 and M1950 (Yukon) heaters. With the exception of the H45 space heater, fielded in 1992, nonpowered field heaters have not been improved since the late 1950's.

In the past, Army field heaters have been ranked as high as the number 9 priority on the Army safety list. Use of antiquated heaters has caused numerous fires that have burned soldiers and caused extensive property and equipment damage. Units may augment their assets with



☐ **Family of space heaters.**

inexpensive, unvented heaters, but this also can lead to an unsafe situation. FOSH will eliminate the severe safety hazards and operational deficiencies that characterize current non-electrically powered heaters while retaining their simplicity and ruggedness. FOSH heaters operate without the use of electrical power and can burn all types of liquid and solid fuel. New vaporizing R-tube burner technology overcomes major combustion and safety problems.

The space heater arctic (SHA) will replace the Yukon heater. It reduces fuel use by 20 percent and maintenance requirements by 40 percent. Replacing the 5,000 Yukon heaters in use in the Army with SHA's will save $1 million in fuel and $2 million in maintenance costs over the course of a single heating season; the SHA will pay for itself in one season. Current funding will provide an initial issue of 200 to 300 SHA's. Subsequent requirements will be supported by funded requisitions from the requesting unit.

A thermoelectric fan (TEF) is designed for use with the FOSH. The TEF is a compact, lightweight unit that is set on top of the heaters. It has a built-in thermoelectric module that converts heat from the stove into electricity to power a 450-cubic-feet-per-minute fan. The fan blows air over the heater and down to the bottom of the tent, thus improving air circulation and providing more even distribution of heat throughout the entire shelter. Improved heating performance as a result of the TEF allows the heaters to be operated at lower outputs, thus reducing fuel consumption further.

Shelters

Lightweight maintenance enclosure. The lightweight maintenance enclosure (LME) is a frame-supported lightweight shelter designed to provide units with a covered facility for conducting tactical maintenance operations. The LME is a modification of the TEMPER, in which the tent frame has been extended to add the height needed for enclosing tactical vehicles and equipment. The end walls have been designed with sliding fabric doors to permit total enclosure during conditions of extreme weather or blackout. Since the LME is a modification of the TEMPER, its similar erect-and-strike procedures, as well as common components, will reduce both the logistics burden and training requirements. The LME is a table of organization and equipment replacement item for the standard Army maintenance tent (the Fritsche). The LME is approximately 50 percent lighter, $5,000 less expensive, and has 50 percent fewer parts than the Fritsche.

☐ **Light maintenance enclosure.**

The LME erect-and-strike time is 50 percent less than that of the Fritsche. Erecting and striking the LME can be accomplished in 35 minutes, and no materials-handling equipment is required. The LME is equipped with its own commercial power distribution box and standard florescent light set. It also can be connected end-to-end in 32-foot increments to increase its length.

Current LME production funding will provide approximately 1,300 of the required 5,000 shelters by fiscal year 2003.

Modular general purpose tent system. To support the Army during initial deployment to Bosnia, 3,000 general purpose tents were drawn from stockage. These tents leaked so badly that the tops of another 3,000 tents were cut-off and placed over the originally issued tents. New general purpose tents now use new heat-seal seaming technology to prevent leaks. The modular general purpose tent system (MGPTS) is a pole-supported and more habitable replacement for the current general purpose small, medium, and large tents.

The MGPTS uses tensioned fabric to create a structure that distributes wind, rain, and snow loads from the fabric directly to the support system. This design enables the MGPTS to distribute loads more efficiently with lighter support systems than conventional GP tents. The MGPTS serves as a billeting, command and control, unit supply, or field services shelter. The modular design consists of one type of end-section fabric, one type of intermediate-section fabric, and one type of side pole, end pole, and center pole. The system has a 7-foot eave height and is 18 feet wide. It can be extended indefinitely by adding 18-foot intermediate sections.

☐ **Modular general purpose tent system.**

The MGPTS uses the same erect-and-strike procedure for each size of tent. Windows and screens are built into the tent walls. The MGPTS imposes a reduced logistics burden since it has only 7 main component national-stock-numbered items, compared to 13 in current GP tents. The MGPTS connects to TEMPER and other MGPTS tents by using the standard TEMPER vestibule that is already in the system. Additionally, the MGPTS has a much greater floor area and usable volume than GP tents.

While soldier support items of equipment are not the high-dollar, glamorous items that capture headlines, they are essential items that make a difference in a soldier's life regardless of his rank or duty position. For relatively small investments, major improvements can be made, savings can be achieved, and operating and support costs reduced. We have the technology, the need, and the opportunity to provide soldiers with better quality equipment. We can provide them more efficient, more reliable items that directly impact their combat effectiveness. We must take advantage of the opportunities and be as attentive to soldier support equipment as we are to weapon systems themselves. If we don't, we will have 21st century warriors supported by World War II-vintage equipment.

SFC Miller and his crew finally found time to do some personal rearming, refueling, and repairing. Their first stop was the "WB." Initially, soldiers were skeptical of the waterless bathing station that claimed to get you clean and refreshed, yet used no water. But after the initial leariness wore off along with the dirt, this system became one of the most popular soldier support items in the inventory.

While Miller was getting refreshed, so were his field uniforms. The ILADS (improved laundry advanced system) was working its magic. Water consumption had been reduced further over the LADS by adapting elements of the WB. Miniaturization, such as the new 10-kilowatt tactical quiet generator-miniature (TQG–M), had reduced the laundry system to the size of a small CONEX container. The ILADS could be pulled by the new Hummer II. Improved recycling technology also separated oils and lubricants from soiled laundry, treated them, and containerized them for return to the LCS as the base liquid for the PLOP system.

Next stop for SFC Miller was the field mess, where he exhaled into the personnel resource identification and status monitor (PRISM) that was the human equivalent of the M1A4's FunGun. The PRISM determined his sustainment needs and provided the data to the containerized automated ration machine (ARM). The ARM presented Miller with a series of options. He pressed option key 3 on the ARM, which was preprogrammed to prepare his meal in the Tex-Mex style he favored. Within seconds, a spicy chicken burrito and salad were dispensed, all formulated with the precise calories, electrolytes, and performance-enhancing nutrients needed to invigorate mind and body. Miller chuckled at the breath mint tab on the burrito's wrapper.

Showered and fed, SFC Miller headed for his bunk, ready to crash. Commercial mattress giants, working with the outdoor expedition and adventure industry, had really produced winners with the new field bunks. But to Miller, the smart shelter enclosing him was one of the marvels of his time. The in-fabric bug repellant was just for starters. This shelter was supported by seamlessly woven Kevlar airbeams. The exterior active camouflage fabric blended with the surrounding environment, adjusting and adapting to surrounding nature, sunlight, and cloud cover and altering its appearance accordingly. It also was capable of changing shape to reduce wind loading.

Stealth technology applications also made the shelter infrared defeating and eliminated the age-old problem of light discipline. By applying infrared-defeating techniques to the visible light spectrum, it now was impossible to detect light emanating from an open door at night.

The topper, however, was the ability of the tent material to become rigid in response to weather and ballistic threats. The shelter's name, BAM (ballistic and multipurpose shelter), was appropriate.

The latest field heaters also were a big hit with SFC Miller's soldiers. Self-contained and capable of running continuously for 48 hours on a watch battery, they were the size of the small speakers Miller used to have connected to his computer. On the base, there was a telescoping wand that extended up to 4 feet and served as a ground stake. You could set this heater on your desk or stick it in the ground next to your bunk. At the lowest setting, one heater would meet the requirements of the soldier crew tent; at the highest setting, three heaters could keep an MGPTS comfortable.

While a soldier's life had not gotten easier over the years, the leaders were staying attuned to how to keep it tolerable. SFC Miller was thankful that senior leaders paid as much attention to soldier support items as they did warfighting equipment.

ALOG

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Total Ownership Cost Reduction— A Secretary of Defense Imperative

by Lieutenant Colonel Randy T. Mathews

Secretary of Defense William S. Cohen announced in 1997 that reducing total ownership costs for our defense systems not only made good sense but was the only way that the Department of Defense (DOD) would be able to afford to sustain and modernize its weapon systems in the near future. He charged the Defense Systems Affordability Council (DSAC), the successor to the Defense Manufacturing Council, with identifying, tracking, and reducing total ownership cost for our weapon systems. The DSAC chartered a number of subgroups to investigate and report on promising methods of accounting for ownership costs, identifying total ownership cost-reduction tools, providing incentives to management and industry, and empowering managers at all levels to find and fix cost drivers.

As anyone who has ever owned a pet knows, the cost of acquiring the critter is quickly overshadowed by the cost of food, veterinarian visits, toys, and maintenance products. Defense systems, while not cute, cuddly, or even fun, follow the same rationale: approximately 81 percent of the total ownership cost of a system is incurred after the item has been delivered to the user. The project manager is responsible for the research, development, acquisition, and fielding of any given system. However, once supplied to the user in the field, a system is used, maintained, modified, and disposed of by a variety of individual organizations. Each of these organizations, from the Army Materiel Command to an individual company, battery, or unit, has responsibility for a slice of the total ownership cost.

Total Ownership Cost

The term "total ownership cost" (TOC) raises a bit of confusion in many quarters. We all know what we paid when we purchased our last car. Once we drove off the dealer's lot, we assumed responsibility for additional ownership costs: gas, oil, car washes, steering wheel covers, wax, tires, and so on. If we add to the purchase price those costs associated with daily operation, maintenance, and insurance, we begin to get a feel for total ownership costs.

A memorandum from the Under Secretary of Defense for Acquisition and Technology on 8 October 1997 defines TOC in defense terms as "the sum of all financial resources necessary to organize, equip, sustain, and operate military forces sufficient to meet national goals in compliance with all laws, all policies applicable to DOD, all standards in effect for readiness, safety, and quality of life, and all other official measures of performance for DOD and its components." TOC is more comprehensive than life-cycle cost (LCC). LCC is all directly identifiable costs for developing, producing, fielding, operating, supporting, and disposing of a specific system or product line. It is a subset of DOD TOC and is estimated at various points in a system's life cycle. The verb "estimated" is used here rather than "calculated," because the DOD still is working to capture all the costs associated with a particular system but has not implemented a comprehensive system to capture or aggregate these costs. For the purpose of this article, TOC should be considered synonymous with LCC, as a more manageable entity for our defense managers.

The Army and TOC Reduction

The Chief of Staff of the Army and the Army Acquisition Executive (AAE) identified the reduction of operations and support (O&S) costs as a high priority that is vital to achieving our modernization goals. Reducing TOC is key not only to reducing fiscal demands on the operational commander but also to generating savings that can be reinvested in support of Force XXI modernization objectives. The importance that Army leaders place on TOC reduction is documented in an 18 May 1998 memorandum, signed by the Chief of Staff of the Army and the AAE, and reinforced to the acquisition community by its inclusion in performance evaluations for both military and civilian program, project, product, and item managers and Army Training and Doctrine Command systems managers. The Army has been successful in reducing acquisition program costs in earlier efforts—a cost-reduction and reinvestment initiative garnered in excess of 10 percent savings of programmed modernization funding, which was redistributed to high-priority Army needs.

