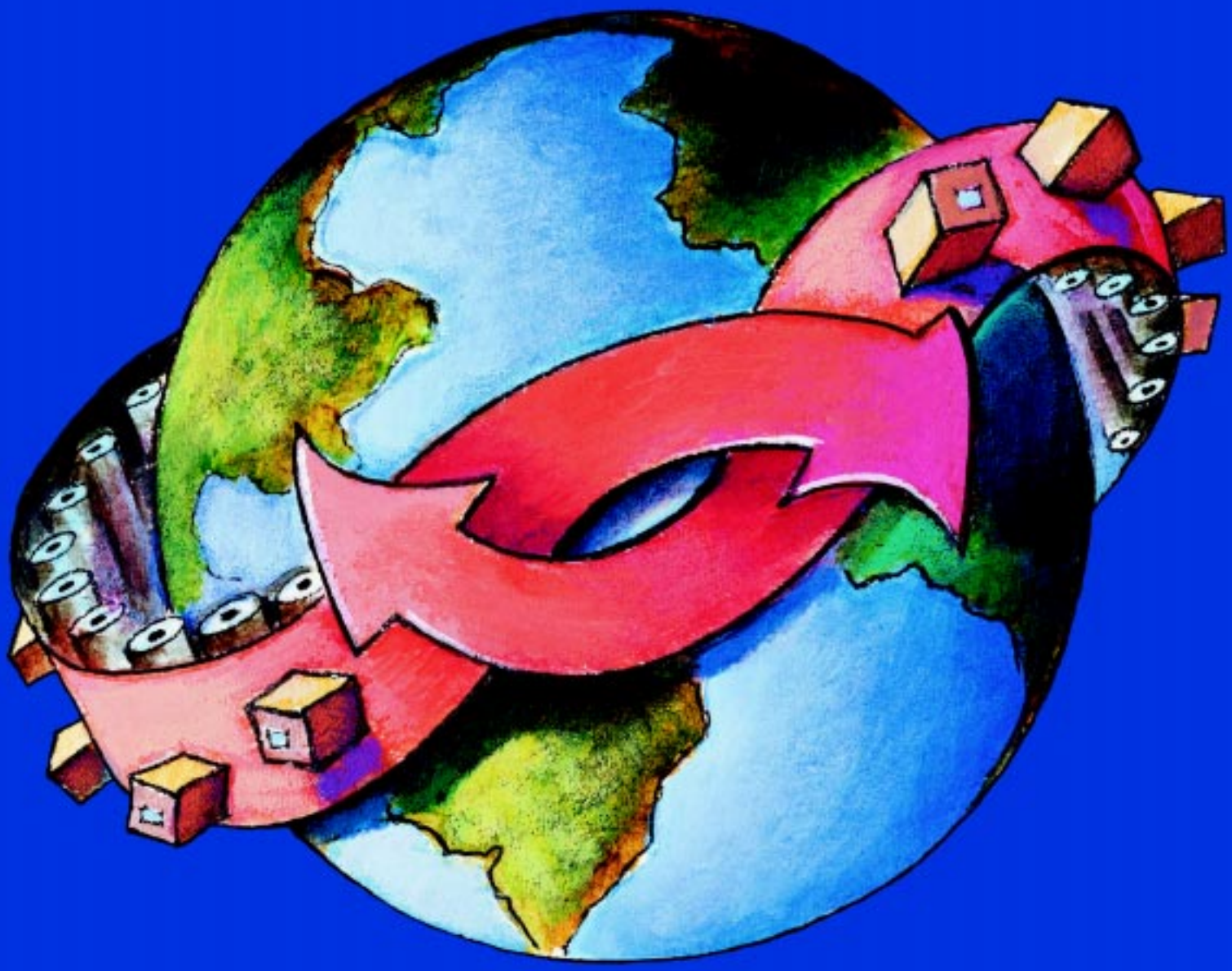
Global Thinking
Global Logistics



Selected Readings

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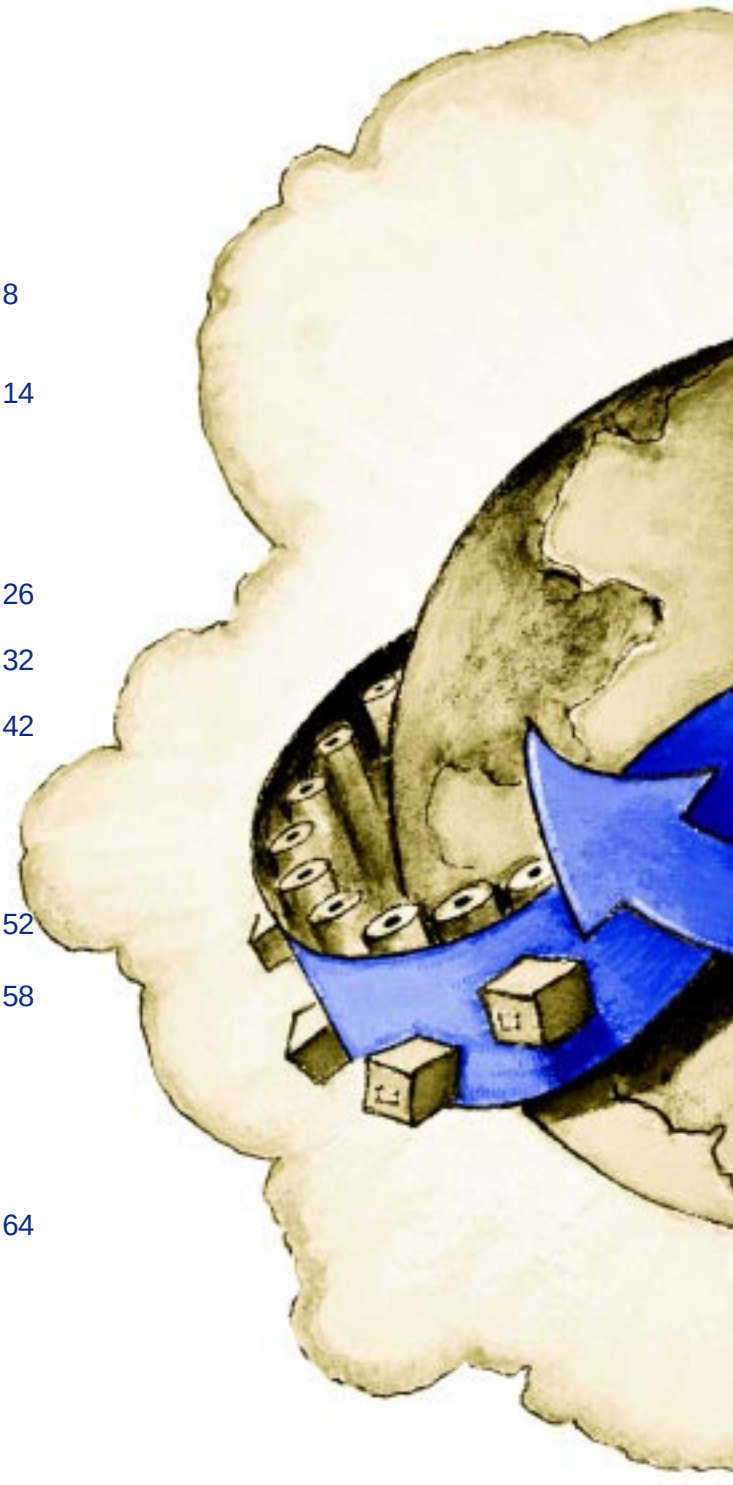

Competitive Sourcing and Privatization

Logistics Support

Logistics History and Doctrine

Current Challenges

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Global Thinking Global Logistics

The only thing harder than getting a new idea into the military mind is getting an old one out.

—B. H. Liddel Hart

Jomini observed that logistics is "the practical art of moving armies." He spoke further of providing for the successive arrival of convoys" and "establishing and organizing lines of supply."[1] From this, it can be said that logistics is the practical art and process of moving military forces and keeping them supplied. An understanding of the problems involved in supporting military forces as affected by changes in technology, organization, world geopolitics, and many other relevant factors is essential. Likewise, gaining some level of understanding concerning the effect logistics has on strategy—to include the various levels of wartime strategy, as well as peacetime planning and organizational strategy—is also essential.

"Strategy, like politics, is said to be the art of the possible."[2] However, what is possible is not something based solely on weapons platforms, numerical strength, tactics, or doctrine. Rather, it must take into account what Van Creveld called the hardest facts of all: those concerning requirements for supplies available and expected, organization and administration, transportation, and arteries of communication.[3] In today's rapidly changing global environment, the strategic decisions made concerning logistics during peacetime may prove to have a greater effect on what is possible during crisis or wartime than at any other time in history.

Logistics has proven to be the key element in 20th century warfare; however, it has also proven to be an element that was often not adequately documented or understood. Military professionals, historians, and theorists have been all too susceptible to the view that relegates logistics to the background of their work. A recurring theme has been the tendency for both political and military leadership to neglect logistical activities in peacetime. They are then forced to expand and improve them hastily once a conflict has broken out. This may not be as possible in the future as it has been in the past. A declining industrial base, flat or declining defense budgets, force drawdowns, and base closures have all contributed to eliminating or restricting the infrastructure that made rapid expansion possible. The real impact of competitive sourcing and privatization (formerly outsourcing and privatization) on military strategy, force protection, and logistics support is still a matter of conjecture and debate. Similarly, the capability of just-in-time logistics to support military operations has enjoined a great deal of debate. Nevertheless, modern warfare demands huge quantities of fuel, ammunition, food, clothing, and equipment. All of this must be produced, purchased, transported, and distributed to military forces. Of course, the means to do this must be sustained. The reality is that logistics is the primary consideration in all modern military operations—crisis, operations other than war (OOTW), or war itself. Making peacetime or wartime organization, planning, or strategic decisions without considering this reality is to do so at peril.

The US role in the post-Cold War world has changed dramatically. Military forces are no longer dedicated solely to deterring aggression. They must now respond to and support a variety of combat and humanitarian missions. From peacekeeping, to feeding starving nations, to countering drug operations, the military must continue to adapt to evolving missions and work with a broad range of allies or coalition partners. Logistics infrastructure and processes must evolve to support the new spectrum of demands. In the process, the lessons of history can neither be forgotten nor ignored. New technological advances must be capitalized upon and integrated into the support infrastructure, but technology should not be viewed as a *silver bullet* for all problems and situations.

Technology cannot be viewed as a separate entity within either the military or society in general. This illusion of discreteness simply does not exist. It is and will remain an integral part of both. The real issue is to recognize that technology is a tool with limitations, and these limitations should be considered when reacting to situations. Organizational change should and must accompany technological change if new capabilities are to be exploited. Stephen Rosen, in *Winning the Next War*, points out that innovation does not always result from new technologies. Rather, new technology may simply be used to improve the ability to perform a mission.[4] The relationships among technological change, innovation, fundamental military operations, and changes in concepts and organizations are nonlinear. That is, changes to input may not yield proportionate changes in output or other dynamics.[5]

Significant organizational, intellectual, and technological changes are seen during periods of transition. The most important change, however, must be intellectual. Without this, technological change becomes meaningless and organizational change impossible. The military is now in a period of rapid change. Recent changes—order of magnitude changes—in technology have led to both long-range and strategic planning efforts that integrate current and future technological advances into operational concepts. In the logistics arena, these concepts include Focused Logistics and Agile Combat Support. The vision of both these concepts is to fuse information, transportation, and other logistics technologies in order to provide rapid response, track and shift assets while en route, and deliver tailored logistics packages in all operations or during war.[6] This same vision includes enhanced transportation, mobility, and pinpoint delivery systems.[7] The operational forces that must be logistically supported will be

smaller and more flexible—emphasizing mobility, speed, and agility. Current plans are for these forces to rely on technological superiority in stealth, precision weapons, surveillance, and dominant battlefield awareness.

Military logistics, at a more fundamental level, is in a period of transition brought about by the information revolution. In spite of the large sums of money expended for information systems, many challenges concerning workflow, improving data integrity, and efficient communications must still be overcome.[8] A variety of human and cultural factors still impede full-scale adoption of many new information technologies—complexity and difficulty in the use of some systems, loss of control, changes in fundamental power relationships, uselessness or old skills, and changes in work relationships. Further, some organizational cultures are, by their very nature, risk averse.

Global Thinking, Global Logistics is a collection of articles and essays by many authors with diverse interests and approaches. However, it contains four distinct areas of interest or issues that face the military as it enters the 21st century: competitive sourcing and privatization, logistics support, logistics history and doctrine, and current challenges. The content was selected for two reasons—to represent the diversity of global logistics issues facing the military of the next century and to stimulate thinking about these issues. In fact, the latter is mainly what this collection of works is all about. The articles that follow cover a lot of ground, but each provides a set of thoughts, postulates a theory, or illustrates important lessons from history that warrant serious thought.

Our collection begins with "A Civil Sector Force Multiplier for the Operational Commander," by Colonel Joseph B. Michels, USAF. In this article, Colonel Michels examines the question, will Focused Logistics, as envisioned by Joint Vision 2010 (JV 2010), provide the robust wartime logistics support required by the operational commander? In the course of his analysis, several issues come to light: the resistance of the conservative DoD/military culture to change; the degree of technological dependency envisioned by JV 2010; and major contractor, competitive sourcing, and privatization issues. The second article dealing with competitive sourcing and privatization problems is an award-winning piece by Colonel Steven J. Zamparelli, USAF, "Contractors on the Battlefield, What Have We Signed Up For?" Colonel Zamparelli, following a brief review of the evolution of competitive sourcing and privatization, looks at a number of major issues concerning the increased use of contractor personnel. These range from support of high-technology weapon systems to contractor security. In the process, he examines contractor responsibilities, noncombatant status, and contractor discipline and control. His conclusions are particularly salient: (1) contractors are becoming more responsible for taskings previously accomplished by military personnel; (2) contractor numbers are increasing, and their support is directly related to combat operations; (3) as the US military has attempted to compensate for force drawdowns, the distinction between military member and contractor support has been conveniently blurred; (4) the blurring of the distinction between the military member and the contractor places both the commander and contractor personnel in a predicament regarding the laws of war, employment contracts, and the effect these issues have on meeting mission requirements; (5) while a transition of support functions, perhaps even operational functions, from the military to the private sector is required by budget necessity, it is happening without a master plan or risk-based assessment; and finally, (6) there is little evidence that the strategic and doctrinal implications of contractors on the battlefield are being addressed.

Three articles addressing logistics support are included: "Munitions Availability and the EAF," by Lieutenant Colonel David K. Underwood, USAF and Captain John E. Bell, USAF, and "The B-52: Past, Present, Future," by Karen A. Irvin; "Division Aviation Support Battalion," by Major Samuel J. Ford III, USA. Major Ford discusses a vexing problem that has caused difficulties in both the Army and the Air Force—split deployment and operations for aviation units. His focus is solely on Army helicopter units, and he proposes a modular organizational approach to eliminate the shortfalls in critical equipment and personnel when a unit is split-tasked for multiple operations. His suggested

solutions may have implications beyond Army aviation units. Lieutenant Colonel Underwood and Captain Bell's article provides a primer on the munitions problems associated with getting bombs on target within the 48 to 72-hour window for Expeditionary Aerospace Force (EAF) operations. They begin with the discussion of the worldwide availability of munitions, examine the various rapid response and prepositioning problems currently in existence, and highlight the major difficulties and limitations in moving and transporting munitions within the EAF concept. Their recommendations deserve serious consideration by other EAF researchers, EAF planners, and leadership. Ms. Irvin's work concludes this section. She looks at the needs and requirements for a strategic bomber force from a macro perspective and then focuses on the specifics of what must be done to keep the B-52 a viable conventional bombing platform until its service life ends in the mid-21st century.