Examples of two current TOC efforts are the M1A1 Abrams Integrated Management (AIM) XXI program and conversion of RC–12N aircraft to the RC–12P configuration. The AIM XXI joins Anniston Army Depot, Alabama, with General Dynamics Land Systems to establish a comprehensive sustainment management program by standardizing and returning the M1A1 fleet to zero miles, "like new" condition. Economic analysis showed that O&S costs were reduced by as much as 50 percent while improving availability and maintainability and producing cost-avoidance modification opportunities. The RC–12N to RC–12P TOC reduction initiative was approved for funding in Program Objective Memorandum (POM) 00-05, requiring an investment of $16 million in fiscal year (FY) 2000. The projected savings over the life of the program are $65.7 million.

Logistics TOC Efforts

Thus far, our discussion has been of "acquisition" and very little of "logistics." As noted earlier, "pure" acquisition ends when the system is fielded—when only 19 percent of the life cycle cost has been spent. It is in the domain of the traditional logisticians that the greatest gains in reducing total ownership costs can be made. While aggressive acquisition reform measures have been successful in trimming our "up-front" systems costs, they have not been enough. The Revolution in Military Affairs was intended to broaden our thinking, to look beyond our current historical horizon. The Revolution in Military Affairs has spawned a number of efforts, including the Revolution in Military Logistics (RML), which have the potential to lower TOC. Two of the three RML domains, technology application and acquisition agility and force sustainment, speak directly to the TOC reduction goals.

Logistics initiatives that have direct TOC reduction impact include fleet management, the supply management Army operations and support cost reductions (SMA OSCR), and integrated sustainment maintenance (ISM). In the area of fleet management, for example, the estimates for LCC savings for the M109 family of vehicles indicate an expected 20- to 30-percent savings over traditional organic logistics support, with a parallel increase in readiness. SMA OSCR shows the potential for saving $275 million over FY's 1998 to 2003. OPTEMPO savings from ISM are estimated at approximately $140 million over the same years. Leveraging savings in the O&S phase of a system's life cycle provides the greatest opportunity for saving, as 81 percent of the system cost is in this phase.

A Coordinated Effort

The Army has recognized the need to integrate acquisition and logistics efforts for TOC reduction. An overarching integrated process team (OIPT), co-chaired by the Assistant Secretaries of the Army for Research, Development, and Acquisition and for Installations, Logistics, and Environment is being chartered to coordinate all Army TOC reduction efforts, reduce duplication, provide leadership for TOC issues in the Army, and serve as a single Army voice to the Office of the Secretary of Defense. This OIPT will oversee the activities of working-level IPT's, which are composed of acquisition, logistics, and resource managers. Early fruit of this cooperative effort includes the Modernization Through Spares (MTS) program. In that program, performance-based specifications drive procurement of spares that capitalize on state-of-the-art commercial products, processes, and practices to improve readiness, reduce sustainment costs, and extend a system's useful life. Acquisition and logistics managers at all levels must continue to work together to achieve the Army's TOC reduction goal.

The Road Ahead

TOC reduction is not a fad program. It is a policy that must be integrated into every action we take, every decision we make, and every dollar programmed or spent on a system. The Army is making dramatic changes as it reshapes itself for the future. We have reduced the number of divisions, and restructured them to be more lethal yet less manpower-intensive. We have moved the field soldier and command structure into the information age and provided battlefield awareness and control capabilities without precedent. These major changes must be matched by our commitment to support and sustain the force within the fiscal reality of reduced Federal defense spending. We must mirror these physical and organizational changes with new paradigms for systems life-cycle management.

Ongoing Army initiatives exemplifying this thinking include establishing a disciplined process to identify and fund investment initiatives in each POM; having program executive officers and program managers identify their top 10 cost drivers and develop plans to produce and track O&S savings; developing and enforcing sustainment cost management annexes for each acquisition program; instituting paperless contracting; reducing acquisition cycle time; and conducting a study of competitive sourcing and privatization.

Acquisition and logistics managers have made progress in identifying areas in which total ownership costs can be reduced. The "low-hanging fruit" has been harvested. Collectively, we now must find innovative ways to maintain the momentum of the TOC reduction effort.

Conclusion

The Army's leaders are committed to meeting the Secretary of Defense's challenge for TOC reduction. We have our best team on the case—you and me. It is up to each of us to look within and without our areas of responsibility and find opportunities to preserve readiness and reduce the financial burden on the commander in the field. Chinese warrior and philosopher Sun Tzu made a good point 2,400 years ago when he said: "Opportunities multiply when they are seized." We must now capitalize on the ongoing TOC reduction efforts and make them multiply. **ALOG**

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One-Stop Shopping at CECOM

by Kathleen A. Bannister

The Army Communications-Electronics Command has reorganized its support to the field, bringing contractors and Army civilians under the umbrella of regional electronic sustainment support centers.

The Army Communications-Electronics Command (CECOM), headquartered at Fort Monmouth, New Jersey, has taken service to the military customer to new heights by putting all of its service providers under one big umbrella. As the Army downsizes, its ability to keep up with its sustainment maintenance requirements has been reduced. At the same time, there has been an explosion in battlefield technology, much of which requires support at a level of expertise that is dominated by contractors. To meet the challenge, CECOM has established Electronic Sustainment Support Centers (ESSC's) to provide "one-stop shopping" for command, control, communications, computer, and intelligence and electronic warfare maintenance.

A Historical Perspective

The Vietnam War produced a new kind of support requirement, which continues today. In addition to the base camp (provided in many cases by local nationals) and general logistics support, technical personnel were on site throughout the country to support the growing amount of complex, newly fielded electronic equipment. This equipment ranged from increasingly complex radios and radars to the computer mainframes used in headquarters areas and Saigon. Even the automotive and munitions communities were producing more complex equipment with which the quickly trained soldiers were unfamiliar. While soldiers could not repair them easily, they could get assistance from in-country Army civilian logistics assistance representatives and contractor technical and repair representatives.

By the time Iraq invaded Kuwait on 2 August 1990 and President George Bush coordinated the insertion of the XVIII Airborne Corps as the first wave of troops into Saudi Arabia on 6 August, the U.S. military had assumed that contractor support was going to be a reality for all time. The Army Materiel Command (AMC) and its subordinate commands made hasty plans to get their contractors and civil service personnel in place in the desert as soon as the President and the other nations involved approved the deployment. In an article in *Army* magazine, then Lieutenant General Jimmy D. Ross recognized that AMC deployed and operated several specialized repair activities to support Army systems, employing 1,066 contractors and more than 850 AMC personnel.

The battle in the desert was, without a doubt, an outstanding victory for the United States and its allies. The logistics support rendered to the soldiers was remarkable and played a major role in the success of the mission. But during Operations Desert Shield and Desert Storm, contractor support proliferated across the battlefield. CECOM alone supported 168 end items, at least in part, with 134 contractor personnel representing 25 companies—and these companies were not all located in one spot on the battlefield. As one might expect, this left the soldier in the field somewhat confused about where or to whom he should go for support.

Contractor support presented additional challenges, the chief of which was command and control of contractors in the theater. To resolve this problem, CECOM established a special repair activity that served as an umbrella organization to provide command and control and life support for the contractors supporting command, control, communications, and computer systems. In addition, the CECOM Intelligence Materiel Management Center established a similar organization, the Rainbow Special Repair Activity, for intelligence and electronic warfare systems.

The ESSC: One-Stop Shopping

Although the victory was ours, understanding what we did in Southwest Asia and how we can do it better is critical to our success in future contingency operations. Postwar studies showed a need for a better way of organizing and controlling contractors on the battlefield and making them more accessible to the soldiers and their units. Activities such as the CECOM Special Repair Activity and the Rainbow Special Repair Activity were models for future success.

Since the Gulf War, AMC, and CECOM in particular, has increased its reliance on contractor support for sophisticated communications-electronics and weapon systems. The increased rate of technological advances and the growing application of commercial off-the-shelf and nondevelopmental items are the primary reasons behind this trend. Since the war, CECOM has deployed numerous contractors and Army civilian personnel to ensure continuous sustainment support.

What we needed was some way of managing these multiple service sources. The solution was a structure that would join all of these service providers into a single, cohesive support entity. The ESSC's provide that structure on a regional basis by acting as an umbrella for all service providers. The "umbrella" is the ESSC staff. A CECOM civilian at each of four regional facilities coordinates these efforts and is backed up by a management cell at Fort Monmouth. The four ESSC's are located at Fort Bragg, North Carolina; Fort Hood, Texas; Friedrichsfeld, Germany; and Camp Market, Korea.

These four centers provide support that is diverse enough to support six Intelligence Electronic Warfare Regional Support Centers (IEW RSC's); five Tobyhanna Army Depot (Pennsylvania) forward repair activities; four mobile subscriber equipment regional support centers (MSE RSC's) run by contract personnel from GTE; the Standard Army Management Information Systems; Tier III office automation equipment; Common Hardware Systems; and many more new customers on a regular basis. In addition, the ESSC's support contingency deployments, such as Bosnia and Hungary, where there is an active support cell reporting to the ESSC located in Germany, and Operation Desert Thunder in Kuwait.

IEW RSC's are located at Fort Bragg; Fort Gordon, Georgia; Fort Hood; and Fort Lewis, Washington. There also is one in Germany, at Friedrichsfeld and Bad Abling, and one in Korea, at Camp Kyle and Camp Humphries. The Tobyhanna forward repair activities are at Fort Bragg, Fort Hood, Germany, and Korea (all collocated with IEW RSC's) and Hawaii. The MSE RSC's are located near the Fort Bragg, Fort Hood, Germany, and Korea ESSC's.

This structure allows a number of economies of scale to be realized. The cost of operating an ESSC can be spread over many customers, even though they do not have the same contractor base. There also is a standard management information system used by most contractors for data management, and that system covers all of the equipment repaired at all sites. In addition, several of the sites are involved in repair and return of electronic items like circuit card assemblies, and all provide technical assistance to the soldier level of repair. The intent, then, is to provide management and a common management information system while maintaining a "single face to the field."

The single face to the field is exemplified by the "one-stop service" that allows the customer unit to drop off its broken items at any of the service providers in its region. From that drop-off point, the specific service provider or the ESSC manager will pick up the broken items and get the repairs underway. The return route for the equipment is equally as simple for the soldiers being supported: a call is placed to the unit to determine the best method of returning the items. To date, this capability has been established at the Fort Bragg and Fort Hood ESSC's.

Managing Regional Support

An ESSC's main function is to provide management oversight of all service providers assigned to its region and, by doing so, provide a unique, multifaceted repair capability to all Army units located within that region. The regional ESSC site manager not only oversees all maintenance being performed by the attached service providers but offers the services of these activities to Army units who need additional maintenance support. This type of support is possible because the ESSC can funnel reimbursable work to any of the regional service providers through a series of omnibus and support contracts as well as agreements with Government depots.

This capacity for accepting new work has proven very useful in satisfying regional maintenance requirements through the Army's recently established Integrated Sustainment Maintenance (ISM) process. It also has been very successful in providing support to project managers of soon-to-be-fielded systems that require field support that cannot be provided by organic military units. This has provided the double advantage of reducing the number of contracts used to provide field support and making more efficient use of existing resources already deployed to provide support.

Supporting IEW Equipment

An example of this can be seen within the IEW RSC's. Currently, the IEW RSC's combine CECOM's contractor logistics support and interim contractor support contractors and the major Army commands' limited number of general support-level soldiers into a repair and maintenance force in one general area. This work force provides a broad range of engineering, management, logistics, and technical services. Experts provide over-the-shoulder training to soldiers with lower skill levels and to soldiers at the units. This is accomplished face to face as well as telephonically.

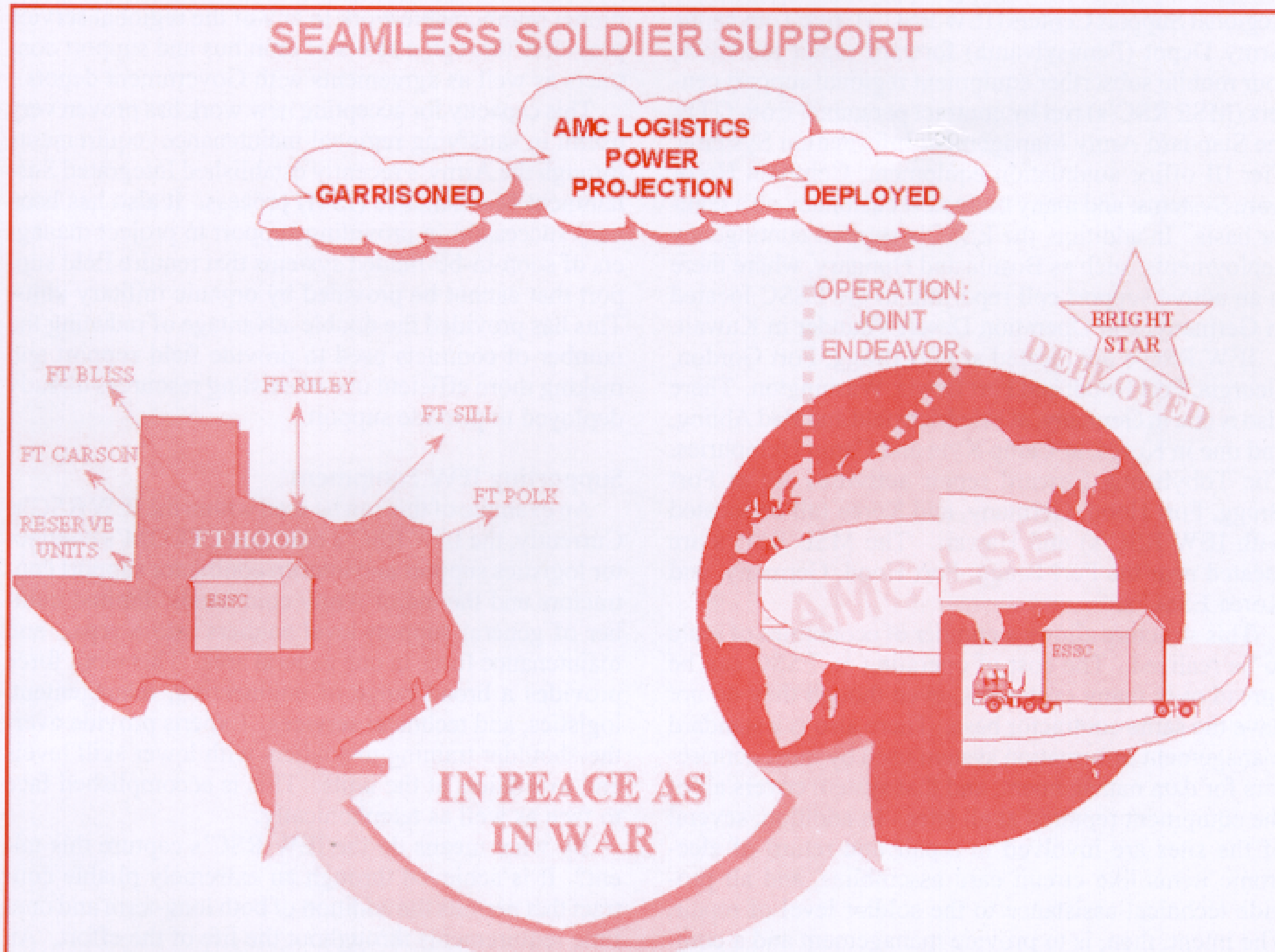
By what means do the IEW RSC's capture this talent? It is achieved through an extremely pliable contract that permits the addition of both long-term and one-time requirements throughout the life of the effort. An important factor here is the number of personnel at the facilities who hold high-level clearances. High-level clearances permit more flexibility in performing repairs at the field level because the site work force is available to work on the equipment while it is operating. The contractor work force is highly cross-trained to use the time available efficiently.

Maintenance and Supply Services

Another example of the service provided by the ESSC has been occurring in Germany. Considerable changes in the Germany Status of Forces Agreement are being negotiated, and the results will affect the status and privileges of both contractor personnel and Government managers while they are in Germany. The ESSC manager hopes to have all CECOM contractors in the country certified as technical experts. The site manager in Germany is responsible for keeping the rest of the CECOM community aware of the status-of-forces changes and assisting them to meet the new requirements.

ESSC Government site managers are tasked with finding, establishing, and maintaining facilities at their locations. In some cases, this has meant finding a new home for the maintenance function at that location. In others, it has meant repairing existing facilities because no others will be available in the foreseeable future. Managers also coordinate with supported units and their corps headquarters to obtain accommodations during an exercise or deployment.

The ESSC collects and evaluates maintenance data on repairs to determine their operational effectiveness and identify efficiencies that will enhance readiness, reduce maintenance turn-around times, streamline repair processes, organize and consolidate resources, increase responsiveness, and control costs. Out of this effort come management reports that show customers where their funds have been spent and project leaders



☐ The ESSC's support units and installations in their regions. In a contingency, a part of the ESSC deploys with the units it supports. Unit commanders can expect the same contractor support in garrison or theater–another aspect of one-stop service.

which items have high failure rates. These reports are developed by using the single data base used by most of the service providers.

Customer Service

An often overlooked ESSC service is the interface with the customer. Once all repairs have been completed and data collected, the ESSC is required to provide customers with the data they need for all of their missions. The ESSC does this through status reports, funds expenditure reports, maintenance reports of many varieties, and tailored reports. The reports of the ESSC manager and the management support cell are frequently much different because of the target audiences they reach, but they are just as important. There also are negotiations at several levels for new work or additional work from the same customers. Some of these negotiations result from changes in the configuration of a system, others because of the replacement of a system with something newer and better, and yet others because the bill payer for the repairs has changed.

In addition to the obvious customers—the military units in the field—the ESSC serves multiple program executive offices and their associated program, project, and product management offices by providing sustainment maintenance and warranty support through one of the ESSC service providers. For example, both the Tobyhanna Army Depot forward repair activities and the MSE RSC's provide support to the Product Manager for Common Hardware Systems. This system offers the Army an effective and cost-efficient method for addressing sustainment issues.

In addition to sustainment maintenance, the ESSC provides centralized management of critical, expensive, low-density spares and repair parts. At present, the ESSC acts as a forward supply activity for the Joint Surveillance Target Attack Radar System. This arrangement reduces authorized stockage list requirements (and associated costs) and provides greater visibility of assets on hand.

The capabilities of ESSC's include replication of software, software and local area network (LAN) management, and provision of help-desk-type capabilities. These efforts are largely confined to specific systems, which require considerable concentration on software due to their complexity.

Another aspect of one-stop service that eases the minds of soldier customers as they prepare to deploy is the "seamless soldier support" offered by the ESSC's. What does this mean? Simply put, the contractor support the unit commander has become accustomed to in the garrison is the same contractor support he will have when he reaches his unit's deployment site. AMC has established a logistics support element (LSE) to provide maintenance and other support to units as a soldier support cell forward.

In garrison, the ESSC's support several units and bases. When one or more of those units is called on in a contingency, a piece of the ESSC also will go forward to continue the support. This slice of the ESSC is tailored to the systems being deployed and the mission. In most cases, the support cell consists of the same contractor and Army civilian personnel who were at the garrison with the soldiers. At the same time, there is never a loss in the quality of service at the garrison, where the remaining contractors and civilian personnel provide for the troops left behind.

While the main focus always has been on the Army, the ESSC umbrella is extending its broad support to include specific Air Force, Marine Corps, and Navy systems, as well as the National Weather Service and allied forces requirements.

This wave of the future will continue to expand its customer base to such an extent that customers are nearly as numerous as the systems covered. During this era of dwindling budgets, the one-stop shopping concept has become the Army's low-cost, and highly effective, alternative.

In the future, program executives and program managers can incorporate the ESSC concept into their acquisition and sustainment strategies, which will contribute to a "win-win" situation for both organizations. They can reduce costs by using existing maintenance capabilities instead of proliferating "stovepipe" systems. On the other hand, by increasing its customer base, the ESSC can realize reduced costs that it can pass on to customers.

The ESSC offers the Army an opportunity to establish a consolidated electronics sustainment maintenance approach that will continue to improve unit readiness and equipment availability at reduced cost. **ALOG**

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Combat Ration Logistics—From Here to Eternity

by Joseph A. Zanchi and Alan J. LaBrode

As the 21st century approaches, state-of-the-art technologies are providing today's warriors with the highest quality rations in the world. Modern battlefield requirements demand ration support systems that adequately provide for the needs of the individual warfighter in extremely intense and highly mobile combat situations. The revised national military strategy of power projection of primarily continental United States (CONUS)-based forces and planning for Joint Vision 2010 and the Army After Next require revolutionary approaches and "out of the box" thinking to support this dynamic battlefield of the future. The preeminent land power forces capable of dominance across the full spectrum of conflict require an individual mounted and dismounted warfighter who can be sustained in any field environment. Widely dispersed, quick-moving, deployed forces will require total battlefield asset visibility and velocity management of all rations.

The Army Soldier and Biological Chemical Command's Soldier Center of Excellence at Natick, Massachussetts (known until 1 October 1998 as the Natick Research, Development, and Engineering Center), is responsible for the design, development, and testing of military rations for the Army, Navy, Air Force, and Marine Corps. Under the auspices of the Department of Defense (DOD) Combat Feeding Program, research and development efforts since Operation Desert Storm have led to significant progress in improving the quality, variety, and acceptability of rations while reducing their weight and volume. Volume requirements for shipping special-purpose rations have been reduced by up to 38 percent. Ration storage life also has been extended, nutritional quality and content have been increased, and the durability of packaged rations has been improved. Additionally, stocking and ordering rations have been made significantly easier.

Innovative Integrators

The standard military ration for the individual warfighter is the meal, ready to eat (MRE), which replaced the meal, combat, individual (C ration), in the early 1980's. The MRE must maintain high quality when stored for 3 years at 80 degrees and 6 months at 100 degrees Fahrenheit, must be highly palatable, and must meet the nutritional requirements of the Office of the Surgeon General (OTSG). Ration development constraints include wholesomeness, producibility, cost, self-heating capability, modularity, weight and cube, and performance enhancement. In addition, MRE packaging must meet stringent durability requirements, to include the ability to withstand airdrop, rough handling, and temperature extremes.