Two articles are included in the logistics history and logistics doctrine segment. The section begins with an award-winning piece by Cadet First Class Daniel McConnell, USAFA, Captain Richard A. Hardemon, USAF, and Senior Master Sergeant Larry C. Ransburgh, USAF—"The Logistics Constant Throughout the Ages." McConnell, Hardemon, and Ransburgh trace the impact of fuel—and its historical antecedent, fodder—on major military campaigns, strategy, and tactics through World War II. A great many lessons from history are highlighted in this piece. Arguably, fuel will remain the dominant logistics factor that limits strategic and tactical planning as well as actual operations, for the foreseeable future. That article is followed by "Logistics and Airpower—A Failure in Doctrine?" by Air Commodore Peter Dye, Royal Air Force (RAF). While Dye's work speaks specifically to Royal Air Force doctrine document AP 3000, it has implications for the US Air Force as well. He contends that the RAF is mistaken in rejecting the view of airpower which maintains that airpower is dependent on adequate logistics and infrastructure arrangements derived from and, in turn, sustained by a nation's industrial base in favor of one that focuses almost exclusively on the nature of air vehicles. In Dye's words, this is "the equivalent of the Army describing its doctrine in terms of the tank or the navy, the surface ship."

This book concludes with "The Potential Effect of Cultural Differences in a Culturally Diverse Workplace" by Doctors Paul F. Tully and John E. Merchant. On the eve of the 21st century, the challenges facing organizations are quite different than they were just a few years ago. A recent survey of American managers listed coping with change as the number one challenge facing them and their organizations. These challenges are global competition, need for organizational renewal, finding strategic advantage, maintaining high standards of ethics and social responsibility, supporting diversity, and managing the new employee relationship emphasizing empowerment and teamwork. Each of these challenges is affected by culture. Tully and Merchant focus on these cultural differences and how to deal with them from a global organizational perspective.

Notes

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What throws you in combat is rarely the fact that your tactical scheme was wrong . . . but that you failed to think through the cold hard facts of logistics

—General Mathew B. Ridgeway

A Civil Sector Force Multiplier for the Operational Commander

Colonel Joseph B. Michels, USAF

The demise of the Cold War, reallocation of fiscal resources, and the kinds of joint future coalition warfare or operations the United States expects to conduct during the 21st century require innovative and creative thinking by America's military leaders. Recently, the Chairman of the Joint Chiefs of Staff issued *Joint Vision 2010* (JV 2010), a document that provides a conceptual framework for America's Armed Forces to think about the future.[1] The premise of JV 2010 is that joint military interoperability, coupled with a strong technological underpinning, will be a key tenet in conducting military operations in the 21st century. The JV 2010 document identifies four new operational concepts requisite in the conduct of future military operations. These concepts are Dominant Maneuver, Precision Engagement, Full-Dimension Protection, and Focused Logistics.[2]

Historical Foundation

The use of civilian contractors and reliance upon the civil sector in support of war efforts are rooted in history. During the Revolutionary War, much of the land transport was provided through the contract system of hiring teams and drivers.[3] This is one of the earliest recorded examples of civil sector support to an operational commander. In another example, during the Mexican War of 1850, General Jessup, the Quartermaster General, relied heavily upon private transportation throughout the entire war effort.[4] Prior to World War II, the US military routinely relied on the private sector for much of its support. Former Secretary of the Air Force Sheila Widnall noted:

> Lest you think this is a new phenomenon, let me take you back to the era before World War II when private support was standard. It was only during the Cold War when we realized the huge buildup of government operations that we came to think of government support as the norm.[5]

Further, Clausewitz recognized the need for civil sector involvement in the sustainment of forces when he described the ability of the warfighting soldier to *live off* households or the community during battle.[6]

However, the role of logistics in waging war has evolved from the simple requirements of the American Revolutionary War soldier to the complicated and costly logistics requirements of today's modern warrior and machines.[7]

Rear Admiral Henry E. Eccles clearly recognized the need for significant civil sector involvement in his seminal work, *Command Logistics*, when he stated:

> We should remember that since the amount of logistics support available to any commander is limited, the commander who utilizes his limited resources most efficiently will have the greatest freedom of action and combat capability.[8]

Efficient use of limited resources in today's environment strongly dictates active and viable involvement of the civil sector with the operational warfighting commander. Thorpe clearly recognizes this fact when he states, "preparation for war is not complete until the laboring man is prepared for war."[9]

The technological underpinnings of JV 2010 and the Focused Logistics operational concept rely predominantly upon the flow of information back to the operational commander. Sophisticated, technologically advanced computer and information systems are required to not only provide the necessary command and control of the warfighting forces but also identify and ascertain availability of provisions and supplies during combat and noncombat operations (operations other than war). Morgenstern recognized this need for the operational commander when he stated:

> . . . the deeper analyses of the problems of military logistics will show that the most difficult and most important aspects lie in the field of information and in the flow of messages and papers.[10]

Technology available in the civil sector allows improved means of communication and opportunities for new organizational arrangements.[11] These organizational arrangements allow for greater managerial control and improved planning by the operational commander.[12]

Civil Sector Involvement with Military Operations

Civil sector involvement in future military operations, as envisioned by JV 2010, is primarily through civilian contractors who do work formerly done by organic military personnel. This concept is called outsourcing, which is defined as the transfer of a function previously performed in-house to an outside provider.[13] Competition by the government with the private sector in performing services that are not inherently governmental in nature has been expressly prohibited since the middle of the Eisenhower administration. *Bureau of the Budget Bulletin 55-4* expressly prohibits such functions:

> The federal government will not start or carry on any commercial activity to provide a service or product for its own use if such product or service can be procured from private enterprise through ordinary business channels.[14]

Current acquisition policy contained in *Federal Acquisition Circular 90-29* confirms the same basic position:

> It is the policy of the Government to rely generally on private, commercial sources for supplies and services, if certain criteria are met while recognizing that some functions are inherently governmental and must be performed by Government personnel.[15]

Many studies have investigated the outsourcing process and identified various factors that result in successful outsourcing contracts.[16,17,18,19,20] As government enters the 21st century, many senior leaders strongly advocate the use of methods and models that are successfully employed in the private sector but have not been applied extensively in a nonprofit environment such as defense. The presumption of efficiency in the private sector is challenged less

forcefully, but the challenges rely on theories of noncompetitive markets, examples of malfeasance by contractors, and concerns for equity when private firms profit from provision of public services.[21,22,23,24] New, innovative methods and *out-of-the-box* thinking are required more than at any time previously in order to achieve the defense mission with the fiscal resources allocated. Creativity and innovation are the keys in today's resource-constrained environment.[25]

These precepts are diametrical to the function of a governmental bureaucracy, especially that of the Department of Defense. As the largest bureaucracy in the federal government, change and innovation are not ideas or concepts that are easily embraced by entrenched government bureaucrats. Carnes Lord perhaps best described the dynamics of bureaucracy in his book *The President and National Security* when he stated:

> Perhaps the most powerful factor determining bureaucratic behavior is the instinct of organizational self-preservation. Like all other forms of life, bureaucracies tend to pursue survival before all other goals. Also like other forms of life, they tend to be resourceful in adapting to their environment. Bureaucratic entities are, as a result, notoriously difficult to kill off, even after their original reason for being has disappeared. Organizational survival is inseparably bound up in organizational identity.[26]

Warfighting *CINCDOMs* represent the best of a long-entrenched bureaucracy. Organizational support paradigms, structures, and frameworks not familiar to the operational commander are inevitable in improving efficiency of operations. The JV 2010's *Focused Logistics* operational objective mandates logistics done in a new manner and relies on civilian contractors to provide that support—a tall order for any warfighter to swallow, let alone implement. However, with no organic military resources to rely upon, the civil sector will become paramount in the successful accomplishment of the military operation.

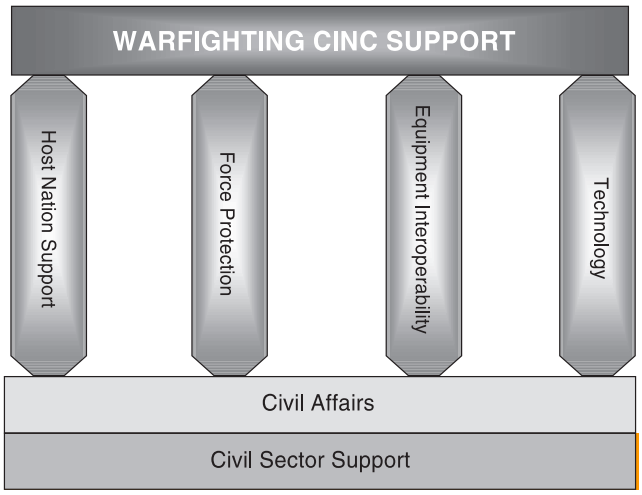

Figure 1. Operational Logistics Pillars

Operational Logistics in the 21st Century

The support provided to the warfighting commander in chief (CINC) is composed of the four pillars identified in Figure 1. The foundation of the entire support structure is civil sector support. As used in this context, various contractors supporting the operational CINC are identified in Table 1.

Commercial contractors may include such well-known US companies as Brown and Root, Boeing Services, and Holmes & Narver—companies that have offices and headquarters in the United States and make a primary business of providing military base infrastructure support and contracted assistance to the American Government overseas. Conversely, foreign commercial contractors could also be successfully employed to provide support to the operational warfighter and may be essential if American contractors are unavailable or unable to perform the tasks required. Third World national contractors may also be employed, as is the case in Southwest Asia where many Third World nationals from countries such as India, the Philippines, and Pakistan are employed to do labor-intensive work.

In each case cited, relationships must be forged that will vary based on the type of contractor. Religious, racial, ethnic, and gender differences must be considered by the CINC when determining how the contractor will be used. The CINC's civil affairs staff is absolutely critical in ensuring optimum civil sector support.

The civil affairs staff comprises the next *layer* on the CINC support matrix. This staff possesses the capabilities to not only understand the culture, ethnicity, and religion of the region in which the warfighting CINC is operating but also work with the local native population in obtaining support necessary for the CINC to either conduct operations other than war (OOTW) or warfighting operations. The foundation of CINC support is composed of both civil sector elements and civil affairs staff amalgamated to obtain any required necessary support.

The four pillars of CINC support are integral to JV 2010's Focused Logistics concept. Coupled with the civil sector and civil affairs support, these pillars provide the integral structure for proper execution of the warfighting CINC's overall objective.

Host Nation Support

Host nation support will become increasingly critical in the 21st century as we rely upon the civil sector and warfighting coalition partners for much of our warfighting support in both armed conflict and OOTW. With the light, agile, tailored-to-task, readily deployable forces of the future, host nation support will be vital in ensuring that American fighting forces can effectively prosecute any action.[27] This host nation support can take the form of supplies, roads, aircraft, aircraft fuel, seaports, piers, overflight and landing rights, and information connectivity into the host nation communications infrastructure. Military civil affairs

Contractor Type	Location
Commercial	International
Organic, indigent to hostile region	Host nation/nation where hostilities are transpiring
Third World Nationals	Worldwide, Third World Countries

Table 1. Contractor Types and Locations

personnel with specific language skills representative of the region in which the operation or conflict is transpiring will be increasingly vital to the CINC. These native-speaking people will provide the operational commander with insight and understanding.

Force Protection

The most significant command responsibility is the protection of one's troops before, during, and after the hostility period. Nothing is more paramount in this regard than troop or civilian contractor protection. The strong reliance on civil sector support will necessitate that force protection be constant and vigilant throughout the hostility period. Manning augmentation of military protection forces by civil sector contractor personnel is used to protect buildings, equipment, and vehicles of American combat personnel. The various types of contractors defined in Table 1 can be used for this task. The warfighting CINC must be able to critically assess the risk of using the different types of contractors for the various mission elements. Significant here is the fact that contract personnel from Third World countries may be providing the bulk of the security for American equipment or administrative facilities. This is indeed a distinct paradigm shift from the Cold War era. However, with force reductions, troop drawdowns, and the need to outsource support infrastructure, warfighters will be used in combat operations exclusively. No longer will organic military personnel perform various support functions. Critical to success in the force protection arena is trust between the contractor and the American soldier. This trust may take a long time to earn but a short time to destroy. The CINC must spend significant time and energy ensuring a strong trust develops between the fighting forces and the civilian support contractor personnel.

Equipment Interoperability

The third tenet of the warfighting CINC's support is equipment interoperability. During the Cold War, equipment interoperability specifications for the North Atlantic Treaty Organization (NATO) were common for all member countries. Equipment interoperability is vital in the 21st century where coalitions will be formed to prosecute many of the actions in which the United States may be involved.

The warfighting environment of the 21st century involves both American military forces and coalition forces of other nations. As the United States draws down its overseas force structure and transitions to an expeditionary force based in the continental United States (CONUS), reliance on the support infrastructure of our coalition partners will be even greater than now. When the height of the Cold War involved equipment interoperability according to standards of NATO, equipment interoperability was much less an issue than it might be in the future. Military personnel were normally responsible for repair, operation, and maintenance of equipment, accompanied by a long logistics support tail that provided parts for any maintenance discrepancy. The Focused Logistics portion of JV 2010 relies heavily upon civil sector support in the theater of operations, generally with support provided by the host nation in which the conflict is being conducted. Significant problems are envisioned by this approach.

The strong reliance that JV 2010 places upon commercial equipment, processes, and procedures strongly dictates that American, European, and Third World equipment have compatibility and interconnectivity. However, this interconnectivity will probably be impossible to obtain. There are not only different standards of operation and sizes of equipment but also differences in such simple things as power sources or the control panel operating language. Interconnectivity becomes an even greater issue when concerned about metric and standard type threads and equipment measurements. Strong reliance upon the civil sector, in theater, may result in failure to rapidly obtain the necessary spare parts to ensure strong equipment viability.

A solution to this problem may be the use of commercial, international equipment instead of military-unique or specific hardware. The reduction in support infrastructure and support tail and the use of commercial contractors may diminish many interoperability issues. Civil sector dominance will become increasingly vital to ensuring global coalition equipment interoperability.

Technology

Technology and information science-based civil sector support provide the infrastructure for the operational commander of the 21st century. Commercial technology exploitation has successfully been tested by the Defense Logistics Agency. These technologies include the Automated Manifest System in which the shipment manifests are contained within a laser card that can be scanned at all points within the delivery cycle, providing up-to-the minute status of the commodity destined for the battlefield electronic commerce/electronic data interchange—the use of *paperless* transactions for procurement, ordering, delivery, and payment of supplies—is routinely used throughout the world. Premium Service, an analogous service to Federal Express overnight package delivery, has been used in peacetime operations in the CONUS. Dedicated truck support is also being successfully used to deliver repair parts to and from the repair depot to the base of utilization. Most of these technologies are currently CONUS based, with plans to use each in a worldwide contingency.[28]

Each technology described previously will only be as viable as the supporting infrastructure the military has in

place. These technologies change rapidly, to the degree that many different software versions or releases may be on the battlefield at the same time. This will become and remain a significant issue for the operational commander. Martin van Creveld recognized the importance of technology when he cited:

> The shorter the war, the greater the importance of weapons and weapons systems. The longer it is, the greater the role of military activities other than fighting, pure and simple, and the greater the role of technologies that impinge on these activities or govern them.[29]

Technology will dominate the concerns of the operational commander in the future. With the many *technology-driven* systems that are currently being fielded, a homogeneous system integration of the various technological types will be essential to successful operational battlefield success. Van Creveld recognized systems homogeneity when he identified:

> No weapon has ever won a war on its own and without support, clearly some integration is required. On the other hand, there exists a point beyond which integration, regardless of whether it was brought about by the strength of the opposition or by the inherent nature of technology itself, will lead to diminishing returns.[30]

Information warfare and the prevention of information systems disruption must be a real concern of the operational commander's J6. Viruses, *Trojan Horses,* and other data-related disruption agents must be continuously expected with the great dependence upon high-technology information systems. The ability of the enemy to penetrate and disrupt one of the technologically based information systems poses additional security issues. If the enemy is able to successfully remove a space-based asset or its communication up or down link, the operational commander will have no access back to higher headquarters or other command and control facilities. Contamination or enemy infiltration of the commercial sector support systems may prevent them from providing the operational commander with the required computer systems support. This continues to be an increasingly major concern when relying upon civil sector support.

Conclusions and Recommendations

Will Focused Logistics as envisioned by JV 2010 provide the robust wartime logistics support required by the operational commander? The evidence presented so far is inconclusive; however, it does suggest that JV 2010 is *not in touch* with reality.

The DoD/military culture is conservative, risk averse, and not prone to risk taking. Further, entrenched bureaucracies are highly resistant to change for a variety of reasons. Risk taking will have to be encouraged if vital civil sector support, as envisioned by JV 2010, is to become a true reality. Large-scale exercises both in CONUS and overseas must be dedicated to the support doctrine espoused by JV 2010 and the Focused Logistics objective. Systems failures must be expeditiously remedied and improvements made. Pilot studies of various sizes, using JV 2010 Focused Logistics concepts and ideas, should be immediately implemented to identify shortfalls and failures. Careful analysis of each pilot study will identify changes required to optimize JV 2010 tenets and objectives. These lessons learned will be vital to all operational commanders, regardless of the theater of operation.

The strong degree of technological dependency envisioned by JV 2010 will not be possible until some *umbrella* architectures are developed for many of the disparate logistics technologies. These *umbrella* architectures must be international in nature and scope, as our dependence upon coalition warfare strongly dictates the United States will most probably use coalition warfare in all hostile engagements.

Contractor force protection, both physical and electronic computer systems, must be carefully planned in critical detail. This is a *knotty* question, for not only must the contractor personnel be protected but also the equipment, supplies, and computer information systems. New concepts must be developed to make this a reality. These concepts must be successfully integrated with operational coalition combat forces, a matter that defies any easy solution.

The JV 2010 Focused Logistics objective is based upon some lofty and highly optimistic technological assumptions that are pervasive throughout the Focused Logistics objective. The DoD Computer-Aided Logistics Support initiative is now approximately 15 years old, but still no unitary international standard or discrete systems architecture has been successfully developed for all combat forces worldwide. Without careful monitoring of JV 2010's Focused Logistics objective, the same problems could plague this idea as well, leaving the operational commander without any real logistics support provided by the civil sector.

Cultural changes and paradigm shifts will be required if JV 2010 and civil sector logistics are to become a reality.

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Contractors on the

Battlefield

What have we signed up for?

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When war broke out on the morning of Jan 17th as United States and allied aircraft bombed Iraq and Kuwait, the US contractors did not leave Saudi Arabia; some industry personnel even remained on the front lines with US troops."[1] From now into the foreseeable future, when the US military deploys for combat, peacekeeping, or peacemaking efforts, Department of Defense (DoD) contractor personnel—significant numbers of them—will deploy with the military forces. This is not such a startling revelation since civilian contractors have accompanied troops to war throughout history. No, what makes this issue worthy of research is not the fact that contractors are supporting these operations but the scope, location, and criticality of that support. Nonmilitary members are maintaining fielded weapon systems, supporting field operations, and managing and operating information and intelligence systems. "Contractors and civilians have been participating in military operations since Vietnam [or earlier], but never at current levels."[2] Senior Army logisticians interviewed by the Logistics Management Institute (LMI) for a post Desert Storm report were almost unanimous in their belief contractors played a vital role on the battlefield, especially in supporting high-tech weapon systems.[3] According to the DoD Inspector General (IG) in a June 1991 audit: "If contractors leave their jobs during a crisis or hostile situation, the readiness of vital defense systems and the ability of the Armed Forces to perform their assigned missions would be jeopardized."[4]

That finding was more than 7 years ago when there were some 1 million more personnel on the DoD roles.[5] Never has there been such a reliance on nonmilitary members to accomplish tasks directly affecting the tactical success of an engagement. This has blurred the distinction between soldier and civilian. This blurring is evident in the following passage from *Air Force Core Values*, regarding why we have core values:

> The first reason is that Core Values tell us the price of admission to the Air Force itself. Air Force personnel—whether officer, enlisted, civil servant or contractor—must display honesty, courage, responsibility, openness, self-respect and humility in the face of the mission.[6]

Air Force personnel? Price of admission to the Air Force? Contractor personnel may have all of these virtues, but they are not Air Force personnel! Their contract is their admission ticket, not an oath. Contractors are not DoD employees, no matter how much the Services wish it to be so. This fact and our cultural differences cannot be simply ignored through inclusion. On the other hand, this new reliance on in-theater contractor support is reality and cannot be disregarded.

In a postwar article entitled "Desert Storm and Future Logistics Challenges," former Army Chief of Staff General Carl Vuono did not even mention the role of contractors in the war or, more importantly, a logistics challenge of the future.[7] The military is facing a fundamental change in the way it conducts warfare, and there is little evidence that the players have been adequately prepared for that change. Both commanders and contractors need to understand the legal and operational implications stemming from or escalated by the increasing operational role of DoD contractors. The point is not to cast doubt about the patriotism or the loyalty of DoD contractor personnel—they have done the job when called. Rather, we must recognize and plan to accommodate the important differences in roles and responsibilities. If we do not, we will create significant operational and legal challenges for the field commanders, as well as for the civilian operators. After providing some background on

civilians in the combat environment, this article focuses on the following critical issues: the contractors' responsibilities, command and control or the commander's authority to discipline and direct, and the contractor personnel's combatant versus noncombatant status and implications and their effect on force protection requirements.

Background

Throughout the history of warfare, civilians have traveled with armies and accomplished those functions now called logistical support.[8] The State's employment of these civilians in this capacity has been recognized in the laws of armed conflict as defined by the Laws of the Hague in 1907 and the Articles and Protocols of the Geneva Conventions, last held in 1949. Civilian support to armies was accepted based upon a universal perspective that noncombatants could accomplish support tasks as long as those tasks kept them out of direct confrontation with the enemy. This would allow the soldiers to handle the business of warfighting and allow the private sector to do what it does best. Today, we unquestionably accept that the use of civilian support remains legal yet the requirements of warfare have dramatically changed the scope and relevance of the support tasks they provide, thus making their distinction as noncombatants less obvious.

US History

As far back as General Washington's Continental Army, civilians were employed to drive wagons, provide architect/engineering and carpentry services, obtain food stuffs (when not foraged), and provide medical services.[9] The Continental Congress believed civilians should accomplish these tasks so that the soldiers could be free to be with their units and focus on warfighting responsibilities.[10] It made sense to use civilians to accomplish these logistical tasks because they were considered either too menial for soldiers or were well established or specialized functions in commercial industry.[11] This philosophy and thus the use of civilians in noncombat roles remained relatively unchanged from the War of 1812 up through the Vietnam War. In each of those conflicts, significant numbers of civilians continued to accomplish basic logistics requirements in support of the soldiers, as shown in Table 1.

The use of civilians in wartime was not, however, without problems. During the Revolutionary War, for example, a regiment of artificers was raised to work with civilian artificers supporting construction and ordnance requirements. A special report to Congress on the state of this regiment emphasized the disgruntled comments of the military members contrasting their wages with those paid to the civilians.[12] "It was difficult to persuade men to reenlist after the expiration of their three-year terms."[13] Sound familiar? Additionally, there was often a question of these contractors' commitment and responsibility. During the Civil War:

> . . . draft exemptions were sought for teamsters to encourage them to drive wagons to western posts; however, teamsters were not only difficult to find, they proved to be recalcitrant employees, so toward the end of the war, the tendency was to replace civilian drivers with soldiers who could not resign or swear back with impunity.[14]

The key point is that when problems with contractor support did arise commanders could turn the task over to military personnel who had at least some basic skills. Additionally, the general policy of the military related to employing contractors was "the closer the function came to the sound of battle, the greater the need to have soldiers perform the function because of the greater need for discipline and control."[15]

War/Conflict	Civilians	Military	Ratio
Revolution	1,500 (est)	9,000	1:6 (est)
Mexican/American	6,000 (est)	33,000	1:6 (est)
Civil War	200,000	1,000.000	1:5 (est)
World War I	85,000	2,000.000	1:2.0
World War II	734,000	5,400,000	1:7.0
Korean Conflict	156,000	393,000	1:2.5
Vietnam Conflict	70,000	359,000	1:6.0

Table 1. Civilian Participation in Conflict

With the Vietnam War, the employment of civilians began to change. *Business Week* called Vietnam a war by contract.[16] "More than ever before in any US conflict, American companies are working side by side with the troops. One big reason is that military equipment has become so complex."[17] "Specialists in field maintenance checking on performance of battlefield equipment, have dodged Vietcong attacks on military bases at Da Nang and Pleiku."[18] No longer were contractors away from the sound of battle. No longer were they relegated to basic logistics tasks. They were becoming specialists in the tools of war. "There might have been a time in the past when the site of military operations was an exclusive club for those in uniform, but those days are waning."[19]

> When US troops set foot on Saudi Arabian sand, many defense industry contractors were close behind. The contractors followed the military to the make sure that their multimillion dollar weapon systems functioned properly in the harsh desert environment.[20]

The trend is for an increasing number of civilian operators in theater to support logistics and, more importantly, combat operations. "One in 10 Americans deployed for NATO peacekeeping operations in Bosnia is a civilian. By contrast, 1 in 50 Americans deployed for the Persian Gulf war was a civilian."[21] (Note that these figures are for contractors deploying with the troops and should not be compared with the figures in Table 1.) That ratio will continue to shrink as more functions are being turned over to the private sector through competitive sourcing, privatization, and changing logistics practices such as lifetime contractor logistics support.

Why Has This Happened?

Three factors have contributed to this trend: deep cuts in uniformed personnel, a push to privatize functions that can

be done outside the military, and a growing reliance on contractors to maintain increasingly sophisticated weapon systems.[22]

Actually, there is a fourth reason for the deployment of contractors into the battlefield: to provide flexibility in the face of congressional, executive branch, or host-country-mandated troop ceilings.[23] For example, at the height of the Vietnam War, there were more than 80,000 contractor personnel supporting the war effort who did not count against troop ceilings set by President Johnson. Similarly, in Bosnia, the US military has been able to get more tooth (soldiers) in-theater by having more than 2,000 contractor personnel in forward locations above the congressional limit of 20,000 US troops. However, while there is certainly a benefit to the Department of Defense stemming from an increased reliance on contractors, whether this is a cause of the increased contractor participation or simply the result is open to argument.

Manpower Reduction

"Since the end of the Cold War, the Department of Defense has cut more than 700,000 active duty troops from the ranks."[24] Additionally, more than 300,000 DoD civilian positions have been eliminated. These cuts have occurred without a commensurate reduction in operational requirements. In fact, all of the Services have experienced a significant increase in operating tempos over the last 10 years while operating with about one-third fewer forces. The Air Force, for example, has an average of 12,000 airmen deployed on any given day. Ten years ago that average was around 2,000.[25]

> The Army has had a 300 percent increase in mission commitments during the past several years, and they do not appear to be tapering off. During the same period, the Army has reduced the US Army Materiel Command's (AMC) military strength by 60 percent and reduced the number of AMC depots by 50 percent.[26]

Out of necessity, there has been a growing recognition that more of the jobs previously accomplished by military members must be accomplished by civilians. This move to a greater reliance on nonmilitary support is recognized by all the Services. In the Air Force, it is articulated in *Global Engagement: A Vision of the 21st Century Air Force*. "The force will be smaller. Nonoperational support functions will increasingly be performed by Air Force civilians or contractors."[27] Two parts of this excerpt need to be scrutinized.

First, the reference to increased participation by Air Force civilians must be looked at with skepticism. While historically a significant portion of the competencies cut from the active duty forces were passed on to the Department of Defense, that is no longer possible. As discussed above, they, like the active forces, have faced significant cuts since the Gulf War. Those cuts continue. According to Deputy Secretary of Defense John Hamre, 237,000 DoD employees will participate in public-private competitions from 1997 to 2003.[28] Only a year earlier, the *Air Force Times* reported that Service planners were considering giving private contractors more than 160,000 jobs performed by service members and DoD civilians.[29] Additionally, Global Engagement's statement regarding nonoperational support functions is suspect. As cuts to the military forces and budgets continue, the skills being reduced or eliminated are becoming more related to operations, as opposed to their historical base support focus. During Desert Shield and Desert Storm, for example, contractors had maintenance teams supporting Army tracked and wheeled vehicles (anything from 2-1/2-ton trucks to 65-ton M1A1 tanks); the Fox nuclear, biological, and chemical vehicles; and TOW and Patriot missiles.[30] The Air Force had contractors flying in support of the Joint Surveillance, Target Attack Radar System (JSTARS), as well as performing in-theater organizational maintenance. During Operation Just Cause, a total of 82 contractors were in Panama to support aviation assets.[31] These certainly appear to be operational activities. They may even be considered combat operations. Nonoperational is defined in terms of what is privatized rather than by whether the function is core to warfighting.

Privatization and Contracting Out

While declining manpower is placing more operational jobs directly in the hands of the private sector, the budget and manpower reduction is also forcing the Department of Defense to look at demilitarizing large areas of core functions through privatization or contracting out. In the past, core functions were defined as those requiring a military or organic capability because it was combatant in nature, required potential deployment into harms way, or required the capability to be expanded (surged) in times of crisis. They were specific skills, maintenance and munitions handling, for example. Today, there has been a move away from functions toward a focus on more broadly defined core competencies. For example, the Air Force identifies its core competencies as Air and Space Superiority, Precision Engagement, Information Superiority, Global Attack, Rapid Global Mobility, and Agile Combat Support.[32] Thus, functions previously felt to be sacrosanct are now candidates for transition to contractors. The largest of these function being rapidly transitioned is maintenance, most significantly, depot maintenance. Less than 10 years ago, maintenance was considered to be a core logistics function. For years, the Pentagon has been after Congress to repeal the law requiring that government employees accomplish 60 percent of depot weapon system maintenance. They have recently succeeded in reducing that to 50 percent and are not through yet.[33] By 2003, almost 40 percent of DoD maintenance depots and 55 percent of the depot work force will have been eliminated.[34]

Another core function facing either privatization or contracting out is information and communications—the functions supporting Information Superiority. Information Superiority, which includes information warfare, is

identified as a core function in Global Engagement and emphasized in Joint Vision 2010. Yet, the Air Force has plans to reduce the communication-computer occupational field by 24 percent within the next 5 years.[35] There are many other examples. Where noncommissioned officers used to test and calibrate weapons, civilian technicians are now doing the work.[36] The Aerospace Guidance and Metrology Center—once the military facility responsible for the maintenance, repair, and calibration of missile guidance systems and Air Force measurement standards—is now completely a contractor operation. New initiatives under consideration include contracting out all software maintenance on the B-2 bomber and the total maintenance effort for the F-117 fighter. The Air Force is also studying the possibility of outsourcing all of its precision measurement equipment laboratories. If implemented, the Services will eventually be devoid of the organic capability to support these systems and missions. In time of war, they will be completely dependent on contractors to provide whatever support needed whenever it is needed. Commanders need to ensure the contract supporting them accurately reflects and supports peacetime and wartime requirements.