☐ Enjoying an MRE in the field.

Since its introduction, the MRE has been improved continuously. However, as a result of feedback from Operations Desert Shield and Desert Storm, major customer-driven improvements have expanded variety and

□MRE improvements.

improved palatability, consumption, and nutritional content to enhance performance on the battlefield. These rapidly fielded, customer-focused improvements have been made possible through the efforts of the Combat Ration Integrated Product Team (CRIPT), whose members include the customer, combat developer, materiel developer, procurement agency, and vendors. Since 1993, 70 new items have been approved for inclusion in MRE's, while 14 of the less acceptable items have been replaced. The number of menus has increased, incrementally, from 12 to 24, and 4 vegetarian meals now are included (2 in each case). A new easy-open meal bag with commercial-style colors and graphics has been added, and nutritional labeling has been implemented.

A continuous product improvement program will enhance all of the fielded individual rations further by evaluating new items and preparing and transitioning performance-based requirements to the Defense Logistics Agency's (DLA's) Defense Supply Center Philadelphia (DSCP) for procurement. Current and future initiatives provide technology insertions to improve the MRE continuously to provide sustained energy, mental alertness, and eat-on-the-move capability for the warfighter, while reducing weight and volume, improving logistics, and enhancing performance.

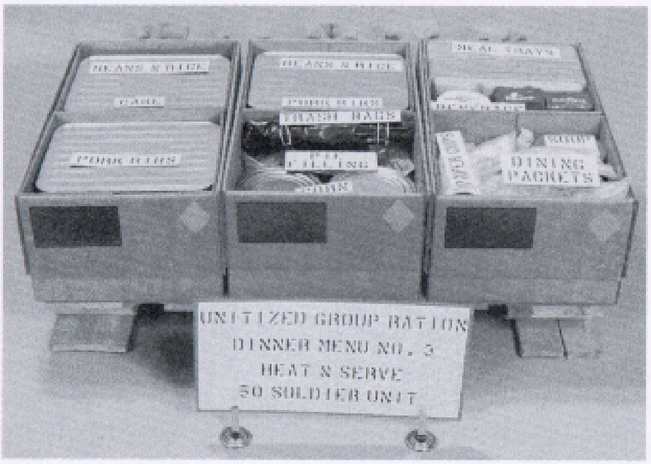
Use of time and temperature indicator (TTI) labels on MRE ration cases has proven to be a great success in quickly and effectively monitoring the quality of prepositioned MRE's. Because military rations must be pre-positioned, stored, and used under all environmental conditions worldwide, the TTI indicators are an important tool in ensuring that only the highest quality food is provided to our warfighters. The TTI labels attached to every MRE shipping case during assembly provide food inspection teams a new capability that virtually ensures "least fresh, first out" stock rotation. Since introduction of the labels, ration waste, spoilage, and inspection time have been reduced drastically .

The "bull's eye" TTI label has an outer reference ring and an inner circle that darkens with time. It darkens more quickly as the temperature increases. The quality of food products is highly dependent on the time and temperature of storage; therefore, the darkening of the inner circle is directly related to the quality of the food. In February 1998, the 106th Medical Detachment (Veterinary Services), with support from Eighth Army and the Pusan Storage Facility, retrofitted approximately 125,000 cases of MRE's stored in Korea with TTI's that were pre-stressed to match the remaining shelf life of the MRE's. The remaining shelf life was determined based on the quality of the ration components observed during on-site inspections conducted by Natick personnel. This ration inspection helped to ensure that only high-quality rations are provided to our forces. As a result, the MRE's are more acceptable to the troops, more likely to be consumed, and consequently, they maximize the nutrient status of the soldiers. Future enhancements to the TTI label include a bar-code system that will provide readily accessible and retrievable baseline product data for inventory management and inspection, with encoded information adjustable to user requirements.

□Nutritious HooAH! bar.

Unitized Group Rations

The unitized group ration (UGR) is designed to simplify and streamline the process of providing the highest quality group meals to troops in the field by integrating heat-and-serve (H&S), shelf-stable, and perishable rations with quickly prepared, user-friendly, brand-name products. The UGR is used to sustain groups of military personnel during operations that allow orga-



☐ **Unitized group ration.**

nized food service facilities to be set up. With the introduction of the UGR, the number of line items to be ordered was reduced from as many as 34 to no more than 3. The pre-mixed selection of UGR menus ensures variety and maximizes consumption by avoiding menu repetition and boredom. The UGR has 5 breakfast and 10 lunch or dinner menus. Currently, the UGR–H&S is available for procurement. Each UGR-H&S module provides 50 complete meals, which are packed in 3 boxes, including disposable trays, cups, flatware, and trash bags. Each pallet contains 8 modules, or 400 meals. The UGR H&S is assembled at Government depots and has a shelf life of 18 months at 80 degrees Fahrenheit.

The UGR-A currently is being field-tested. UGR-A is a "build-to-order" ration that can be delivered directly by the vendor when given a 30-day maximum lead time. It has a 6-month shelf life. This all-commercial option will provide all of the components needed to prepare 50 perishable meals (A-rations) in the field. A medical supplement to the UGR streamlines the ordering process for medically unique components that augment the UGR for hospital field feeding. Each module is designed to support a 50-patient combat support hospital for 5 days.

The Fielded Group Ration Improvement Program continues to assess new and improved group ration components, including nondevelopmental and in-house-developed entrees, starches, vegetables, snacks, and desserts to determine customer acceptance and preference. Fiscal year (FY) 1998 field assessments of the UGR included monitoring the procurement, distribution, and acceptance of an all-commercial A ration and a field evaluation of new and improved H&S ration components. The UGR-A award by DSCP to a prime vendor represents the first attempt to move unitized commercial A rations to the field, where it is being praised by cooks and soldiers. The UGR-A data collection plan was completed and implemented in the second quarter of FY 1998. Two test sites—Fort Hood, Texas, and Fort Stewart, Georgia—currently are procuring the UGR-A. All aspects of this concept are being monitored at both sites, including acceptance by troops, cooks, and food-service personnel and the logistics involved in its use. Fifteen menus were reviewed and revised to reflect Natick data collection and industry analysis of surge capabilities. Packaging improvements will continue to be incorporated to reflect state-of-the-art technologies.

Feedback has indicated that the process of ordering, issuing, and preparing meals has been simplified greatly while offering a menu that is both nutritious and highly acceptable and maximizing the "right size-right component" concept for the customer. It offers recognizable brand-name commercial products; reduces labor with easy-to-prepare, user-friendly components; reduces lead-times in ordering; and reduces Government inventories.

Field studies also were conducted in several areas to assess different levels of interest in improving food stability and determining the shelf life of rations in environmental extremes. An investigation conducted under the Food Stabilization Program revealed that use of solar shields yielded a 5-degree Fahrenheit decrease in internal temperature of container storage vans, which increased the shelf life of rations, validated TTI quality correlation, and determined objective color evaluations for heat-sensitive ration components as quality indicators. This information was forwarded to the Army Veterinary Command and DSCP for inclusion in DSCP Handbook 4155.2, Inspection of Composite Operational Rations, and distribution to inspectors. As a result of additional test data, storage temperatures of MRE's have been adjusted, which will result in a saving of $3 to $4 million per year in storage costs. Further, heat-sensitive ration components were reformulated and improved to increase heat stability.

Long-Range Patrol Packet

To meet the needs of special operations forces, a lightweight, low-volume food packet was developed that was similar to the long-range patrol (LRP) food packet used successfully during the Vietnam War. However, because of advances in food and packaging technologies, the new food packet provides 40 percent more calories than the earlier version. The long-range patrol-improved (LRP-I) food packet has gained high troop acceptance, is inexpensive, can be airdropped, has a potential 10-year shelf life at 70 to 80 degrees Fahrenheit, and weighs less than 1 pound per individual meal. Packaging and design changes incorporating brick packaging for instant dehydrated entrees have significantly reduced the weight, volume, and producibility of the LRP-I and increased menu and component variety.

As a result of the improved LRP design, there is now a peel-and-seal menu bag and a new, more logistically supportable case configuration. The new design represents a 21-percent weight reduction, a 38-percent volume reduction, a 20-percent increase in pallet load capacity, and a reduction of 19 MILVAN's per procurement in logistics shipping requirements.

The OTSG and the Joint Service Operational Ration Forum recently have approved combining the meal, cold weather (MCW), and LRP food packets. Twelve new menus were designed and have been approved by the OTSG for their nutritional content. The MCW and LRP will have the same components and menus; however, each ration will retain its current nomenclature and packaging color as requested by the military services. The MCW will have white interior and exterior packaging and the LRP will be brown and tan. Performance-based contract requirements for the newly combined ration are being coordinated.

Significant initiatives focused on eliminating foil-based packaging materials in MRE components and on developing a high-barrier menu bag secondary packaging system also are being pursued. Expected benefits include a net decrease in the cost of ration packaging, increased use of commercial nonfoil packaging materials, improved reliability, reduced battlefield waste, decreased MRE weight and cube, increased acceptance through brand-name packaging, and potential for expanded military use of low-barrier, biodegradable packaging materials

Natick is working aggressively to replace the flameless ration heater (FRH) with a new nonflammable ration heater (NRH) that is equally safe, affordable, and effective while offering unrestricted operation, transportation, and storage. The end products of the heater are nonhazardous and are environmentally safe for disposal.

Considerable effort also is underway to redesign ration menus to reduce the cost and logistics burden of purchasing, storing, and shipping food that will not be consumed, optimize warfighter satisfaction, and maximize acceptance, consumption, and nutrition. This effort is projected to reduce ration weight, size, and cost by 10 percent.

Proof Is in the Pudding

Acquisition reform and changes in MRE storage temperature, time-temperature indicators, and case and shipping container design, along with changes in the 18-soldier UGR, such as packaging reconfiguration, addition of new H&S entrees, and vegetable can substitution, are projected to result in a total savings of approximately $19 million per year.

Integration of the MCW and the LRP food packets, by using standardized commercial entrees and components and reconfiguring the case insert and sleeve, will provide total savings estimated at $400,000 per year. Additional savings in excess of $19 million per year also may be realized through a number of promising individual efforts under the Savings Through Value Enhancement and Operating and Support Cost Reduction programs.

As further evidence of the outstanding efforts to apply acquisition reform within the military ration program, SSCOM personnel were notified in June 1998 that the Military Rations Process Improvement Team had been selected to receive Vice President Al Gore's Hammer Award. They were chosen for this honor for their extraordinary efforts in developing innovative, performance-based contract requirements to replace hundreds of detailed military specifications. The team took the lead, with help from DSCP and the operational ration industry, to ensure that customers receive the best possible rations at the best possible price while complying with DOD directives on acquisition reform.

Fueling the Warfighter—2010 and Beyond

The DOD Combat Feeding Program is inexorably linked with Joint Vision 2010 and Army After Next, as well as Sea Dragon 21st Century and Air Force 2025. To meet the needs of the 21st century warfighter and support the operational concepts of Joint Vision 2010 and Army After Next, science and technology resources in the DOD food program have been allocated to explore breakthrough technologies, including innovative food processing, smart packaging, cogeneration, and diesel reforming technologies. It is envisioned that these revolutionary technologies will enhance warfighter performance by 30 percent, reduce ration weight by 50 percent, reduce food-service-related fuel consumption by 50 percent, and reduce operations and support costs by 40 percent.