Competitive sourcing and privatization among the Services or even within each Service is not being accomplished in a standardized manner. In the Air Force wing or center, commanders are strongly encouraged to contract out base support functions. However, a standard has not been set for outsourcing functions identified by higher headquarters. Some wings, for example, have turned the majority of their civil engineering functions over to contractors, while others have not. As the Air Force moves into the Air Expeditionary Force (AEF) structure, concern is growing over the lack of organic engineering skills at some locations.[37]

Two related outcomes of privatization are further reducing the availability of skilled DoD technicians. First, for those military members in a career field that is being privatized, there are fewer places they can be stationed. Often, the only place they can go is overseas or to a continental United States (CONUS) base that has significant deployment responsibilities, reducing quality of life and retention. Second, privatization provides civilian job opportunities for skilled military members. "When a military repairman achieves journeyman status, he can easily be wooed to leave the Service and accept private employment at higher pay. Often these journeymen then work for contractors who support the military."[38] On the other hand, in the long term, industry is losing a primary source of trained and uniquely skilled labor for the military systems it is now supporting. This most certainly will increase future contractor costs.

Support of High-Technology Weapon Systems

This situation is further exacerbated by reliance on cutting-edge weapon systems technology. The Army's logistics after action report from Operation Desert Storm said, "There is a role for contractors on the battlefield, particularly when the tasks are so complex that it is not economically beneficial for the Army to maintain needed capability within the force."[39] Continual and rapid technological change has made it uneconomical to keep soldiers technologically capable of maintaining, troubleshooting, and in some cases, employing sophisticated weapons. This is driving the military to rely on contractor support, at least during the initial fielding phase of a system and possibly for its life (C-17 contractor logistics support). In the not too distant past, it was DoD policy that the Services establish organic support for the logistical sustainment of new weapon systems as soon as possible after fielding. DoD Directive 1130.2, *Management and Control of Engineering and Technical Services*, required the military to achieve self-sufficiency in maintaining and operating new systems as early as possible and limited the use of contractor field service to 12 months thereafter.[40]

The purpose of this directive was to ensure the Services did not come to rely too heavily on the use of civilian technicians to support their systems.[41] Today, that directive is gone, and the general philosophy has completely reversed. Congressional language now requires that maintenance and repair for all new critical weapon systems be under contractor support for at least 4 years and for life for noncritical systems.[42] Once again, in the future when US forces deploy, there will be many situations where a contractor employee is the only person with the technical skill to perform functions necessary for the employment of a weapon system.

Downsizing has made it a necessity that contractor personnel go to the front lines to support their weapon systems and perform functions the same as military members. We have, in effect, stopped trying to keep an organic ability, thus creating a hybrid—not a military—member, but not quite the historical civilian who accompanies the troops. The ramifications could be significant to fighting and winning.

Issues

The challenges or issues generated from increased reliance on contractors to perform combat support functions are not new to the Department of Defense or the Services. As far back as 1980, there have been several studies, audits, and articles highlighting the Services' increased reliance on contractors, along with warnings of the risk that accompanies that reliance during crisis or hostile situations.

Contractor Responsibility

The greatest risk, at least from a field commander's perspective, is that the contractor will not be there to perform or will leave when hostilities break out. How great is this risk? It is really defined by four elements: the criticality of the missions being performed, availability of alternative resources, authority to direct compliance, and finally, history. There is no doubt that the systems supported and the functions being accomplished are critical to the prosecution of the battle. The systems involved include JSTARS, Patriot, AN/GYQ-21 data-processing equipment, and the Fox chemical biological system, to name a few. Functions

performed include maintenance and even systems operations. As a result of downsizing, privatization, and modernization, there are no DoD resources available to fill potential voids.

Regarding the authority or capability of the commander or the Service, virtually every audit, study, or article written on the subject says the same thing. The Services cannot ensure that the contractor will be there when hostilities begin. Legally, contractors cannot be compelled to go into harms way, even when under contract, unless there is a formal declaration of war. In 1980, the Logistics Management Institute published a study entitled *DoD Use of Civilian Technicians*. The report summary stated:

> . . . continued reliance on civilian technicians means that maintenance skills are not being successfully transferred from the producer to the ultimate user of the system. Should civilians leave their job in wartime or other periods of heightened tension, the material readiness of key systems would be jeopardized.[43]

In November 1988, a related DoD IG report expanded this perspective, stating there was:

> . . . no capability to ensure continued contractor support for emergency-essential services during mobilization or hostilities, no central oversight of contracts for emergency-essential services, no legal basis to compel contractors to perform and no means to enforce contractual terms.[44]

The report recommended that all commands identify war-stoppers that should be performed only by military personnel and other services that could be contracted out if there was an adequate contingency plan that ensured performance if a contractor defaulted. The DoD responded with DoD Instruction 3020.37, *Continuation of Essential DoD Contractor Services During Crises*, which simply lays the responsibilities on the commander for finding alternatives or accepting the risk. In June 1991, the DoD IG completed a follow-up audit report entitled, *Civilian Contractor Overseas Support During Hostilities*. The report's bottom line again was, "DoD components cannot ensure that emergency-essential services performed by contractors would continue during crisis or hostile situations."[45] The report goes on to say:

> If the contractors leave their jobs during a crisis or hostile situation, the readiness of vital defense systems and the ability of the Armed Forces to perform their assigned missions would be jeopardized. Therefore, it is necessary to seek ways to assure that civilian contractor support will continue during periods of greatest need.[46]

Their findings and recommendations for accomplishing this, along with DoD's response to those findings, are summarized below:

Finding 1: DoD components cannot ensure the continuance of emergency-essential services during crises or hostile situations.

Response: DoD Instruction 3020.37, while published in November 1990, had not been completely implemented. That instruction provides that the heads of components ensure annual reviews are accomplished to identify such services. The activities commander shall "either obtain alternative personnel to perform the services or prepare a plan to obtain the services from other sources or accept the risk."[47]

In reality, the component commander cannot compel contractors to perform, even under contract, if it would force them to go into harm's way. Additionally, the three options provided in the response are not realistic. There are no other available resources. Thus, the commander has no real alternative other than to accept the risk.

Finding 2: Require identification of war-stopper services that should be performed exclusively by military personnel.

Response: Not necessary, DoD Directive 1100.4, *Guidelines for Manpower Programs*, identifies those functions that must be military.[48]

IG Final Report: DoD Directive 1100.4 is 37 years old. It does not establish standard criteria for identifying these functions, without which the components will continue to identify a wide range of services.[49] (The report, overall, implied the current reporting was ineffective.) That 44-year old regulation says:

> Civilian personnel will be used in positions which do not require military incumbents for reasons of law, training, security, discipline, rotation or combat readiness, which do not require a military background for successful performance of the duties involved and which do not entail unusual hours not normally associated or compatible with civilian employment.[50]

Finding 3: Require an annual reporting system identifying the number of contractors performing emergency-essential services and the number of contractors involved.

Response: The requirement for the components to conduct the annual assessment and to have contingency plans is sufficient. "The number of contracts is not the important factor; the need is to make sure we are able to carry out our mission."[51]

IG Final Report: The number of contracts and contractors is valuable information. That is evident by the fact that the Assistant Secretary of Defense (Production and Logistics) requested that the IG provide data on the number of contractors and contractor personnel in theater.[52]

This is important information. How does a commander in chief (CINC) or a field commander plan requirements without knowing who and how many personnel will be there or what requirements are actually on contract? It is also a critical factor in determining force protection requirements, an issue discussed later.

Finding 4: Revise DoD Instruction 3020.37, to include "Provisions to safeguard personnel performing emergency-essential services during a crisis or hostile situation."

Response: Not necessary, "the commander is charged by the Geneva Convention with protecting the lives of all noncombatants."[53]

IG Final Report: The response to this finding will not afford the contractor employees with similar priority, rights, and privileges accorded to DoD personnel. Geneva conventions deal with identification of noncombatants, not protection. "Only 1 of 67 emergency essential contracts reviewed contained provisions to protect contractors against chemical and biological warfare."[54]

The DoD response to this finding was incredulous. In Desert Storm, the coalition forces had to provide chemical and biological gear to Civil Reserve Air Fleet (CRAF) pilots to ensure their continued operations into theater. Today, the United States will not allow the CRAF, which provides approximately 33 percent of heavy lift, to travel into a chemical or biologically tainted airfield.[55]

In fact, the DoD response to all of the findings reflects that they either did not understand the issues or, worse, did not care. This is reflected in their policies. In addition to the Services being governed by a 44-year-old instruction, there is a 13-year-old directive, DoDD 1100.18, *Wartime Mobility Planning*, which states that DoD manpower utilization policy is to "encourage civilian employees who occupy emergency-essential positions and contractor personnel who are performing critical support activities overseas to remain in the theater."[56] How? Who? With what? DoDD 1404.10, *Emergency Essential Civilian Personnel*, dated April 1992, says: "It is DoD policy [to] limit the number of emergency-essential civilians to those positions specifically required to ensure the success of combat operations or the availability of combat-essential systems."[57] Yet, virtually every review and study related to the subject has stated emphatically that civilian contractors are providing vital support to critical systems, and their continued support to those systems in time of hostilities is crucial to mission success.

The final element defining risk is history. History has, for the most part, found contractor personnel doing their jobs during times of crises or hostilities. However, in the previously cited LMI study, the authors proposed:

> It was questionable whether the civilians would have remained when the bullets started flying. There were a few instances of contractor/Department of the Army Civilians wanting to leave the theater because of the dangers of war. However, many people have doubts about how long they would have stayed if the operations had been costly in lives.[58]

There have been a few examples to substantiate these fears. In South Korea, in the wake of the 1976 tree-cutting incident in the demilitarized zone, emergency-essential civilian contracting personnel fled their posts at the prospect of imminent hostilities.[59]

Additionally, in the wake of the desert conflict, several CRAF contractors reduced the percentage of systems they would place under the program. We have yet to see any major incident involving contractor personnel or equipment. It must be noted also that in Vietnam and Korea and to some degree in Desert Storm contractor personnel involved "normally had the advantage of at least some military training and were generally familiar with the tactical and operational levels of employment."[60] They might be compelled to stay by their understanding of the mission or out of a feeling of camaraderie. This was not necessarily the case in Southwest Asia and in Macedonia and will be even less likely in the future.[61]

Again, as reported by LMI in its after action report, senior logisticians felt civilians contractors were vital for Desert Storm.[62] That was 8 years ago when we had several hundred thousand more military and DoD civilian members. Today, even more critical functions are in the domain of civilians. Contractor support on the battlefield at today's level of dependence has not been tested in a real life-threatening hostile situation. Desert Storm cannot be held up as the way things will be. We need to prepare for the worst case, and that case is where critical contractor personnel leave their posts. The point is not that civilians would not stay. They may or may not. However, they are not combatants. The point is they do not have to stay, and the Department of Defense needs to work to minimize the risk that fact entails.

The Noncombatant

> In ancient times, as evidenced by the laws of Manu, the Old Testament or the writings of Kautilya on Sun Tzu, there was no attempt to identify those who were entitled to be treated as combatants. In former times, especially in small states, as soon as war was declared, every man became a soldier; the entire people took up arms and carried on the war.[63]

Warfare slowly evolved into the concept of professional armies, and a distinction developed between the soldier and the nonsoldier or noncombatant.

> In order to promote the protection of the civilian population from the effects of hostilities, combatants are obliged to distinguish themselves from the civilian population while they are engaged in an attack or in a military operation preparatory to attack.[64]

The distinction between combatant and noncombatant is critically important to all parties as it defines the treatment of the individual in time of war and is shown in the matrix.

The law of war related to this issue stems from both the Laws of The Hague and from the Laws of Geneva. Section 1, Chapter 1, of the Laws of The Hague, 18 October 1907, entitled "The Qualifications of Belligerents," defines combatants as follows:

> Article 1. The laws, rights and duties of war apply not only to armies but also to militia and volunteer corps fulfilling the following conditions:
>
> To be commanded by a person responsible for his subordinates; to have a fixed, distinctive sign recognized at a distance; to carry arms openly; and to conduct their operations in accordance with the laws and customs of war.[65]

This description was further defined by Article 43 of Protocol I of the Geneva Convention, dated August 1949.

> The armed forces of a party to a conflict consist of all organized armed forces, groups and units that are under a commander responsible to that party for the conduct of its subordinates. Such armed forces will be subject to an internal disciplinary system that, inter alia, shall enforce compliance with the rules of international law applicable in armed conflict.[66]

Those who do not fit these descriptions are noncombatants. DoD civilians and contractors fall into this category. The reasons contractors and DoD civilians cannot be considered combatants are:

- Neither category of civilian is subject to the commander's internal disciplinary system (for US forces, that is the Uniform Code of Military Justice [UCMJ]).
- Neither is necessarily trained to conduct operations in compliance with the law of armed conflict.
- The contractor is not subordinate to the field commander.

The law of war, however, has historically recognized the right of noncombatants to be present in a combat area "and [they] may even be aboard combat aircraft, vessels, and vehicles on operational missions. They may provide technical support and perform other logistics functions."[67] This international recognition is somewhat dated (reaffirmed by the Geneva Convention Protocol I of 1949). As defined in Air Force Pamphlet 110-31, *Civilians Accompanying the Armed Forces*, a category of noncombatants entitled to prisoner-of-war status, includes:

> . . . civilian members of military aircraft crews, supply contractors' personnel, technical representatives of government contractors, war correspondents, and members of labor units or civilian services responsible for the welfare of the armed forces.[68]

It goes on to warn that trends since World War I have tended to blur the distinction between combatants and noncombatants. This includes civilians, resulting in less protection for the noncombatant, because: "(a) growth of the number and kinds of combatant, including guerrillas [and] (b) growth of noncombatants engaged in activities directly supporting the war effort, including armament production."[69] The pamphlet is dated 19 November 1976, and significant changes in weapon systems and operations have occurred since that time, making that distinction even more difficult.

While the Protocol—and subsequently this pamphlet—recognized the noncombatant status of civilian aircrews, it is extremely improbable that the authors of either document envisioned civilian technicians assisting in the collection of surveillance data during operational missions. Did they envision civilian maintainers providing battlefield maintenance of a TOW missile, the M1A1, the Bradley, or the Patriot missile, as was evident during Desert Storm when they accepted the civilian-accompanying-the-troops philosophy? How about contractors supporting the gathering and interpreting of data from the Joint Air Forces Control Center and feeding intelligence and targeting information to operators? Were they the noncombatants described in these conventions? As we privatize the communications-computer field, will contractors, who at least supplement our information warrior force, be noncombatants?

Category	Military Target	POW Status	War Criminal
Combatants	Yes	Yes	No
Noncombatants	No	Yes	No
Illegal Combatants	Yes	No	Yes

Table 2. Combatant vs. Noncombatant

In his legal opinion regarding the noncombatant status of having contractor/civilian operators for the Dark Stars remotely piloted vehicle, W. Darrell Phillips—Chief, International and Operational Law Division, Air Force Judge Advocate General School, Maxwell AFB, Alabama—determined these operators would risk losing their noncombatant designation and could be considered illegal combatants.[70] A person:

> . . . cannot be a combatant and a noncombatant at the same time. However, by Article 51 (3) of Protocol 1, 1997, a noncombatant, that is to say a civilian who takes part in hostilities, loses his/her status under both the Protocol and Civilian Conventions and for as long as he operates in that capacity, becomes a legitimate object of attack.[71]

Additionally:

> . . . since they are not combatants (lawful) and not within the extremely restrictive category of levee en masse if they commit a combat act (defined in the terms of the German manual as "participate in the use of a weapon system")[72] then they are liable to trial as "unlawful" combatants or war criminals.[73]

The implications are that by having a contractor accomplish a particular job, field commanders may be asking them to give up their protected status and even possibly risk execution if captured. Additionally, there is certainly some question as to whether the commander is violating the law of war by having a civilian noncombatant participate in combat. So why not just make them combatants? US civil law precludes civilian contractor personnel from meeting the four criteria specified in Section 1, Chapter 1, Article 1 of the Laws of The Hague and the requirements of Article 43 of Protocol 1 of The Geneva Convention, which determine legal combatants. Regardless of their inclusion in the Air Force Core Values, contractor personnel have not been held to the same standard that society holds its military members. The fact is these personnel are different from soldiers, and these differences mean a great deal to a commander's pursuit of combat operations. If employed improperly, the commander could risk being liable for violation of the laws of war. Additionally, a commander could commit the US Government to care and benefits for contractors commensurate with those of veterans.