Revolutionary technologies are being pursued aggressively to provide novel, fully integrated combat rations and food-service field equipment. Natick's combat support systems food and food-service equipment business area and critical, focused technology thrust areas provide direct support to some highly leveraged technology initiatives. These initiatives promise to provide soldiers with improved "fuel" that is tailored to increase combat effectiveness and reduce battlefield stress.

Leap-ahead technologies in combat rations and field food-service equipment will enable warfighters to achieve full-spectrum dominance by using performance-enhancing ration components, diesel fuel reforming technologies, advanced waterless preparation equipment, smart processing and preparation, automation, and alternative-energy-driven systems. These affordable systems will reduce both logistics support requirements and the associated combat footprint.

A number of technology initiatives support key strategic military objectives—

• Dominant maneuver will be achieved with enhanced mobility and increased agility through lightweight, low-volume, globally compatible rations and equipment that will enable the warfighter to go farther and faster, and to be more lethal. Innovative formulation and processing technologies, such as pulsed electric field, radio frequency, pulsed light, high-pressure, ohmic, or microwave thermal processing, and application of biotechnology, will be explored and developed. Synergistic approaches to both processing and packaging will provide foods that are nutritious, fresh, compact, lightweight, and consumable across the continuum of combat operations. Novel, nonthermal processing methods, combination preservation strategies, multifunctional polymeric materials, and active packaging systems will provide higher quality field rations at reduced cost and reduced weight and volume will foster a stable industrial base with a large surge capability. Initial laboratory studies indicated that warfighters will extend their physical endurance by approximately 17 percent by consuming an energy rich-beverage. Rapidly deployable, trailer-mounted kitchens will keep pace with warfighters enabling fresh, cook-prepared meals to be provided farther forward.

• Focused logistics will be supported through tailorable ration and food-service equipment modules that are compact and highly proficient and require minimal theater support. This will shrink the logistics umbilical cord significantly worldwide. State-of-the-art primary packaging improvements to the LRP food packet already have resulted in a 16-percent reduction in the number of MILVAN's needed to support a 10-day feeding cycle. Technologies for safely moving, storing, preparing, and dispensing shelf-stable, fresh, and frozen foods in the field during combat operations will enhance the nutritional status of the individual warfighter, improve morale, and counter the threat of energy depletion while supplying the warfighter with high-quality, home-cooked-style meals. Equipment and energy technologies include heat-driven refrigeration, modified atmosphere systems, thermal energy storage, advanced insulation, waterless food sanitation, and biosensors for assuring food safety. Breakthrough technologies in cogeneration and diesel reforming will reduce fuel consumption for food preparation by 50 percent, with a commensurate reduction of O&S costs by dual use of equipment and integration of commercial off-the-shelf foodservice equipment.

• Enhanced precision engagement will be realized by optimizing the warfighter's cognitive abilities. Cutting-edge food and nutrition technologies will be developed to increase mental alertness and enhance thinking. These evolving technologies are expected to reduce combat stress and allow 24-hour sustained operations. New laboratory analytical techniques, modeling, and simulation will be used to establish guidelines on the impact of specific nutrients on soldier performance and will transition into ration feeding programs that enhance warfighter performance.

• Full dimensional protection will be supported through dynamic ration module selection systems. The systems will tailor combat rations and field food-service technologies to support the warfighter and optimize performance in all environmental extremes. Multifunctional packaging systems and high-barrier polymeric materials that protect subsistence from battlefield threats, to include chemical and biological agents, will enhance the capability to feed the warfighter in all combat environments.

Cogeneration and diesel reforming technologies will enable the use of thermophotovoltaics instead of generators, thereby reducing thermal and noise signatures, increasing reliability, and reducing operating and support costs. [Thermophotovoltaics involves the conversion of radiant energy into electrical energy by using photocells.] Advanced waste management systems are projected to reduce field waste by 50 percent with a 20-percent reduction in processing costs.

Innovative, multifunctional, and "smart" packages that incorporate antimicrobial compounds and materials

☐ **Flameless ration heater.**

are being developed to absorb or control by-products, odors, aromas, or headspace gases that are emitted by ration components. These packages may be used to contain food products that are most negatively affected by long-term storage. This work will improve ration acceptability, safety, and consumption, thus improving the nutritional status of the warfighter as well as reducing perishable food waste. It also will increase the variety of fresh-like rations by inhibiting or retarding chemical changes or spoilage of minimally processed foods.

The science and technology thrust areas for combat rations and field food-service systems focus on meeting the performance requirements of Joint Vision 2010 and beyond. These technologies are positive force multipliers in both limited and sustained operations. They will enhance the warfighter's capability to process myriad information produced on the digitized battlefield and greatly improve his combat effectiveness, quality of life, and survivability.

Together with our customers, we have completed our first brainstorming session to define conceptual capabilities and the revolutionary technology needed to provide these capabilities in support of the Army After Next. These technological innovations not only will achieve greater performance capability, lethality, sustainability, and survivability, but they also will support transformation strategies that will result in revolutionary military logistics.

Contemplate a self-reliant, future warfighter and soldier system that, together, are able to make a swift and decisive first strike that is supported by a self-tailoring ration system. Such rations will have components genetically structured to release appropriate energy boosters, neurotransmitter precursors, illness suppressors, wound-healing compounds, and performance-enhancing formulations. These components will be controlled either by the warfighter using a nutritional status monitor or remotely by lasers. Pre-selected ingredients will be released at the appropriate time via a skin patch to ensure the soldier's optimum response to the combat, environmental, or tactical situation. A more revolutionary application of this technology may involve undergarments impregnated with selected nutrients. The right nutrients would be absorbed through the skin according to information from nutritional sensors embedded in the clothing system. Developing such self-tailoring rations and in-suit supplements will require a combination of innovations in food formulation, structure, processing, and methods of absorption. These breakthroughs could conceivably provide a 25-percent decrease in logistics requirements, a 100-percent utilization of rations, and a 50-percent improvement in warfighter health and performance.

☐ **Future automated feeding system.**

The DOD Combat Feeding Program is indeed an unequivocal force multiplier supporting our greatest asset, the warfighter. Our partnerships with industry and academia continue to uncover new solutions and capabilities that leverage revolutionary technologies. These technologies provide fully integrated, novel systems supporting U.S. military objectives. It is our collective visionary perspective that will enable the warrior to dominate the 21st century battlefield. It has been said that the best way to predict the future is to invent it. It is a journey that we already have embarked on and a challenge we clearly have embraced. **ALOG**

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Smart Simple Design

by Colonel Sam Chappell and Doug Korba

Many companies around the world are using a technique called Smart Simple Design to improve equipment designs, cut costs, and reduce support requirements. The Army could do the same.

In the Army After Next, the logistics footprint must be greatly reduced compared to current operations. Smart Simple Design could be an important initiative in achieving this goal. It has the potential to greatly enhance warfighter capabilities, readiness, and force modernization by improving reliability and reducing costs in the procurement and life-cycle support of equipment. These results can be achieved by reducing and standardizing the number of parts used in equipment, which in turn will reduce the amount of stocks that must be acquired and the number of people who are needed (at the tactical, operational, and strategic levels) to perform the supply, transportation, and maintenance functions.

The Smart Simple Design initiative encompasses two processes. The first step is using Design for Manufacture, Design for Assembly, and Design for Service (DFMAS) software in the early stages of the design process to achieve significant benefits from reducing costs and logistics support requirements. The second step of the Smart Simple Design initiative is assembling a design oversight and comparison process team to reduce the number of needed parts and standardize parts across different product lines.

Through Smart Simple Design, demand for logistics support can be reduced by designing equipment with fewer, standardized parts; at reduced cost; with higher quality and better serviceability; and with faster manufacture or assembly cycle times. Smart Simple Design could contribute to achieving these Army After Next initiatives—

- Modern design and manufacturing technology.
- Lighter, more lethal force.
- Ultrareliability.
- Technology infusion on existing platforms.
- Next-generation product development.

Smart Simple Design also can contribute to Focused Logistics initiatives and would be consistent with the Army's integrated logistics support policies.

Design for Manufacture and Assembly

Design for Manufacture and Assembly (DFMA™) software allows designers to analyze a product's total structure—how everything functions and fits together—to come up with a cost-efficient design. The underlying principle is: Simplify the structure. Reduce the number of parts, either by eliminating or combining them, and thus simplify the assembly process. Then determine the best design for each part to keep material, manufacturing, and total costs at a minimum. [DFMA is a trademark of Boothroyd Dewhurst.]

Over 400 corporations worldwide are using DFMA software. However, thousands of Army and Department of Defense (DOD) contractors and suppliers (manufacturers) do not use DFMA software.

Here are some examples of the types of savings and benefits that have been achieved in the private sector through the DFMA methodology. Ford Motor Company has trained thousands of engineers to use DFMA and estimates savings of $1 billion over 3 to 4 years. NCR used DFMA to redesign a sophisticated electronic cash register so that its 15 parts (down from 75) can be assembled by an unskilled, blindfolded worker in less than 2 minutes. IBM redesigned its Proprinter so that it has 79-percent fewer parts and no fasteners in the final assembly. Assembly time was reduced from 90 minutes to 3. Since labor costs associated with the assembly process were dramatically reduced, IBM has brought its Proprinter manufacturing operation back to the United States.

Texas Instruments redesigned the M1 tank electronic box and realized total cost savings of 50 percent, a reduction in assembly operations of 49 percent, and reductions in parts costs of 58 percent. In redesigning the reticle assembly for a ground-based armored vehicle, the following reductions were achieved: parts count, 75 percent; assembly operations, 78 percent; assembly time, 85 percent; manufacturing cycle time, 71 percent; and equipment weight, 46 percent.

The use of the DFMA methodology has resulted in an average 68-percent improvement in quality and reliability (based on all available case studies). Quality in design and manufacture is the first step in developing ultrareliable systems and attaining a Six-Sigma standard of excellence. Six-Sigma is a commercial manufacturing best practice that basically means a firm or enterprise commits three errors per million operations. Ultrareliable systems are needed on the 21st century battlefield and Smart Simple Design can help the Army get there.

Designing for Parts Standardization

Although using the DFMA methodology can reduce costs, manufacturing and assembly cycle times, and parts requirements, significant benefits also can be achieved by leveraging the valuable experience the Army has gained in dealing with many different product lines. While a single manufacturer can design its own product with fewer parts and simpler processes, the Army will gain when it is able to standardize parts across many weapon systems and civilian-use equipment. A design oversight and comparison process team can accomplish this task.

The elements of a standardization initiative are found in Logistics Support Analysis task 202, which is contained in AMC Pamphlet 700-28. This task states that there is a requirement for hardware, software, and support system standardization. To achieve such standardization, existing resources (hardware, software, and support system) are identified that will provide benefits if used to support the proposed system. The major reason for requiring this task is to ensure that development of new design components and integration efforts include standardization of parts. The examples given in this task include the standardization of engines, ammunition, fuel, radios, software, and gun tubes.