Discipline and Control

One of the key differences between the contractor and the soldier—and also one of the primary reasons contractors do not qualify under the definition of combatants—is they

are not subject to the military's internal disciplinary system, the Uniform Code of Military Justice, unless there is a declared war.[74] In an overseas deployment, contractor personnel cannot be disciplined by the military for violations of the UCMJ. In fact, typically, the only recourse commanders have for punishing contractors for crimes committed on post is, working through the contracting officer, to send them home and let their respective chains of command or boss determine and administer punishment, if any. The military may, if the offense was of a criminal nature, refer charges to the Department of Justice. From the contractor-employee perspective:

> . . . the most important thing contractor employees need to know are the terms of the contract they are working under and the Status of Forces Agreement (SOFA) between the United States and the country they are serving in. Depending on the SOFA, contractor employees may be subject to local and criminal laws of the country in which they are deployed.[75]

In countries where justice is based upon the Talmudic code—an eye-for-an-eye—this could be extremely important.

This issue of contract brings us to another key difference between the military member and the contractor and another significant reason they are not and cannot be considered combatants. A field commander needs to understand this concept for contractor personnel. These personnel are not compelled by an oath of office, but rather by the terms of their employment contract. "One of the hardest things for military personnel to do is to learn to interpret a contractual agreement literally, to assume nothing."[76] The contractor is authorized to accomplish only those tasks within the scope of the contract and is answerable for performance only to the contracting officer or representative. The contract language directs that the contractor not take orders from anyone other than the contracting officer or a duly appointed representative. The representative cannot direct action outside the scope of the contract. This is a fiscal and liability issue. Commanders risk personal liability for the cost of unauthorized work as well as for the cost of property that might be damaged.

Another important point for commanders' operational planning is the fact they cannot command or give orders to these individuals as they do a soldier. It is also important to understand that contractor employees enjoy the legal right to unilaterally terminate employment rather than accept the hardships and potential danger occasioned by exposure to combat operations.[77] The commander cannot assume that they will remain on the battlefield or even in theater simply because of military necessity or personnel shortages even though they knew the risks when they signed on. Civilians cannot be compelled to deploy, remain in a designated area, or perform certain missions, and they are not subject to criminal punishment for refusal to do so.[78]

One final note. While not a legal issue in the vein of UCMJ or contract law, the laws of war require that combat be accomplished in accordance with the applicable laws of war. This implies a distinct understanding of the conventions and the ability of the State to define its operations in terms appropriate to those laws. The LMI study cited a couple of findings worthy of consideration. First, some of the people interviewed "perceived a lack of clear command and control over contractors. Army units had difficulty determining who had management control over contractors."[79] Couple this with their finding, "our interviewees sensed that the contractors were not aware of the commander's intent and the political consideration of their effort."[80]

Force Security

Since the Khobar Towers incident where terrorists used a car bomb to severely damage the compound housing US military members working at the base, killing 19 and injuring hundreds, force protection has been one of the number one priorities and responsibilities of commanders. What is not often discussed is the commander's responsibility to protect the growing number of contractor personnel. That responsibility is or at least should be expanding as more contractors move into potentially hostile areas to perform necessary functions. In his article, "Contractors on the Battlefield," Lieutenant General Williams, Vice Commander of the US Army Materiel Command, frames the issue: "Noncombatants require force protection resources."[81] It sounds simple enough, but it is not a simple matter. These personnel may not be living or performing their duty at the base or compound. They may have family members accompanying them, and they are not required to observe the same restrictions that commanders may place on military members.

In a potentially hostile situation, there must be security forces available to escort contractor personnel. For that matter, security is also required for government contracting personnel who oversee the contractors' performance. As previously discussed, contractors and other noncombatants cannot arm themselves other than for self-protection. Use of a weapon to defend coworkers or equipment changes their status and could subject them to treatment as a combatant or possibly even a mercenary (subject to execution). Therefore, force protection is a requirement. This often requires commanders to take some degree of risk, regarding the effect on the security of their bases or posts by dividing scarce force protection assets. It is a risk they will be reluctant to take if they do not understand the issue. In a briefing to Defense Contract Command Western District commanders, Lieutenant Colonel Dan Krebs, who had commanded the command's contract administration team in Haiti, stated that one of his greatest tasks was managing the security support for his team as they went to check fuel quality or water shipment.[82]

One of the related challenges, also identified in the *Army Magazine* article, was, "Noncombatants cannot perform rear area security missions."[83] Force protection people are a scarce commodity. Often at overseas locations, other support personnel augment the force protection personnel. The Khobar Towers after action report even recommended

the use of other (non-force protection) personnel to augment the force protection mission.[84] As military support forces are privatized, the resources for augmentation of the security forces dwindle. The result is longer shifts, more deployments, and a severe drop in retention rates, further compounding the problem. It should be noted that one of the Air Force responses to the shortage and retention problems is to look to contract out some of the functions accomplished by those forces on CONUS bases.[85]

Finally, in long peacekeeping or even conflict situations, contractors often bring family members. The mass exodus of civilian technicians that resulted from the tree-cutting incident mentioned earlier was attributed to their fear for the safety of their dependents. After escorting their families to safety, most returned to their posts to fulfill their missions.

This force protection role may be the least understood, yet most important.

Recommendations

Civilian leaders have a mandate from the people of this country to build a smaller, more efficient military. Therefore, you will not see a recommendation for the Department of Defense to fight force structure cuts or downsizing efforts. The Department of Defense is already well down the road in privatization and competitive outsourcing efforts, as it should be. However, it seems to have started the process without a coordinated master plan. The primary recommendation is to make sure core competency requirements are dictating what is outsourced and not the other way around. What is required now is some forethought and planning in bringing about new reductions and in-depth analysis of the effects of privatization and outsourcing efforts to date on warfighting capabilities. The risks need to be minimized by eliminating the unknowns and illuminating the risks, facts, and issues.

A recent distinguished guest lecturer at the Air War College said that with the advent of the Air Expeditionary Force, the Air Force is looking at every job and skill—his example was civil engineers—at those AEF locations before authorizing outsourcing efforts. It is an excellent start. However, analysis needs to go beyond AEF and include actions taken already. Retention rates, deployment requirements, criticality of the systems supported, private sector sources of supply, and training time need to be addressed. Is AEF determining the support concept for weapon systems; as an example, the C-17? A thorough review of all support specialties is needed.

Commanders have been placed in a precarious position. They need these contractors in order to accomplish their mission but have been given no tools with which to work. Doctrine needs to be developed—a joint publication focused specifically on contractors on the battlefield. Things that need to be considered include contractor deployment and time-phased force and deployment data applicability, force protection and self-protection responsibility, discipline, understanding contract scope and authority, liability, and the law of armed conflict applicability.[86] This needs to be taught to officers early on and emphasized just the way officers are taught to lead their soldiers. After all, from a strategic perspective, they are being treated as though they were soldiers.

The DoD IG recommendation for developing a methodology and system for reporting the number and requirements of each contract with emergency-essential responsibilities needs to be followed up. DoD contracting officers are required to have analyzed the requirements and determined whether they constitute emergency essential services. That information needs to be gathered and made available to CINC planners.

Finally and admittedly a little out of the box, we need to get with our lawyers and acquisition experts and define a methodology that provides commanders with administrative and tactical command of contractor personnel during hostilities—maybe a deputizing clause that in times of Presidential-declared crises makes contractors reservists.

We cannot stop the move to increased private sector involvement and can no longer limit the involvement to base operations or supply. Those functions are already significantly private-sector provided. What leaders must do is drive further outsourcing, not by how many military it removes but based upon a risk assessment. The outcome of a wrong choice could well be measured in lives and possibly battles lost.

Conclusion

The Department of Defense is gambling future military victory on contractors' performing operational functions on the battlefield. Contractors are becoming increasingly responsible for in-theater taskings previously accomplished by military personnel. This has occurred auspiciously due to significant and necessary cuts in force structures and the related need to transition, through outsourcing or privatization, *nonoperational* functions to the private sector. However, contractor numbers are increasing in theater and on the front lines, and their support is directly related to combat operations. The functions being accomplished by contractors today are not nonoperational support functions. They include maintenance and even operations of vital warfighting systems— JSTARS, Patriot, M1A1, and Dark Stars, to name just a few. In fact, fiscal policy has driven us to a point where there is—or will be—no organic military capability in many functions critical to weapon systems performance.

What this means is contractors need to be on the battlefield performing their job even when confronted by life-threatening hostilities. The irony is the contractors legally cannot—and possibly should not—be compelled to remain in harms way and participate in hostilities unless war has been declared. They are noncombatants and risk extreme penalty if their actions are determined to be in violation of that categorization. As the US military has attempted to compensate for force drawdowns, the distinction between military member and contractor support has been

conveniently blurred. This is placing commanders and civilian operators in a predicament regarding the laws of war, the terms of this *new soldier's* employment contract, and the effect of these issues on the ability to perform the mission. While a transition of support functions, perhaps even operational functions, from the military to private sector is required by budget necessity, it seems to be happening without a master plan or risk-based assessment. There is little evidence that the strategic and doctrinal implication of contractors on the battlefield is being addressed. Each new outsourcing effort must be reviewed and past efforts analyzed based on their overall implications to our warfighting ability. Our logistics support concepts may need to be adjusted to accommodate rear echelon or less risky support. Field commanders must be provided with information regarding the size and requirements related to contractor operations. Finally, if nothing else, we must provide field commanders and contractors with a doctrinal-based understanding of the challenges faced in times of hostilities.

The single deadliest incident during the Persian Gulf War occurred when an Iraqi scud missile hit barracks housing Army Reservists who were providing water purification support far from the front. Today, the military relies heavily on contractors for this support.[87] If death becomes a real threat, there is no doubt that some contractors will exercise their legal rights to get out of the theater. Not so many years ago, that may have simply meant no hot food or a reduced morale and welfare activity. Today, it could mean the only people a field commander has to accomplish a critical core competency tasking, such as weapon system maintenance or communications and surveillance system operations, have left and gone home. Warfare is changing. It appears, unfortunately, that, rather than face this change, we are hoping that nobody notices.

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Munitions Availibility and the AEF

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Professional logisticians must confront the challenges of a radically new environment as the United States Air Force transitions to an Expeditionary Air Force (EAF). In addition to meeting ongoing commitments in Southwest Asia, the EAF concept is aimed at providing an effective military response during the early stages of a crisis anywhere in the world. Under this concept, airpower deploys within days or even hours in order to halt, fight, and eventually win a conflict. To implement the EAF concept, several difficult requirements must be met. First, the Air Force must be able to respond and sustain operations at austere or even bare base locations around the world within the first few days of a crisis or conflict. Next, the limited nature of available airlift to support deployment operations requires that any Air Expeditionary Force (AEF) remain as light and lean as possible. Third, the commander of a combatant command (CINC) expects Air Force elements to provide the capability to conduct precision attacks and be able to sustain them for an indefinite period of time. To meet these rigid requirements, the Air Force must overcome the problem of transporting and providing thousands of short tons of munitions needed to support a combat AEF.

Worldwide Munitions Availability

During the Cold War, there was a fair degree of certainty about where we would fight the next war, and the munitions stocks at bases in Europe were expected to be used in-place against the threat. However, with the EAF concept, there is no certainty about where we will conduct operations, and munitions at overseas locations may be as malpositioned as stocks in the continental United States (CONUS) at the onset of a conflict. Consequently, it will be an even larger challenge to get the right munitions, to the right place, at the right time. A major requirement for AEF operations is standardized timing scenarios that support both rapid and effective planning. The AEF battle lab has performed much of the analysis in this area. Their timing scenario begins with some level of strategic warning, execution of orders within 24 hours, and bombs on target (BOT) with 24 hours of notification. Other studies and documents, without qualification on the need for munitions prepositioning to meet actual or potential operational requirements, clearly note the need for bombs on target within 48 hours for the EAF concept to be creditable.[1]

To understand the nature of moving and positioning munitions, we must first examine the current locations of munitions inventories around the world and the preparations made or planned to move these stocks in a crisis. Munitions positioning and transportation is set forth by the Global Asset Positioning (GAP) program as outlined in AFI 21-206, *Global Asset Positioning*. GAP is a four-part system that includes Theater Munitions stocks, CONUS munitions stocks, Standard Air Munitions Packages (STAMP), and the Afloat Prepositioned Fleet (APF).

Theater Munitions stocks are already positioned at a handful of overseas locations. Their placement was dictated principally by past planning or operational requirements and less so by current requirements. The largest munitions storage area in the Air Force is at Kadena AB, Japan. It provides a large forward stock of munitions for the Pacific Air Forces (PACAF) and maintains a large munitions transportation capability known as the Tactical Air-munitions Rapid Response Package (TARRP) program. This program consists of 21 weapon-specific Unit Type Code (UTC) packages, maintained by the 18th Munitions Squadron and available for rapid deployment in the theater.[2] In addition to Kadena, there are storage areas at Andersen AB, Guam, and on the Korean peninsula. In Europe, stockpiles at Camp Darby, Italy; Ramstein AB, Germany; RAF Fairford, United Kingdom; and the three fighter wings in the United States Air Forces in Europe (USAFE) provide munitions for European operations. At most of these primary storage locations, providing large shipments of munitions to other operating locations inside or outside the theater is a difficult process and not often practiced. However, under the AEF concept, it is likely the munitions flights at any of these locations will be tasked, often on short notice, to provide munitions for deployment bases or locations thousands of miles in advance of their own location. During Desert Storm, when similar short-notice taskings to move munitions were generated, many problems were encountered. First, the required nets, chains, and 463L pallets required to move munitions were not always available and, in some cases, had to be flown into the shipping locations.[3] At other locations, the host nation required up to 30 days for approval to move munitions in the

country, and access to critical port facilities needed for shipping was not guaranteed.[4] In addition, in today's Air Force, the average munitions specialist, Air Force Specialty Code (AFSC) 2WOXX, is not trained to prepare munitions packages for shipment on 463L pallets. The ability to rapidly move munitions will undoubtedly suffer from a large learning curve unless the unit or command implements its own policy and training prior to a crisis tasking. Finally, it should be remembered—and emphasized—that just because munitions stocks are available in a theater does not mean they are easily transitioned to a forward AEF location.

USAF munitions in the CONUS are usually located in large quantities at either Air Combat Command (ACC) bases with a bomber mission or stored at Army ordnance depots such as Blue Grass Army Depot, Kentucky; Tooele Army Depot Utah; and Crane Army Depot, Indiana. The munitions at bomber bases are already tied to plan-tasked bomber flyaway missions and are not readily available for shipment to an AEF location. Also, Air Force munitions at Army depots have to be pulled from storage and shipped by ground or rail transportation to one of three munitions-explosive sited sealift ports in the CONUS. Their movement could easily take several weeks and is limited by the following: availability and speed of ground transportation for explosives, explosive storage at the ports, and availability of Military Sealift Command contracted shipping to move the munitions from the CONUS. This movement process is not very responsive for meeting emerging expeditionary airpower requirements. The salient point is that CONUS-maintained stocks cannot be viewed as an unlimited source of supply for rapid movement to support expeditionary operations.

STAMP and APF Programs. Currently, the Air Force has a limited capability to provide munitions to support short-notice taskings. This capability is provided via the STAMP and APF programs. Both of these programs are managed by the Ogden Air Logistics Center (OO-ALC) and its USAF Ammunition Control Point. OO-ALC is responsible for identifying munitions availability and sourcing for the Air Force and supports requests for STAMP and APF munitions stocks as outlined in AFI 21-206. The STAMP assets are housed in two Air Force Materiel Command (AFMC) munitions storage areas, one at Lackland AFB, Medina Annex, Texas, and the other at Hill AFB, Utah. Together, these two storage areas have the ability to ship, by air, approximately 46 different types of munitions packages pre-identified as STAMP UTCs.[5] There is very little asset redundancy between the stocks at these two locations, and together they make up the STAMP

program. The STAMP program is relatively small and has less than 100 total manpower billets. Of some significance, STAMP personnel provide the only Air Force training on how to prepare munitions for air transport using the 463L pallet system.

The Air Force currently stocks three prepositioning ships with Air Force munitions as part of the APF program. These ships—the *MV Buffalo Soldier, MV Major Bernard F. Fisher,* and *MV Captain Stephen L. Bennett*—are positioned to rapidly swing munitions to one of several theaters during a conflict. An afloat prepositioned ship (APS) brings a large—but limited—quantity of munitions to a theater and can fill the gap between initial starter stocks and resupply from the CONUS. The newest APS, the *MV Captain Stephen L. Bennett* and *MV Major Bernard F. Fisher* are container ships, and the Air Force intends to replace the *MV Buffalo Soldier* with a containerized vessel during FY01. Once this process is complete, the Air Force will have approximately 5,000 International Organization for Standardization (ISO) containers loaded with munitions prepositioned at sea to support planned or operational demands.[6]

The Difficulty of Transporting Munitions

Munitions movement, regardless of the mode of transportation, is a cumbersome process. To compound this fact, munitions availability, particularly in large quantities, depends heavily on prepositioning and movement via sealift. During Operation Desert Storm, the majority of Air Force munitions assets moved by sea to the theater. In fact, according to a postwar report by AFMC, 326,000 short tons of Air Force munitions were transported by sea to Southwest Asia.[7] The transit time for sealifted munitions averaged 55-72 days after adding in port time and ground transportation to the deployed location.[8] By comparison, 26,000 short tons of munitions needed for Desert Storm were shipped by air using 693 C-141 equivalent airlift missions.[9] This clearly illustrates that even hundreds of airlift missions can only lift a small percentage of the munitions needed for a large air campaign such as Desert Storm. In general, airlift of munitions, especially bomb bodies, to support combat operations is not efficient since an average C-130 aircraft can haul only one munitions package. For example, a 2,000-pound, GBU-10 , laser-guided bomb munitions package will max out the available space of a C-130 and provide only six weapons to the warfighter. The weight of the entire palletized package is well below the aircraft weight limit, but bomb bodies that overhang the 463L pallets and other tie-down considerations make this the maximum load for this weapon type on the C-130. At a rate of only six weapons per mission, the available airlift for munitions movement in a conflict is quickly consumed with only a handful of assets being delivered to the forward combat location in a timely manner. The ability of the airlift system to meet expeditionary timing requirements makes munitions prepositioning and shipment preplanning essential. This is true even if a significant amount of airlift is dedicated for initial movement and follow-on resupply. EAF operations will always be limited by the type and quantity of munitions available at the operational location.

Air transportation is not the only problem associated with munitions movement. In planning for the movement of containerized munitions via rail lines, the Services must be concerned about the maintenance and support of feeder rail lines to DoD sites with concentrated munitions activities. This is a well-documented concern. In 1960, the railroads maintained 217,552 miles of rail track. By 1996, this mileage was reduced to 120,000 miles. Most of the reduction came from the elimination of branch and feeder lines similar to the ones that support military installations.[10] In addition, the movement of 20-foot ammunition containers requires railcars specifically designed for these containers. The total 20-foot railcar slot availability in the United States is 149,000 slots. However, since federal regulations require railcars moving ammunition to be equipped with either steel decks or *spark shields*, only 28,000 slots are usable for munitions. Since the railcars would have to pulled from commercial service, emptied, and diverted to remote Army depots for loading, significant shortfalls and delays are anticipated.[11]

During Desert Storm, munitions movement was hampered because stock record account numbers for deployed assets were not established at the start of operations. This allowed pallet after pallet of materiel to be frustrated because destination guidance was absent. Lack of en route visibility can further complicate this problem. According to a 1998 audit by the Air Force Audit Agency, 10 out of 12 installations lost visibility and accountability of munitions due to a lack of interface between munitions and transportation information systems.[12] To meet the fast-paced timing of the AEF, both of these problems must be resolved.

Another munitions movement concern is the growing congestion at sealift ports and the required synchronization to process and move assets through port facilities. Because of the dramatic increase in the inter-modal cargo business, ports authorities often find it difficult to ensure the availability of port facilities for military deployments. Commercial shippers are encouraged to sign long-term leases with port authorities to capitalize the investment in the port infrastructure. Thus, open storage areas of the past, which were used in munitions operations, are now filled with containers.[13] These open areas remain critical to munitions operations, since separation of containers may be required for explosive safety reasons. Deploying munitions by ship becomes more complicated because only a limited number of ports are certified to handle explosives in the United States. They include Military Operation Terminal, Sunnypoint, North Carolina; Concord Naval Weapons Station, California; and Port Hadlock, Washington. Currently, each of these ports requires infrastructure upgrades to attain the throughput necessary to support potential operational requirements. These upgrades are currently budgeted by the Military

Transportation Management Command and are critical to ensuring the ability to move Air Force munitions from the United States by sea. Maintaining an efficient munitions movement at a sealift port can also be a difficult task. Port synchronization is a fine art that is usually not practiced except during actual contingencies. The US Transportation Command is trying to include port synchronization in military exercises via Turbo CADS. These Joint Chiefs of Staff funded exercises test the DoD ability to transport munitions in 20-foot containers on commercial vessels and have led to the purchase of additional pier and munitions facilities and equipment.[14] Funneling supplies through a port requires a high level of synchronization and capacity balancing to achieve optimal throughput. Each step of port operations is closely linked and can become a bottleneck. Cranes for off-loading become critical paths for achieving high productivity. Communication between port officials is critical, and the lack of manifests and stowage plans can negatively impact the speed of an off-loading operation. In addition, at foreign locations, the availability of the deep-water berths required for most munitions-laden ships is a major consideration. Also, foreign ports usually lack explosive siting and the ability to store large quantities of explosives. Therefore, a ground transportation plan must be established to rapidly move munitions from the foreign port to its final destination. Currently, we rely on *capturing* the host nation's trucking infrastructure through contracting actions to move munitions by ground. In some countries, this can be problematic. For instance, practicing Muslims will not drive on Thursday and Friday. Also, moving property, especially munitions, across borders may require diplomatic involvement that can take weeks to complete. Additionally, limited road networks and weather may cause intertheater trucking to come to a halt.[15]

Munitions Planning Problems for the EAF

EAF planning must recognize that programs such as STAMP and APF bring only limited capabilities to a conflict and do not provide an unlimited supply of preferred munitions to support an AEF. Currently, the Air Force does not have a written munitions concept of operations (CONOPS). However, USAFE has recommended that the Air Force develop a detailed munitions CONOPS with a coordinated positioning strategy.[16] In addition to the CONOPS problem, at present, no sourcing restrictions are placed on filling legitimate theater requests for STAMP. This means that munitions packages are shipped on a first-come first-served basis and, if more than one conflict arises during a short period of time, munitions availability to one theater could easily be limited because of another theater's requests.

The munitions operations at both Hill and Medina have the capability to deliver STAMP packages to their own flight line much faster than airlift can be provided to move them. Often, the STAMP packages wait many days for airlift.[17] This means that relying on STAMP for the initial combat sorties at a new combat location may not be feasible in the current environment and with current airlift availability. Also, even when munitions packages are effectively airlifted to a forward operating location, there must be trained munitions technicians available with forklifts, loaders, lifts, and other handling equipment to assemble and load munitions packages. All-up-round (AUR) munitions containers for weapons such as the AGM-130 are not easy to handle, and most Air Force laser-guided munitions still need to be assembled prior to delivery to combat aircraft. If the timing for the arrival or delivery of these logistics pieces (assets, equipment, and trained people) is wrong, it can put a quick stop to combat sorties needed for the first 48 to 72 hours of a conflict. Finally, at Medina, the privatization of Kelly AFB, an aging munitions infrastructure, and current runway restrictions for airlift aircraft make the future of that STAMP location uncertain.[18] With the development of the EAF concept, the Air Force needs to consider the future of the STAMP program and how it could be improved to better support the rapid supply of munitions to a deployed AEF.

Munitions support from an APS is limited and is directly tied to sealift. The first consideration for an APS or any ship carrying munitions should be their protection as they transit to combat areas. When the United States begins sealift of military resources to a conflict, including munitions, the chokepoints through which the cargo flows must be protected. There are at least seven chokepoints considered vital by the DoD:[19]

- The Gulf of Mexico-Caribbean Sea with the Panama Canal.
- The North Sea-Baltic Sea with several channels and straits.
- The Mediterranean-Black Seas with the Strait of Gibraltar.
- The Western Indian Ocean with the Suez Canal, Babel Mandeb, the Strait of Hormuz, and around South Africa to the Mozambique Channel.
- The Southeast Asian Seas with access to Japan, Korean, China, and Russia.
- The Southwest Pacific with access to Australia.
- The Arctic Ocean with the Bearing Strait.

To use one of the APS, a CINC most likely has to wait several days as it sails to its destination port—assuming that it is not delayed in one of the chokepoint areas. Once an APS is tasked for use, a port with sufficient depth and equipment to handle the ship must be located. In addition, explosive siting requirements must be met, and sufficient ground transportation must be coordinated to ensure that off-loaded munitions can be moved from the ship to the final forward operating location without major disruption of the port operation.

Requirements at the combat location itself can also create additional mission shortfalls. During logistics planning for an operation, the factors limiting logistics velocity at the

reception base and prior to employment must be addressed. These include storage space, net explosive weight restrictions, and the standard conventional loads. Currently, each unified commander's needs in these areas are different, and prepositioning is complicated by lack of standardization. Munitions preferences are driven by planners, operators, theater restrictions, munitions assembly requirements, and trade-offs between different weapons. Also, unit preference remains a driver in the choice of munitions. Pacific Air Forces is the exception to this observation. This command has tried to follow central target planning and munitions allocation with the best available weapon for many years. Obtaining uniformity in these areas and optimizing the selection of munitions for the target assigned to deploying aircraft would yield higher productivity and a reduced logistics footprint.[20] This point is reinforced by the Gulf War Airpower Survey that states: "we must reduce the *kitchen sink* attitude of the operations planners, and preplan the target set and munitions required."[21] Since that statement, HQ USAF has gone to great lengths to develop programs to integrate the nominated target sets, preferred munitions requirements, and the CINC sortie allocations.

Current Efforts and Recommended Changes

To meet the munitions challenges of the EAF, the Air Force must look for ways to improve rapid transportation capabilities, infrastructure, and prepositioning support. Currently, PACAF maintains the TARRP program, and the STAMP and APF programs provide a limited munitions swing stock capability. However, other efforts are underway to improve munitions logistics in the Air Force. In USAFE, plans are underway to develop a rapid air packages program near Ramstein AB, Germany. This program, the Rapid Air Munitions Packages-Europe (RAMPE), will be similar to the STAMP and TARRP programs and will provide USAFE with a similar capability for moving munitions by air to support a pop-up AEF and on-going contingencies.[22] Current plans call for existing munitions stocks in USAFE to be consolidated at an Army ordnance area near Ramstein AB and then transported anywhere a conflict arises in Europe. In addition to this effort, the Military Sealift Command is considering the contracting of an additional (fourth) APS.[23] These initiatives are a good step toward supporting the unpredictable nature of the Expeditionary Air Force and may only be the beginning of a much larger effort.

Based on the need for a more responsive munitions logistics capability, the Air Force should also consider these additional recommendations. First, the future and infrastructure of the current STAMP units need to be considered. These units possess the ability to move munitions by air during the opening days of an AEF. However, a limited size and deteriorating infrastructure make STAMP a minor tool for the AEF. Improvement and expansion of the role of these units should be considered.

Second, munitions flights and squadrons around the world should have the necessary equipment (chains, binders, 463L pallets, dunnage, etc.) on hand in the munitions storage area to be able to react to shipping notifications to support a pop-up AEF in the surrounding region. In addition, munitions palletization training for munitions personnel needs to be added. Some squadrons may even need to consider having a STAMP section that can easily lead the effort during a crisis. A further catalyst for these efforts would be the addition of palletization training for munitions personnel while attending the Air Force Combat Munitions Assembly Course. Worldwide standardization of munitions packages and palletization procedures would reduce the learning curve during a crisis and ensure that combat units received effective munitions packages regardless of where they come from. This standardization might be obtained in the form of a palletization handbook or a technical order to provide munitions personnel with an immediate source of information for moving munitions in a crisis. These actions could serve as a relatively simple starting point in ensuring readiness for a major AEF tasking.

Third, munitions logisticians must continue to move the Air Force toward new munitions systems that are less logistically intensive. Storing and delivering weapons in AUR containers, building miniature munitions, and using insensitive explosives have the potential to reduce the difficulty involved in munitions logistics. In addition, procuring lighter equipment such as the multipurpose bomb trailer and loader should be pursued along with a multipurpose common munitions tester.[24] Each of these advancements will reduce the footprint for munitions and increase our ability to effectively support an AEF.

Fourth, theater logisticians need to identify how to get munitions to the most remote spots where an AEF might deploy within their theater. Once the possible munitions pipeline is identified, they can more accurately inform the CINC as to munitions availability and sustainment at the AEF location. This process will involve a great deal of forward-basing research and preplanning for using alternate modes of transportation (rail, water, and truck). Through this planning process, the Air Force will hopefully be able to identify how to construct an optimum web of rapid response munitions support locations—such as STAMP, TARRP, and RAMPE—that can cover a possible conflict anywhere in the world. Building this web will mean adding munitions storage areas or upgrading old facilities. This effort could help counter the deteriorating munitions infrastructure worldwide and provide an increase in the Air Force's rapid response capability to support an AEF.

Finally, a joint National Inventory Control Point for munitions could set worldwide inventory controls and set priorities on munitions shipments. Such an organization could not only control a worldwide web of munitions locations but also streamline the ability to receive munitions support from the other Services. Such an organization might also prove more effective in coordinating the reallocation of munitions from one theater to the next to support an AEF at a new crisis location.

It is naive to think we can provide a sustained flow of munitions by air anywhere on the globe in a handful of hours. However, through proper preparation, prepositioning, training, and planning, the Air Force can obtain the munitions availability to support the EAF concept anywhere in the world. It will be up to the logistics communities in each theater to determine how they will establish a munitions pipeline for possible warfighting locations in theater. Then the Air Force should move to proactively construct a munitions infrastructure, prepositioning plan, and transportation plan that address the shortfalls in these pipelines before the start of an AEF, not when the conflict has already begun.