However, the opportunity exists to look not just at engines and ammunition but also at fasteners and subassemblies. If an existing engine does not meet the requirements of a new weapon system, then perhaps the same fasteners, or the same transmission or fuel injection system, from that engine can be used while still meeting the specifications of the new system.

Another opportunity that the design oversight and comparison team should include in their processes is examining opportunities for parts standardization among Army systems, systems in the other Services, and civilian-use equipment. If Army and DOD inventories become depleted during times of crisis, commonality between military and civilian-use equipment will allow civilian inventories to be used to help meet the Nation's needs.

Another issue in standardization between military and commercial equipment is end-item design and transportability. At times, the U.S. military must rely on commercial transportation assets to meet support requirements. When this need arises, our tailored support packages and weapon systems must be able to fit through the cargo doors of commercial aircraft and other commercial transportation equipment. This requirement can be met through the design process of Army systems or through influence on the commercial development of transportation assets. In any event, whether it is one of the most advanced weapon systems on the planet or a tailored support package, support will reach the American soldier.

Opportunities for Army Logistics

The benefits found in the above DFMA case studies and the potential benefits of parts standardization can be summarized as follows—

- Total cost reductions throughout the manufacturing and assembly processes represent a major dollar-savings opportunity in procurement.
- Reductions in parts counts, parts costs, and manufacturing and assembly cycle times have major impacts on funds tied up in inventory. A 1-percent reduction in inventory would mean an inventory investment savings of over $700 million, based on DOD's Materiel and Distribution Management Fact Book for Fiscal Year 1994.
- Standardization of parts and end items across military and civilian-use equipment enhances surge capabilities and transportability in times of crisis. Low inventories become more tolerable if the Army is able to draw on civilian stores for common parts.
- Parts count reduction, simplification, and standardization and reduction in the number of fasteners would have positive impacts on Army maintenance. Increasing the ease with which equipment can be serviced means damaged equipment spends less time in the shop and is returned to combat faster, which means increased readiness. This also would mean that fewer tools and less test equipment (and more importantly, possibly no new ones) and manpower are required for maintenance. Reductions in repair requirements, both in volume of repair actions and in difficulty of repairs, also would translate into a reduction in training requirements for the Army's maintenance personnel.
- Reductions in parts counts and assembly opera-

tions mean fewer opportunities for mistakes. This in turn means higher quality and reliability, which leads to increased warfighter readiness. Ultrareliable equipment is an essential part of the Revolution in Military Logistics.

- Weight reductions in equipment offer several interesting benefits, including increased speed and maneuverability and reduced transportation costs.

The Executive Logistics Seminar of September 1996 listed modern design and manufacturing technology as a key enabler for the Army After Next. Smart Simple Design represents modern design and manufacturing technology that is ready to be leveraged now. It is an initiative that does not require significant Army or DOD funding while offering the potential for significant paybacks. To quote Lieutenant General John J. Cusick, the Director of Logistics (J4) on the Joint Staff, in the briefing, *Focused Logistics—Joint Vision 2010*, "Our equipment is first rate, and it is sustainable in all operations." Maintainable equipment that shares repair parts and tooling commonality will reduce significantly the volume and complexity of the resupply system. To achieve first-rate quality and sustainability, including reduced costs, reduced manpower, and improved readiness, the Army and DOD should implement the Smart Simple Design initiative. This implementation should be a joint service effort.

Smart Simple Design Benefits to the Army

- Total cost/part cost reduction
- Part count reduction
- Parts standardization
- Manufacturing and assembly cycle time reduction
- Inventory reduction and added protection
- Improved quality and reliability
- Tool and test equipment reductions
- Weight reductions
- Logistics demand reduction

The specific DFMA software and methodology (or other commercial solutions) are cost- and time-saving design practices that are being used by corporations worldwide with significant results. This technology is ready for the Army to adopt right now. Using a DFMAS-type capability presents cost and service benefits to Army logistics that are tremendous and potential long-term dollar savings that are in the billions. This is especially true when we consider the thousands of contractors and suppliers the Army and DOD use to develop, build, field, and sustain their weapon systems and equipment.

While DFMA software has an excellent track record for achieving parts reductions within components, incorporating Army multiproduct experience in the design process could achieve parts reductions over entire systems and many different product groups. Standardization of parts and components between military and civilian-use equipment can provide added protection from inventory shortfalls. Parts standardization represents a major opportunity to reduce inventories, maintenance equipment, and maintenance training and increase the ease of serviceability across different product lines.

These results point to potentially significant cost savings in supply, maintenance, and procurement and the potential for redirecting funds into modernization and training, while improving service to the warfighter and overall readiness. Resources made available by reducing logistics demand could serve to increase the lethality and firepower of the Army as we move into the 21st century and drive toward the Army After Next. Smart Simple Design has a real place in the Revolution in Military Logistics. With projected fiscal constraints on Army logistics, the "iron mountain" will be a thing of the past.

The reduction and commonality of parts and tooling throughout the logistics system would reduce the number of logistics support personnel required on the future battlefield. The increase in quality and reliability of equipment that doesn't break as often, lasts longer, and is repaired faster translates into improved readiness and logistics demand reduction. ALOG

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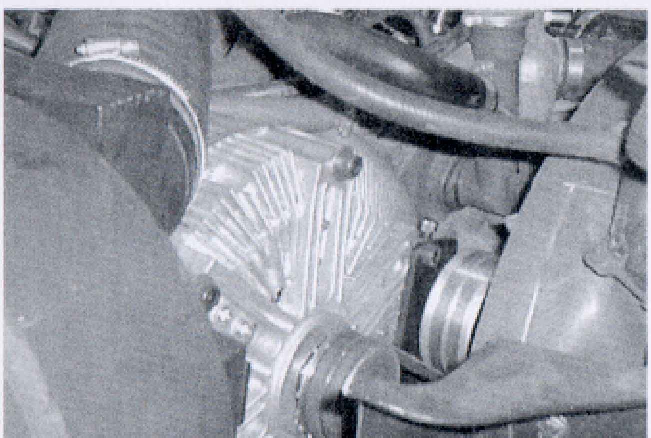
VIPER: Tactical Electrical Power for the Future

by Chief Warrant Officer (W–4) David S. Slaughter

The Army cannot effectively shoot, move, or communicate without some form of tactical electrical power. We use electricity to power everything from basic maintenance handtools to sophisticated computer and information equipment, in a variety of situations and under all environmental conditions. The Army has a requirement for quick and easy access to tactical electrical power that is reliable, cost effective, and efficient. We also need power that is available at sufficient levels to sustain vehicle electrical systems, efficiently charge vehicle batteries, and power such ancillary equipment as multiple radios and tracking and positioning systems.

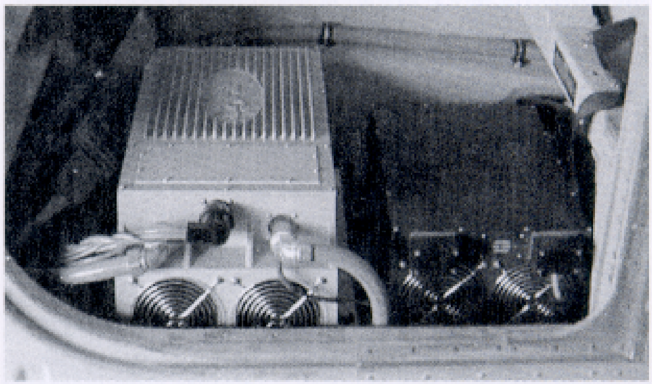
To better support our electrical power needs and provide sufficient vehicle power, the Directorate of Combat Developments for Ordnance at the Combined Arms Support Command, Fort Lee, Virginia, began to explore commercial technology to locate a device that would provide integrated vehicle electricity. The vehicle integrated primary electrical resource (VIPER), shown below left, meets our need for tactical electrical power while increasing vehicle mobility and deployability.



□ **VIPER is a commercially available, 5,300-watt, combination belt-driven alternator and generator that can provide both direct and alternating current.**

VIPER Capabilities

VIPER is a commercial, 5,300-watt, combination belt-driven alternator-generator capable of providing direct current (DC) and alternating current (AC) electrical power simultaneously. The alternator function provides 28 volts of DC to operate the vehicle electrical system and charge vehicle batteries. The generator function provides 120 volts of AC to operate auxiliary equipment, such as computers, communication systems, or tools. Electrical output is pure sine-wave power, so, regardless of equipment sensitivity, electrical power is available for all equipment.



□ **The electronic control unit shown here is mounted in a HMMWV's passenger-side right rear seat well.**

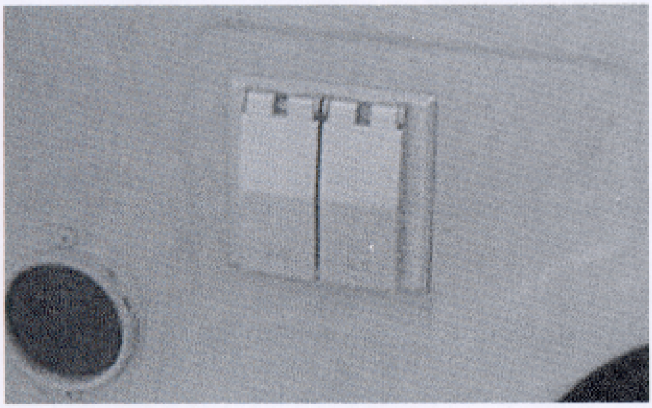
VIPER is configured to produce 2,500 watts of 120 volts AC, while simultaneously producing 100 amperes of 28 volts DC. VIPER will generate dual sources of power on the move or while stationary, and both sources of power are available when the vehicle is idling at approximately 800 revolutions per minute (rpm) (or slightly above vehicle idle). In effect, soldiers will have vehicles that are capable of meeting the electrical demands of the digitized revolution, while simultaneously providing access to AC electrical power integrated on board their vehicles to operate such devices as tools, computers, and medical equipment.

Electrical power output generated by the VIPER alternator-generator is managed through an onboard electronic control unit (ECU). The ECU is the host for the hardware and software that manages the electrical output from the VIPER. The ECU also serves as a load protector and converter-inverter and houses the built-in test and built-in test equipment (BIT/BITE) used in troubleshooting to isolate system faults. The ECU shown on the previous page is mounted in the passenger side rear seat well of a high-mobility, multipurpose, wheeled vehicle (HMMWV).

Benefits of Technology

The VIPER alternator-generator offers leap-ahead technology to support our force-projection Army. The VIPER provides an abundance of electrical power to support near- and mid-term Army modernization strategies for the digitized force while solving current vehicle electrical shortfalls. VIPER provides an efficient means of generating vehicle electrical power compared to traditional vehicle alternators, thus reducing operating and support costs associated with battery recharging and alternator repair and replacement.

VIPER also offers an alternative to small utility generators for short-term operations, such as emergency lighting, tactical operations center movements, or light maintenance and repairs. It does this by providing uninterrupted, vehicle-integrated access to AC power. The availability and access to AC power is as simple as plugging into a common household outlet. The vehicle is fully equipped with convenient outlets for rapid and easy access to this vehicle-integrated AC electrical power, as shown below. Currently, the ground-fault-protected outlets are mounted on the vehicle's right rear side.



☐ VIPER outlets are mounted on the right rear side of a HMMWV.

Application of Technology

The primary application of the VIPER alternator-generator technology is to provide an abundance of DC electricity to solve existing vehicle electrical shortfalls. Current vehicle alternators do not provide an adequate method of charging vehicle batteries. The normal configuration of a HMMWV consists of two 750-ampere-hour batteries, charged by a 60- or 100-amp alternator. However, this configuration is not adequate to meet the electrical demands placed on today's vehicles to operate new technology, such as multiple radio sets, global positioning and location systems, computers, and specialized lighting devices.

The inadequacy of the existing vehicle alternator configuration is increased because traditional alternator output at 800 rpm approximate vehicle idle is a mere 20 to 25 amps. Maximum alternator output is not achieved until the vehicle reaches 2,200 to 2,600 rpm, and during most operations engine speeds that reach that rate are a rare occurrence. A survey of equipment at the National Training Center, Fort Irwin, California, showed that many vehicles are equipped with additional equipment requiring over 70 amps of electrical power to perform mission requirements.

Accordingly, if a vehicle and attached equipment require over 70 amps of power to satisfy mission needs, electrical demand soon exceeds supply, causing premature alternator failure or reducing battery life or both. It also becomes clear why batteries in military vehicles have such a short life cycle: Demand exceeds output and electrical storage capacity, due to the constant drain placed on the vehicle's electrical system. Occasionally, vehicles are equipped with 200- and 300-amp-rated alternators, but the same problem exists: Maximum rated output is achieved only at high rpm. Considering the electrical requirements of multiple radio sets, guidance and positioning systems, and tracking devices, it becomes clear why the traditional vehicle alternator configuration is inadequate.

Although the HMMWV was used to illustrate the inadequacy of our current vehicle alternators, the problem is apparent in all vehicles required to provide electrical power to meet the electrical demands of the digitized force.

The second application of the VIPER alternator-generator technology is full-time access to AC electrical power to operate tools, medical equipment, computers, and other equipment. AC power is always available anytime the vehicle is in operation, supplementing or eliminating the need to carry small power-generation sets. Often, utility generator sets consume a different fuel than used by our vehicle fleets, occupy valuable cargo space, and, because of their sporadic use, are maintenance intensive. According to the Army Modernization Plan, over 25 percent of the current utility generator fleet is gasoline fueled and has an average age of 20 to 25 years. Moreover, utility generators require valuable time to set up and prepare for their intended operation. The VIPER program is not a replacement for utility generators, but it does offer an effective and efficient alternative for quick, short-term AC power access.

Savings

It is anticipated that VIPER will reduce current levels of operating and support costs and provide savings in both dollars and man-hours. The greatest savings will come from the VIPER's ability to efficiently charge vehicle batteries. Current vehicle alternator configurations rarely achieve the maximum output of their rated capacity; that is because engine speeds seldom reach the levels needed to produce sufficient output to sustain vehicle operations and recharge batteries. Battery replacement and repair programs are an annual multimillion-dollar expenditure for the Army and are very costly in man-hours as well. VIPER will reduce these costs by providing a method for efficiently charging vehicle batteries.

It also is anticipated that VIPER will provide substantial savings by supplementing the need for small utility generators. VIPER provides an alternative to small utility generators for quick operations, such as lighting an airfield for emergency landings, operating a pump to supply fresh drinking water, supplying power to repair a disabled vehicle, or providing electricity to operate specialized medical life-saving equipment. Because VIPER is able to provide AC power in the vehicle when it is in operation, we can reduce, and possibly eliminate, a portion of the costs associated with purchasing, transporting, and maintaining small utility generators.

VIPER should reduce operating and support costs because of its design features and built-in test features. By design, the VIPER alternator-generator has only one moving part, compared to many moving parts in traditional alternators. Components of the VIPER, as well as the components of the ECU, are modular, which permits quick replacement of internal parts. Additionally, built-in test equipment will aid troubleshooting and expedite fault isolation. The VIPER alternator-generator will experience fewer failures than current alternators, and repairs will be simpler and more expedient and can be accomplished at forward locations. This will contrast with traditional alternators that require extensive repair and testing at distant facilities. Additional savings will be realized through the ability to complete repairs on site, thus increasing readiness and reducing repair and return time to the user.

Cost

A production model VIPER alternator-generator with a total output of 5,300 watts, divided among AC and DC electrical output, cost $2,500. However, the VIPER can be configured to the user's needs, so cost per unit is flexible and variable. The $2,500 cost is the cost of a complete kit, which consists of the alternator-generator, ECU, throttle control, receptacles, and wiring.

A recent survey at the National Training Center of a HMMWV fleet of 500 vehicles equipped with 60-amp alternators revealed that alternators are experiencing a monthly failure rate of 20 percent (meaning that one HMMWV out of every five needs a new alternator every month). The VIPER alternator-generator will eliminate these high failure rates, because electrical output will exceed demand. Furthermore, with the VIPER, every HMMWV becomes a 2.5-kilowatt mobile utility generator, at no additional cost.

In addition, a benefit analysis would show savings in man-hours expended to replace and repair current alternators, costs associated with installation-level battery-charging programs, and man-hours expended on the logistics effort to maintain current alternator stocks. Although the initial investment cost of the VIPER alternator-generator is higher than traditional alternators, a favorable cost comparison would be realized quickly due to increased efficiency and capability.

Where We Are Today

The VIPER alternator-generator project is funded under the fiscal year 1998 concept experimentation program. Prototype VIPER's were mounted on National Training Center HMMWV's in April 1998 and are currently in field testing. Additional VIPER's, with modifications and refinements based on initial prototype testing, will be installed early this year. The Test and Evaluation Coordination Office at Fort Lee performed the first operational and environmental evaluation of the VIPER in August and September 1998.

The VIPER alternator-generator also was an approved advanced concept technology (ACT II) program for fiscal year 1998, which will lead to a 10,000-watt version alternator-generator prototype. The ACT II VIPER alternator-generator is scheduled for final demonstration in March at the National Training Center.

The long-term vision of the VIPER alternator-generator program is to become the one common belt-driven alternator for all of our vehicle fleets, equipped with a fully programmable ECU to meet the mission requirements of all vehicles.

The primary objective of the VIPER alternator-generator program is to provide an efficient method of charging vehicle batteries while providing AC power quickly and easily and accomplishing both tasks simultaneously. The VIPER provides us the opportunity to harness and use an existing mechanical vehicle power source to our advantage while gaining the benefit of electrical power, integrated and on board our vehicles. Thus, our vehicles truly become multicapable. VIPER technology increases our mobility while providing a needed, cost-effective efficiency. But most importantly, we increase vehicle combat readiness and operational effectiveness while enhancing the soldier's quality of life on the battlefield.

Chief Warrant Officer (W–4) David S. Slaughter is assigned to the Army Combined Arms Support Command at Fort Lee, Virginia.

Basic Research to Reduce Logistics Demand

by Deborah Pollard and C.T. Chase

The Army's strategic research objectives focus on achieving the capabilities that should characterize the Army After Next.

Imagine soldiers who take no supplies or repair parts to the battlefield but instead make what they need out of available resources by rearranging molecules, one atom at a time. Or imagine wounds and fractures being healed in extremely short periods of time. Imagine weapon systems that continuously report their readiness status and reduce the maintenance requirement to "condition-based" repairs. Better yet, imagine systems that never fail during an entire mission because of their advanced material design, faultless assembly, and ability to detect impending failure. How about batteries that last days and weeks instead of hours? Better still, how about creating power by converting human energy into a usable resource? Or how about a computer so small it fits into a package the size of an ammunition pouch, weighs only a couple of ounces, and has the power of today's supercomputer? Need supplies sent somewhere? No problem! Have the unmanned ground vehicles loaded by an autonomous piece of materials-handling equipment and then send them on their way, all under the watchful eye of a command and control system that has constant visibility of what is going on throughout the entire battle space.

Is all this possible? Probable? It depends on where we put our money and what results from our research efforts. The Army and the Department of Defense (DOD) are focusing research on those issues and technologies that will help us to achieve the enabling characteristics defined for the Army After Next (AAN). As logisticians, we are responsible for sustaining the force as well as reducing the Army's logistics signature and its demand for support. We should understand the possibilities for reducing demand on the logistics system that could be available if Army research is successful.

Applying Technology for the AAN

The AAN project is based on operational concepts with which many of us are somewhat unfamiliar. The extension of the original Joint Vision 2010, which expanded the military horizon into the next millennium, made us realize that there was a great potential for the infusion of technology to improve the way we do things, manage things, and see things. Focused logistics, as a tenet of Joint Vision, was aimed principally at integrating information, logistics, and transportation technologies to improve the logistics process and reduce demand requirements on the battlefield.

As we came to understand the potential adversary of the future, planners and futurists started to look beyond the 2010 timeframe. They are trying to picture what the Army after the "digitized" Army will look like. This Army After Next is tough to conjure, and for the most part it is being designed by people who will not serve in it. We do know that it will be a rapid-projection force with a limited number of new fighting systems, coupled to a large, upgraded force that will follow on as needed. We need to define, evaluate, and adopt logistics applications from new technologies that show exceptional promise for reducing the amount and cost of combat service support (CSS) requirements.

When AAN developers say something like, "We want the force to be self-sustaining for several days" (which could be as many as ____, you fill in the blank!), we logisticians tend to start thinking about how that is go-

Logistics Technology Strategic Research Objectives

- Nanoscience
- Biomimetics
- Mobile wireless communications
- Smart structures
- Compact power sources
- Microminiature, multifunctional sensors
- Enhancing soldier performance
- Lightweight armor by design

ing to be done. One of the double-edged swords we face is the necessity of reducing logistics demand in order to provide resources for buying modern weapon systems while simultaneously designing a support capability that can keep up with the AAN force.

Much of the solution lies in the judicious application in logistics of technologies under development in the Army's strategic research objectives (SRO's) program. The SRO's are derived directly from the characteristics sought for the AAN. The Army Science and Technology Working Group (ASTWG) has selected nine basic research areas for special emphasis. Six of these SRO's are familiar to some in the logistics community (see the chart above).

There also are three new SRO's that were approved at the July 1998 ASTWG meeting. (At the time of this writing, detailed information on specific research was limited in most cases.) These three new areas are—

- Lightweight armor by design.
- Microminiature, multifunctional sensors.
- Enhancing soldier performance.

In order to appreciate the importance of these SRO's, it is important to remember that in the logistics business we continue to change the answer to the question, "How we gonna do that?" while keeping constant "what we do." History tells us that. The Revolution in Military Logistics (RML) depends to a significant degree on the successful application of new and exciting technological possibilities. In a recent article in *Parameters* (Autumn 1998), Thomas K Adams writes, "There is a tendency among strategic thinkers, especially in the military, to ignore or discount the potential effects of technology beyond its short term applicability to military systems." That cannot be the case in support of the AAN and the RML. Revolution implies rapid change, and the investigation of new logistics applications of technology will result in many improvements in the way we will support the force of the future.

To manage this rush toward employing new research in support of the RML and the AAN, we need to be aware of what these SRO's really are. They are focused on three areas: reduced force structure, reduced costs of operation, and dramatically improved support to the warfighters. Here is a brief look at each SRO.