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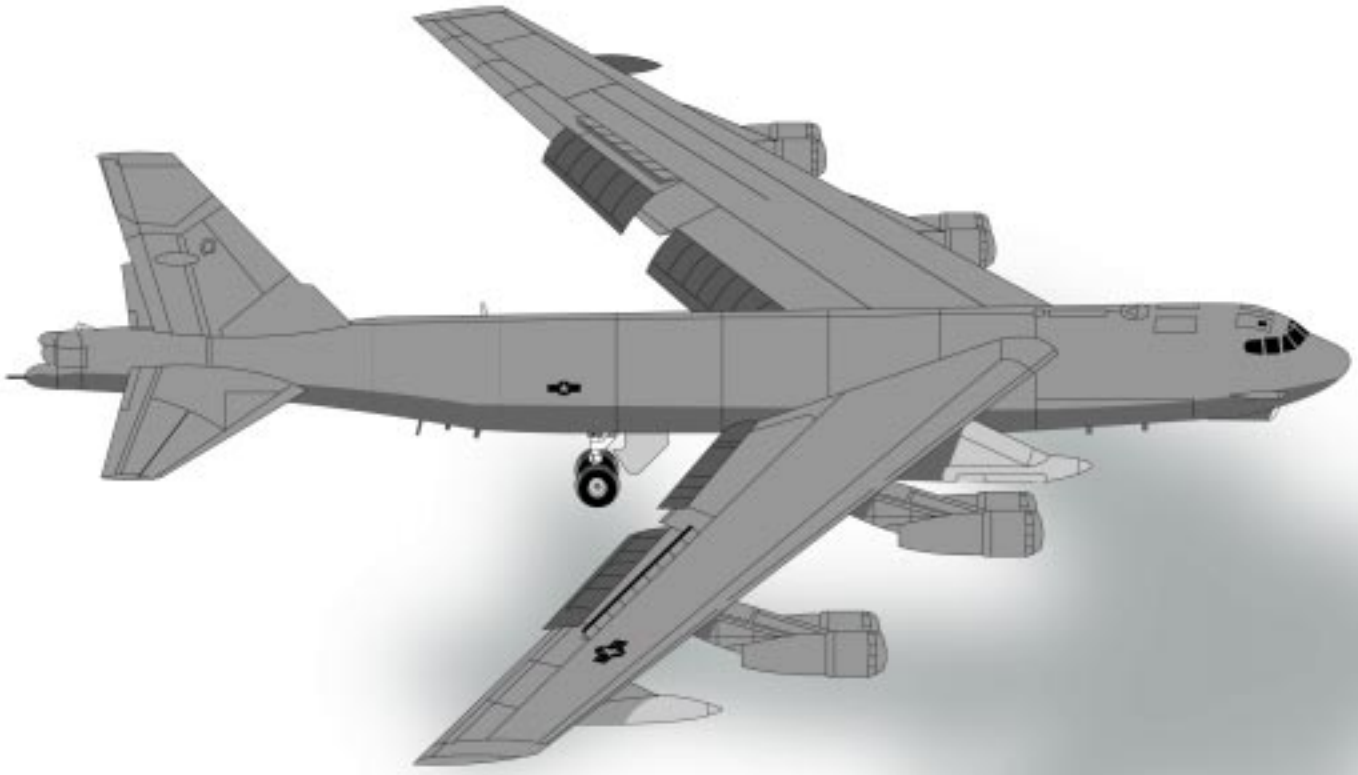

The B-52

Past, Present, Future

Karen A. Irvin

The B-52 is the oldest bomber in the long-range strategic bomber force. The Air Force originally planned for the replacement of the B-52 to become operational in the mid-1960s. However, Secretary of Defense Robert S. McNamara believed development of the intercontinental ballistic missiles and the F/FB-111 negated the need for B-52s or its replacement and canceled the replacement program. Fortunately, the importance of the long-range range strategic bomber was later recognized. Unfortunately, the production of a replacement for the B-52 was delayed until the 1980s. In spite of the development of both the B-1 and B-2, various political, budgetary, and design issues—coupled with operational requirements—will keep the B-52 in service until at least 2030. By then, the average age of aircraft in the B-52 fleet will be 70 years. To ensure the mission capability of the B-52s, investments will have to be made to upgrade the bomber and develop new precision weapons. This is in addition to the investments that must be made to upgrade both the B-1 and B-2. The earliest any new bomber development program could begin is 2013.

Why Does the Air Force Need a Long-Range Strategic Bomber Force?

The long-range strategic bomber originally was designed specifically to fly intercontinental distances and deliver a large payload of nuclear weapons. The bombers were part of the US nuclear triad, which provided deterrence and ensured retaliation against a first strike from the Soviet Union. As a result, defense dollars spent to maintain and upgrade the bombers were easily justified based on the security of the United States. Since the end of the Cold War, however, many people have come to believe there is no need for a long-range strategic bomber force.

Today, one of the major reasons the Air Force is enhancing the conventional capabilities of the long-range bomber force is because of the reduction in overseas bases. The enhanced conventional capabilities of long-range bombers will directly support the National Military Strategy (NMS), the objectives of which are to promote peace and stability and, when necessary, defeat adversaries.

Air Force Responsibilities

The Air Force is responsible for the preparation of forces necessary to effectively prosecute war and military operations short of war under integrated joint mobilization plans.[1] Four of the major functions of the Air Force are to organize, train, equip, and:

- Provide forces for the conduct of prompt and sustained combat operations in the air—specifically, forces to defend the United States against air attacks, gain and maintain general air supremacy, defeat enemy air forces, conduct space operations, control vital air areas, and establish local air superiority.
- Provide forces for appropriate air and missile defenses and space control operations, including forces for the strategic defense of the United States in accordance with joint doctrine.
- Provide forces for strategic air, missile warfare, and joint amphibious, space, and airborne operations.
- Furnish forces to operate airlines of communications.[2]

Current Strategic Environment

The role and functions of the Air Force have not changed since the end of the Cold War, but the global strategic environment in which the Air Force operates has changed dramatically. The current strategic environment presents a number of threats to our national security and the sovereignty of our allies. Threats to US interests include:

- Aggression by rogue states. These rogue states have the capabilities and desire to threaten our vital interests through coercion or aggression. They continue to threaten the sovereignty of their neighbors and international access to resources.
- The spread of weapons of mass destruction (WMD). Many rogue states lacking conventional warfighting capabilities are developing nuclear, biological, and chemical weapons and long-range delivery system.
- Terrorism, illicit arms trafficking, and drug trafficking. State-sponsored terrorism is a major concern because of the increasing possibility of these acts occurring on US territory.
- Failed states and uncontrolled migration. When states fail, mass migration, civil unrest, famine, mass killings, and aggression against neighboring states occur.

Air Force Core Competencies

Core competencies provide a basis for the Are Force contribution to the nation's total military capabilities. Core competencies are what distinguish the Air Force from the other Services. The core competencies of the Air Force are:

- Air and Space Superiority—an important first step in military operation. It provides freedom to attack as well as freedom from attack. It is established when the enemy is incapable of effective interference anywhere in the theater of operations. Local or mission-specific superiority may provide sufficient freedom of action to accomplish mission objectives if resources required to achieve total air and space superiority are too high.
- Precision Engagement—the ability to concentrate combat power at a decisive place and time. Precision engagement allows the military to avoid the brute force-on-force tactics of previous conflicts.
- Global Attack—the ability to attack rapidly and persistently with a wide range of munitions anywhere in the world at anytime. As a result of the closing of overseas bases, the importance of rapidly projecting power from the continental United States (CONUS) has increased.

- Rapid Global Mobility—refers to the movement, positioning, and sustainment of military forces. As a result of closing overseas bases, the importance of rapid global mobility has increased because the majority of forces are deploying from the CONUS.
- Agile Combat Support—reduction of logistics footprint of the forward-deployed forces by responding effectively and efficiently to combat support requirements.
- Information Superiority—the ability to collect, control, exploit, and defend information while denying the enemy the ability to do the same. The Air Force is the operator of air and space-based intelligence, surveillance, and reconnaissance systems.

The dependency upon rapid and accurate dissemination of information has increased for two reasons: more weapon systems are dependent upon this information for targeting of precision weapons and information can provide the locations of friendly forces and reduce fratricide.[3]

The long-range strategic bomber force directly supports both air and space superiority and global attack. Further the long-range bomber is an unparalleled warfighting asset because of its mission flexibility, large payload capacity, and rapid global response. In the future, the United States will probably not have the luxury of assembling overwhelming forces before taking action. Desert Storm was undoubtedly an anomaly and taught future adversaries that they must pursue and achieve their military objective prior to a large buildup of US or US and coalition forces. During the initial stages of future conflicts, the long-range bomber force will be tasked to attack globally in order to halt the enemy and assist with establishing air superiority.

The current defense posture requires the military to maintain the capability to fight and win two near simultaneous major regional contingencies (MRCs) and retain the nuclear capabilities necessary to deter the proliferation of weapons of mass destruction. An MRC can be divided into four phases: halt the invasion, build up combat power in the theater while reducing the enemy's combat capability, decisively defeat the enemy, and provide post war stabilization.[4] Long-range bombers have the capability to be decisive during the first two phases for several reasons.

- Lack of host nation basing or denial of permission to fly through foreign airspace. Potential host nations may deny support because the conflict does not affect their national interest, they wish to remain neutral, or they disagree with the proposed action. Long-range bombers launched from the United States obviate this problem.
- The enemy's centers of gravity (COGs) are outside the range of tactical strike aircraft.
- Enemy COGs are outside naval cruise missile range.
- US military forces are engaged in another MRC and not available for the second MRC.

Composition of the Long-Range Strategic Bomber Force

For more than 40 years, the long-range strategic bomber force was on alert. If deterrence failed, its mission was to penetrate Soviet airspace and strike critical targets with nuclear weapons. While strategic bomber forces participated in conventional bombing campaigns during the Vietnam conflict and the Gulf War, the nuclear mission of the Single Integrated Operational Plan was primary. With the end of the Cold War, the importance of the nuclear mission decreased. The bombers were taken off alert, and the nuclear mission continued to exist, but in a modified form. The emphasis of the long-range strategic bomber force shifted from a nuclear role to a conventional mission. Today, the bomber's nuclear and conventional roles are about equal in importance. To be fully viable in the conventional role, however, the bomber aircraft will have to be modified to deliver global positioning system (GPS)-guided munitions. In 1992, Secretary of the Air Force Donald Rice stated: "The bomber force we are constructing—a combination of mass, reach, and immediacy with precision strike—will be a weapon of choice for operational commanders."[5] The 1993 Bottom Up Review (BUR) confirmed that long-range strategic bombers will remain a valuable part of the post-Cold War defense force structure.

The purpose of the BUR was to analyze the post-Cold War strategic environment in order to define the strategy, force structure, modernization programs, industrial base, and infrastructure needed to protect and advance US interests.[6] Two broad categories of danger were identified: the proliferation of nuclear, biological, and chemical weapons and the threat of large-scale regional aggression by major regional powers. The BUR recommended that the US military have the capability to fight and win two near simultaneous major regional conflicts and retain the nuclear capabilities necessary to deter the proliferation of weapons of mass destruction.

The BUR estimated 100 bombers would be needed for a single MRC, and a force of 184 bombers would be needed for two near simultaneous MRCs. The Quadrennial Defense Report (QDR) determined that the Air Force would maintain a total fleet of 187 bombers and 142 of those bombers would be assigned to operational units.[7] The 1992 Bomber Road Map established conventional roles for the B-1, B-2, and B-52; described advanced weapons; and described the modifications required to make the bombers capable of performing conventional missions.[8] The B-2 and B-52 would retain their nuclear capabilities according to the Bomber Roadmap. In the event of two near simultaneous MRCs, the bombers would *swing* between the MRCs. If necessary, the B-2 and B-52 would be quickly reconstituted to a nuclear capability.

According to the Bomber Roadmap and the BUR, each bomber would have a different role in future conflicts, and that role would change as the conflict progressed. Because

of its ability to penetrate and elude the enemy's integrated air defenses, the B-2 would attack targets using short-range munitions. During early stages of the conflict, B-2s would attack heavily defended targets and suppress enemy air defenses. Initially, the B-1 would use short-range weapons to directly attack moderately and lightly defended targets. Standoff weapons would be used by B-1s to attack heavily defended targets. B-52s would be restricted to directly attacking lightly defended targets and launching long- range cruise missiles at heavily defended fixed targets until the enemy air defense was suppressed. Once that occurred, B-52s would use medium-range weapons and direct attack munitions from a high altitude.

The QDR, BUR, and the Bomber Roadmap confirmed the need for a long-range strategic bomber force, but there continues to be disagreement concerning its composition. This disagreement dates back to the 1960s and stems from political and budgetary considerations surrounding the acquisition and modernization of the bombers. Prior to the McNamara years, the Air Force was responsible for bomber force structure, acquisition, and modernization with very little presidential and congressional interference or oversight. Starting in the 1960s, the President, Congress, and Secretary of Defense assumed a more active role in reviewing defense requirements and proposed acquisitions.

The B-1 program began in the 1960s as a replacement for the cancelled XB-70. In the early 1970s, it was also proposed as a replacement for the B-52. When President Carter was criticized for canceling the B-1 program, his administration released information to the public about the development of an advanced bomber, which was virtually invisible to radar. The Carter administration believed the B-52s would suffice until the advanced bomber became operational. During the tenure of President Reagan, the B-1 program was resurrected as a stopgap measure. The Reagan administration felt the B-1 was the ideal bomber to fill the void between the time the B-52s were retired and the advanced bomber became operational. Further, the B-1 program had popular support because parts would be manufactured in 48 states. Unfortunately, B-1 developmental and design problems forced the B-52 to continue its role as the nation's primary bomber until the B-2 became operational. The B-2 also experienced developmental and design problems. As a result, the planned purchase was decreased from 132 to 71 bombers. Later, the number of B-2s to be purchased was decreased from 71 to 21.

According to the Congressional Budget Office (CBO), the long-range strategic force is to be composed of 94 B-1s, 20 B-2s, and 66 B-52s.[9] The number of bombers funded to fly each year will vary from 142 to 154 depending upon which report is referenced. Since the CBO report was published, the number of authorized B-52 and B-2 aircraft has increased to 71 and 21, respectively. The Clinton administration believed the BUR provided the United States with the blueprint for transitioning from a defense focused on countering the Soviet Union to one focused on the emerging post-Cold War strategic environment.

Critics of the BUR's recommendations have raised several concerns. They have questioned whether the planned inventory of bombers is large enough to conduct two near simultaneous MRCs. Supporters of the BUR recommendations argue that the Air Force must get more out of the planned force. Others have argued that the Air Force needs more B-2s to meet potential mission requirements.

Retired Major General Jasper Welch has questioned the adequacy of the planned bomber force and advocated purchasing additional B-2s.[10] Welch analyzed the quantity of munitions needed and the rate at which these munitions must be delivered. He makes the case that the large quantities of expensive standoff weapons required to halt an aggression are unaffordable. General Welch believes the cost of buying additional B-2s would be offset by its ability to attack any target using relatively inexpensive precision munitions. The cost of standoff weapons has been estimated to cost approximately $1M each, and precision munitions are estimated to cost about $100K each. The cost of modifying the B-1 and B-52 with new avionics and standoff precision weapons would eliminate the purchase of additional B-2s.