Nanoscience

Simply put, nanoscience is building things one atom or molecule at a time. The theoretical science tells us that this involves no violation of the laws of physics, so it is an area with almost unlimited potential. Nanoscience is a rapidly developing area for research, and its applications and implications are almost universal.

Atomic assembly is relatively common now, so the trick will be to increase the speed and abilities of the "builders" to a level where it will make sense to manufacture things in this manner. When this can be done, just think of the possibilities!

Several ideas come to mind immediately. How about producing perfectly assembled materials with no internal or external flaws, which will make equipment more reliable? In fact, we can picture a situation in which we take nothing to the fight but "nanobots" that are programmable to make things like food, fuel, and parts from the resources available in the area. How about programmable reliability? This technology could reduce the logistics tail by orders of magnitude beyond what we now can conceive.

It is essential that the logistics community understand what nanoscience is and where it could take us. While it is highly theoretical now, think back 20 years and see what technology investment has created for us. Nanoscience could do the same.

Biomimetics

Biomimetics is the process that enables us to develop novel synthetic materials, processes, and sensors by exploring design principles found in nature. Ever wonder where the idea for Velcro came from? Wonder what we could do with glue like that an abalone shell uses to stick itself to rocks so that it is almost impossible to remove? These are ideas taken from nature.

Biomimetics is imitating nature. The uses for it extend across the spectrum of logistics and CSS. Medical applications in use today include immediate repair of broken bones. How about using biomimetic adhesives to fix broken or combat-damaged equipment? Even better, how about creating lightweight structures and components that are ultrareliable and frictionless? One important area of research is the development of superconductor materials, which could lead to advanced propulsion systems without motors or gears as we know them.

Mobile Wireless Communications

Research in this area will produce fundamental advances in the rapid and secure transmission of large quantities of multimedia information from point to point, broadcast and multicast over distributed networks for command, control, communications, and intelligence systems. Such transmissions will function independently of the factors of terrain and environment that can disrupt conventional communications.

There is a concentrated effort underway to identify and develop capabilities in sensors and in the transmission and display of large volumes of data. These capabilities will allow logistics operations to be split. Think beyond the Global Combat Support System–Army and into the deep future of holographic displays. Sensors will have instantaneous and continuous communication links with control centers. By applying this technology to their systems, logisticians and combat soldiers alike will have confidence in the overall logistics system. Mobile wireless communications are a key to achieving the real-time situational awareness that is so important to the success of the RML.

Intelligent Systems

This SRO focuses on the development of advanced systems that can sense, analyze, learn, adapt, and function effectively in changing and hostile environments while completing assigned missions or functions. Robotic systems; Hal-like computers (remember the movie "2001"?); unmanned aerial, ground, water, and underwater systems that "think" by means of knowledge-based and artificial neural networks—all fit this category. Systems like these remove the burden from CSS soldiers and improve their ability to provide support.

The Army foresees weapon systems that have the "brains" to monitor operational performance and prevent failure by warning the logistics system of the telltale signs of impending problems. These systems can be designed to reduce the hazardous exposure of soldiers during critical repairs or operations and to conduct a virtual assessment of the probability that they can execute a particular course of action successfully. They also will feature something that is every soldier's dream, an exoskeleton that will increase the soldier's ability to lift the system. The judicious use of these systems will pay off in a significantly reduced force requirement for traditional logistics tasks.

Smart Structures

This SRO is expected to demonstrate advanced capabilities for modeling, predicting, controlling, and optimizing the dynamic response of complex, multi-element deformable structures. Huh? What does that mean? Basically, what we're talking about is the same science that studies how to keep bridges and buildings from routinely collapsing during earthquakes. Bridges that respond to external stimuli can be strengthened to support heavier items or made more elastic to reduce their susceptibility to destruction.

From a logistics support perspective, this SRO will allow investigations into improving the containers we use to move things by making them smart. These containers will be able to sense shocks, vibrations, and temperature changes and do something about them. Improved fuel storage capacities and capabilities are not beyond the realm of this research. How about a storage structure that maintains a constant inventory of its contents and logs in every change in inventory status? We could even couple that technology with communications capabilities so that the structure could report its findings to a central registry.

Compact Power Sources

This is an area of great concern to the logistics and CSS community. One of the important RML and AAN goals is reducing the demand for power and improving the performance of compact power sources, including batteries and other power-generating methods. Human energy conversion, concentrated solar power, miniature microturbines, as well as dramatic improvements in power management design—all are being considered during this research. As we move toward the instrumentation of soldiers through the "Land Warrior" program, research must focus on reducing the different kinds of batteries the Army uses and the amount of power required by field users and on examining the feasibility and safety of having soldiers replace power cells.

The Army expects to develop miniature power sources that can be embedded with automated identification technology tags and that will be reliable for the entire life cycle of the system to which they are attached. If the Army is going to keep the force light and allow it to operate without resupply for extended periods of time, either researchers need to develop more compact power sources or place more power equipment at support bases. If we ask soldiers who repair systems, "What is the one tool you would like to have?" they probably will answer, "Cordless power tools!" While moving in that direction, we need to solve problems like recharging batteries without special docking stations and creating longer lasting batteries. This is a very fruitful area for reducing logistics demands on the system as we move along the RML toward the AAN.

Microminiature Multifunctional Sensors

These sensors look like intelligent systems combined with mobile wireless communications. Under this SRO, researchers are looking at ways of integrating circuit technologies to create integrated microminiature sensors on a single chip. These sensors will have a multitude of functional capabilities, including, but not limited to, chemical and biological detection, inertial navigation, visual sensing, and health and environmental monitoring.

Other research projects seek to reduce the power requirement for communicating sensor results forward to a control center that can make sense of the information. To some, this would be almost like a computer on a chip, but, at least at first, these sensors will lack an independent analysis capability.

This sensor technology will improve real-time situational awareness; actively protect people and things, which will mean fewer requirements for repair; and act as autonomous sentries around storage areas. This research also will enable CSS personnel to make decisions based on better information about the locations of available supplies and support capabilities. All of these reduce demand on the logistics system.

Enhancing Soldier Performance

Enhancing soldier performance is an area of human research aimed at achieving the AAN objectives for knowledge and speed. Under this SRO, researchers will investigate ways to maximize soldiers' mental and physical performance, enhance their endurance, increase their ability to make decisions, mitigate stressful effects on them, and improve leadership and training.

Once applied, the usefulness of this research to the CSS community should be evident. Who doesn't want to be able to manage sleep discipline better? Is there anyone out there who wouldn't like to reduce training injuries while improving the ability of soldiers to absorb and understand what they are being trained for? What about reduced stress? We do not necessarily want "laid-back soldiers," but we do want soldiers who take a difficult situation in stride and make rational decisions without being inhibited by stress.

It isn't hard to find the potential for reducing logistics demand in this SRO. The CSS community needs to support this SRO by asking for specific categories of analysis to be conducted that relate predominantly to the CSS soldier.

Armor Material by Design

This research effort is aimed at making heavy forces lighter and more deployable and light forces more survivable. Because personal armor is too heavy and does not adequately protect the individual against a broad spectrum of threats, research is needed to find better protection for soldiers fighting in the military operations on urbanized terrain and in built-up areas (MOUT/MOBA) conditions predicted for the AAN.

Basically, the research will focus on technologies for design, processing system integration, and manufacturing to meet performance requirements for mobility and survivability. From a logistics perspective, we need to champion this research for many reasons, not the least of which are reduced deployment requirements and better fuel efficiencies achieved through increased performance per unit of energy. This also will affect the survivability of CSS soldiers as new facilities are included in the leading-edge protection scheme. Indirectly, better protection at lighter weight translates into reduced requirements for stocking supplies and fewer casualties.

These technology research areas need to become household terms to the CSS combat development community. The characteristics of the RML and AAN depend heavily on successfully accomplishing these SRO's, as well as other research done in support of the future operational capabilities produced by the Army Training and Doctrine Command (TRADOC). (See TRADOC Pamphlet 525-66, Future Operational Capability.)

The RML depends on dramatically infusing technology solutions into the way we support. These SRO's play a major role in that development. When translated into simple terms, it appears that there is hope for reducing demand and improving support at the same time. This can be done without smoke and mirrors. The CSS community must give the scientific community its special requirements, coming out of its interpretation of these areas. We can't afford not to do that! **ALOG**

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History of *Army Logistician*

Army Logistician is celebrating its 30th year of publication. Although the first issue was printed in 1969, the origin of the publication dates back to 1961. In a study titled "Requirement for and Feasibility of Publishing an Official Periodical for Army Logisticians," the Army Logistics Management Center (ALMC) (which was designated a college in October 1987) documented the need for a publication that would communicate information on logistics.

On 14 June 1968, ALMC requested authority from the Army's Deputy Chief of Staff for Logistics (DCSLOG) to publish an official periodical for Army logistics personnel. ALMC's parent command, the Army Materiel Command, agreed to fund the publication. The DCSLOG forwarded ALMC's request to The Adjutant General of the Army, who, on 15 August 1968, granted temporary approval to publish a bimonthly, 32-page periodical titled ***Army Logistician***. Publication began with the September-October 1969 issue. During the next few years, ***Army Logistician*** was reviewed and evaluated for essentiality several times by the General Accounting Office and offices of the Department of Defense and Department of the Army. Permanent approval to publish as a professional bulletin in the 700–series was granted in 1988.

Army Logistician's Board of Directors was formed in September 1990 to establish general editorial policy, set long-range goals for the bulletin, and support the continued dissemination of essential information on logistics. Its membership includes the Assistant Secretary of the Army for Installations, Logistics, and Environment; DCSLOG; Commander, Army Materiel Command; and Commander, Army Combined Arms Support Command, who serves as Chairman.

In October 1991, command and control of ALMC transferred from the Army Materiel Command to the Army Training and Doctrine Command. Since then, ***Army Logistician*** has been funded by the DCSLOG and published by the Army Logistics Management College, an element of the Combined Arms Support Command at Fort Lee, Virginia.

In 1995, ***Army Logistician*** established a home page on the World Wide Web. Previously published issues can be viewed at: http://www.almc.army.mil/orgnzatn/alog/alog.htm.

Since 1969, ***Army Logistician*** has had three editors: Thomas A. Johnson, 1969 to 1987; Terry R. Speights, 1988 to 1996; and, currently, Janice W. Heretick. Under their leadership, the publication process has experienced many changes. Articles that once were handwritten or typed and sent to a printer for typesetting now are prepared using word processing software. The text then is positioned on each page using electronic prepress software. Hand-drawn art and original black-and-white photographs formerly were sent to a contract printer for positioning and reproduction. Now, most illustrations are generated on computers and all art and photographs are scanned in and positioned on the page electronically before they are sent to the printer. Long-distance communications were only by telephone and U.S. mail until the office entered a phase of fax machines and overnight mail services. Now electronic mail is used not only to communicate with authors and others but also to ship each issue to the printer.

Obviously, the printing and publications field is experiencing its own revolution. Electronic media has overtaken the field of printed publications. Given the rapidly changing world of electronics and automation, we only can dream about what the future holds. The ***Army Logistician*** staff anticipates continued participation in the fields of electronic and printed media and will continue to use the best available technology to deliver timely and authoritative information to the Army's logisticians.