The Bottom-Up Review: An Assessment, written by Andrew F. Krepinevich, examines two questions directly related to the adequacy of the BUR recommendations.[11] The first question is: Does the BUR provide a persuasive case for adopting its recommended defense program?" The second question is: "Is the BUR program affordable in the near term and sustainable beyond the near term, given the budget projected for the defense?" He concludes that the BUR:

- Fails to take into account the potential influence that the emerging military revolution could have on the determinants of military effectiveness and the parameters for effective defense investment strategy.
- Maintains the US planning perspective that existed during the Cold War focuses on the near-term future and the most familiar threats, as opposed to the greatest or most likely threats to national security.
- Recommendations are unaffordable and become progressively less affordable, given the projected resource constraints. Over the longer term, the BUR defense posture could suffer funding shortages of $20B per year.
- Emphasizes the need to plan to refight the Gulf War more effectively.[12]

It is clear that the debate over the BUR recommendations on the bomber force will continue.

B-52—The Utilitarian War-Horse of the Past

The B-52 program began in 1945 when the Army Air Forces issued a series of military characteristics for a bomber to replace the B-36. These characteristics specified a bomber with a range of 5,000 miles capable of carrying a 10,000-pound bomb load at 35,000 feet with a minimum cruising speed. In 1948, Strategic Air Command (SAC) instructed

Boeing to use the Pratt & Whitney J-57 turbojet engine in its design of the B-52. The J-57 engine was still under development; however, SAC had determined that it was the only engine capable of meeting intercontinental range requirements. Boeing was also instructed by Air Force Generals Curtis LeMay and Thomas Powers to design the B-52 around the atom bomb. Additional specifications included requirements that the bomber be designed to carry a variety of conventional bombs weighing up to 20,000 pounds.[13] The production contract was signed in February 1951, and the first B-52 entered service in June 1955. The last H model B-52 was produced in 1962. The H model is expected to continue in service until at least 2030 and perhaps later.

In 1963, war planners were considering B-52s for use in Southeast Asia, and a study was conducted to determine B-52 capability to carry all available conventional bombs. In 1964, thirty-eight B-52Fs were modified to carry up to fifty-one 750-pound bombs. These aircraft were used in Operation Arc Light, the first B-52 mission in Southeast Asia, which occurred on 18 June 1965. Later 46 more bombers were modified, but the 84 modified bombers were still not enough to support the air war. As a result, B-52 modification continued.

Since the 1970s, B-52s have been modified to carry a wide variety of guided conventional munitions. During the late 1970s, the aircraft were modified to carry nuclear armed air-launched cruise missiles (ALCMs) under the wings and internally. In 1984, as part of the upgrade to the Air Force's maritime role, the B-52s were modified to carry the AGM-84 Harpoon antiship missile. The aircraft was also modified to carry the AGM-142 Have Nap standoff missile during the 1980s. In 1990, during the buildup for Desert Storm, B-52s were again modified in order to carry 1,000-pound British Royal Ordnance with time delay fuses and the conventional ALCMs (AGM-86C).

On 17 January 1991, seven B-52Gs were part of the first wave of coalition aircraft to strike Iraq. The bombers flew nonstop from Barksdale AFB and launched 35 AGM-86C missiles against power stations and communications facilities. During Desert Storm, B-52s flew approximately 1,600 sorties and dropped 29 percent of the total tonnage of munitions delivered by all US aircraft.[14]

B-52—The Utilitarian War-Horse of the Present and Future

With the end of the Cold War, the Air Force initiated the *Bomber Road Map* study to determine how to reshape the long-range bomber force. This report concluded that the Air Force should maintain a fleet of 212 bombers consisting of 97 B-1Bs, 20 B-2s, and 95 B-52Hs. The subsequent BUR and QDR determined a long-range force of about 187 conventional bombers would be required to support two MRC requirements. Of the 187 bombers, 71 would be B-52s. The Bomber Road Map study recommended retiring all B-52 G model aircraft and modifying the H model to assume the conventional role. Today, the B-52H is certified to carry all airborne nuclear weapons and most conventional munitions.

B-52 Inventory

In the May 1997 report of the Quadrennial Defense Review, Secretary of Defense William Cohen stated that 71 B-52Hs would be part of the US nuclear triad. The B-52 will assume the dual role of a conventional and nuclear bomber. The number of primary authorized aircraft has varied from 66 to the current level of 71 in the past several years as shown in Table 1. The 23 attrition reserve H excess aircraft were slated for retirement in the original FY99 budget.

US Senators Byron Dorgan and Kent Conrad of North Dakota, both supporters of the B-52H, were instrumental in obtaining an additional $54M in FY99 funding. This additional funding has helped maintain the attrition reserve H excess aircraft at the current level of 23. Recently, the Air Force reviewed the requirement for attrition reserve H excess aircraft and determined that five aircraft are needed. As a result, beginning with the FY00 Program Objective Memorandum, the Air Force has programmed for only five excess aircraft. The other 18 bombers will be retired. This recommendation is controversial and will likely be opposed by the North Dakota senators. Senator Dorgan stated: "It's [maintaining the B-52 in the Air Force inventory] also a cost-effective measure for our national defense, because the B-52s can continue to be available for service for decades. Keeping these workhorses as part of our Air Force saves the taxpayers money while providing an effective and versatile weapon system for our military."[15] Senator Conrad noted: "The B-52 is quite simply the best *bomb-truck* for the buck, it can fly farther to deliver a greater quantity and diversity of weapons than any other weapon system in the world today."[16] Several years ago, Senators Dorgan and Conrad successfully made the case that taxpayers are better off keeping B-52s in inventory than building new B-2s at a cost of $2B each. It is estimated that the cost of flying 25 B-52s for 5 years is about the same as buying one new B-2.

Airframe Economic Life

The economic life of the airframe is defined as that time when cracking becomes so extensive that it is judged to be more economical to replace the airframe or major components of the airframe than to continue inspection and repair. The critical crack length (CCL) of safety critical areas on an aircraft are assessed to determine the safety limits, economic repair limits, and inspection requirements. The lower bound

	FY94	FY95	FY96	FY97	FY98
Total Authorized Inventory (TAI)	66	66	71	71	71
- Primary Aircraft Inventory (PAI)	57	57	57	57	57
- Backup Aircraft Inventory (BAI)	6	6	6	6	6
- Attrition Reserve (H Keepers)-	3	3	8	8	8
- Attrition Reserve (H Excess)	28	28	23	23	23
Total Aircraft Inventory "H"	94	94	94	94	94

Source: Lt Col Jim McGinley, B-52 System Program Director Briefing to General Luebbert, October 1998.

Table 1. B-52 Aircraft Inventory

structural life is a conservative estimate of the actual economic life. The results of an Aircraft Structural Integrity Program (ASIP) study indicate that the lower bound life of the B-52H structure is calendar year 2030 with the planned base-line operational usage including tactical maneuver usage.[17]

The operational mission of the B-52 has changed over its 40-year life. The original design was based on a high-altitude mission. In 1959, the mission was changed to include not only the low-level mission but also the airborne alert mission. In 1962, contour low-level flying was added to the operational mission requirements. All of these changes have a marked effect upon the structural integrity of the airframe. The B-52H has undergone significant stress and fatigue modifications to strengthen the structural integrity of the aircraft and extend its service life. The structural modification programs were initiated as a result of a fatigue test program, force usage reports, and data collected from the flight loads recorder programs. The following is a list of B-52 structural modifications that have been accomplished:

- Inspar wing replacement.
- Body station 1655 bulkhead modification.
- Body and empennage strength improvements.
- Upper front chord modification.
- Life-extension improvements.
- Modification of the inner spar rib-wing center section.[18]

The operational life was extended from 5,000 hours to 12,140 as a result of the inspar wing replacement modification.[19] The other modifications have had similar effects on extending the service life of the bomber.

Figure 1 indicates that the upper wing surface will be the limiting factor for the aircraft service life. When the flight hours of the airframe reach 32,500, the CCL of the upper wing surface will exceed the safety limits and repair limits. The flight hours for all 94 aircraft are shown in Figure 2. The majority of the airframes have less than 16,000 flight hours; however, three airframes have 16,000 plus flight hours. The average annual number of flight hours for the B-52 is 380 hours, but it is expected to increase because of frequent deployments to Southwest Asia. Figure 3 gives a graphical depiction of what year the upper wing surface economic life will be achieved based on the average annual fight hours. This indicates the service life of the average airframe is beyond the year 2040.

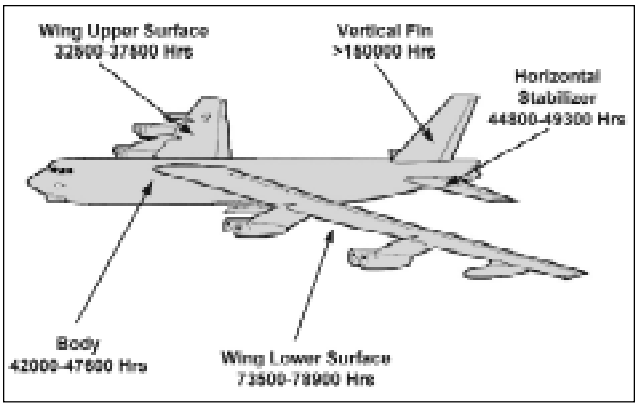

Figure 1. Airframe Economic Life[20]

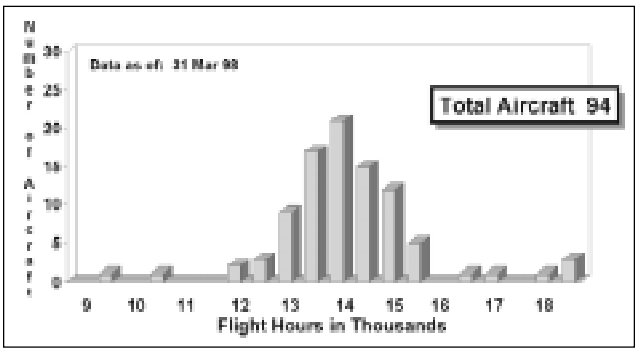

Figure 2. B-52 Fleet Flight Hours[21]

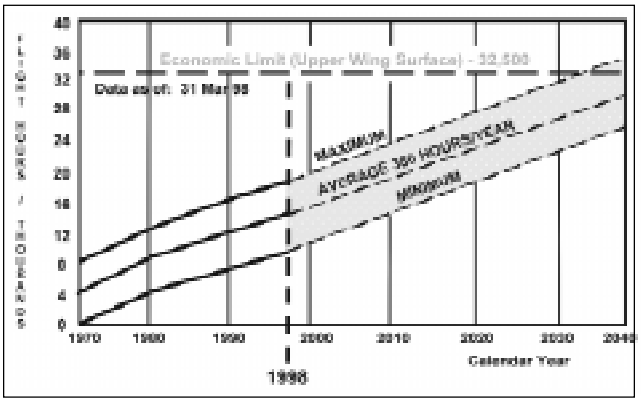

Figure 3. Upper Wing Surface Economic Life[22]

Programmed Depot Maintenance and Aircraft Structural Integrity Program

Both Air Combat Command and the B-52 System Program Director (SPD) have numerous ongoing programs and plan to initiate a new study each year to ensure the B-52 will be mission capable into the next century. Two of the most important activities are the programmed depot maintenance (PDM) and the Aircraft Structural Integrity Program. Every 48 months, each aircraft undergoes PDM. The PDM process involves the inspection and teardown of aircraft components, functional testing of aircraft systems, replacement or repair of failed items, overhaul of systems, replacement of time critical items, and integration of modifications. Each aircraft requires approximately 27,000 man-hours to complete the PDM process. The PDM man-hours are allocated for the actual work preformed on the aircraft and do not include the man-hours for the onsite support provided by the SPD staff. The average cost per aircraft for the PDM process is approximately $3.2M. The majority of hours allocated for the PDM process are for ASIP

tasks. In addition to the hours expended in depot for ASIP tasks, thousands of hours more are expended at the operational bases inspecting the structural integrity of the airframe. During PDM, areas that are inaccessible or exceed the capabilities of the operational bases are inspected and repaired.

The ASIP is conducted to ensure the aircraft structure can maintain the design limit load capability without catastrophic failure. The Air Force initiated the first *ASIP-like* program on the B-52 fleet as the result of several B-47 crashes caused by fatigue failures. Since 1959, the B-52 fleet has had a program to determine and track the operational *safe-life* of each aircraft. The *safe-life* analysis used test results to relate operational and design life. In the early 1960s, the *safe-life* analysis transitioned to the Durability and Damage Tolerance Assessment (DADTA) approach. The DADTA process was used because aircraft structures are manufactured with defects and cracks.

The objective of the DADTA is to identify the safety critical areas of the airplane structure and determine the safety limits, economic repair limits, and inspection requirements. The base-line damage assessments are calculated based upon estimated usage and average mission profiles from initial operation to 1961. Damage accumulations since July 1961 have been calculated from individual service records. Several aircraft representative of the bomber fleet are selected for DADTA inspections and testing to determine which structural details require inspection, rework, or modification of the entire fleet. Sixty-six structural details were selected for crack growth analysis as a result of subsequent DADTA updates to incorporate the effects of tactical maneuver training and extend the service life to the year 2030. Of the 66 structural details, 20 were identified as critical and would require maintenance action prior to the year 2000. An additional 12 structural details have been identified as requiring inspection prior to 2030.

The DADTA provides the data updates to the Force Structural Maintenance Plan (FSMP) and the Individual Airplane Tracking Program (IATP). The FSMP defines the airplane inspection and modification requirements and cost associated with the implementation of the inspection plan or incorporation of the modification. FSMP also provides overall visibility of the probable future maintenance costs and an assessment of the operational impacts associated with maintenance actions if the plane is flown according to projected usage. The inspection procedures developed during the DADTA are an integral part of the FSMP. The FSMP program requires B-52 inspection records be maintained in a database. The results of the inspections are input into the B-52 IATP.

Individual aircraft usage records have been maintained on all models of the B-52 since July 1961. The objectives of the IATP are to provide data on aircraft usage by tail number and provide an assessment of the critical crack length. The CCL is used to schedule inspections of the safety critical items. Crack lengths from the time of initial deployment to the second quarter 1975 were calculated using the average mission profiles developed for the DADTA. Air Force Technical Order Form 16 has been used since 1975 to report and track the missions flown. The IATP was converted to tracking potential crack growth during the early 1980s. In the early 1980s, an individual airplane-tracking program was developed to track potential crack growth in safety critical areas defined by the DADTA. The crack growth IATP provides schedules for each airplane, a detailed inspection, and/or maintenance time for each safety critical area. Additional development of the IATP is underway to host the software on a personal computer system to permit aircrews to input mission profile data into a digital format to improve usability of the program and data. The following is a list of current structural integrity problems:

- Fatigue cracking in the BS 694 bulkhead. A comprehensive inspection and modification program is in place. Bulkhead chord replacement will be required on some aircraft.
- Multisite cracking in Section 47 skins. The skins are undergoing inspection and repair at Programmed Depot Maintenance. The skin may require replacement in the future.
- Fatigue cracking in the flaptracks. A comprehensive inspection, repair, and replacement decision matrix has been developed to aid in the disposition of damaged flaptracks.
- Midbody side skin crack. An engineering effort is ongoing to determine the cause and solution to this problem.
- Upper wing skin spanwise splice cracks. The wing upper inspar skin spanwise splices receive eddy current inspection during PDM. Both metallic and composite repair methods have been developed for use in the event that damage is found.
- Stress corrosion cracks of engine strut attachment fittings. Several stress corrosion cracks have been discovered during the installation of ECP 1175-215. Cracked fittings are replaced with new ones fabricated of stress corrosion resistant.[23]

The ASIP manager is currently conducting teardown of all ASIP details as well as other fatigue and corrosion suspect areas on selected retired G-model aircraft. Significant results have been yielded since the beginning of this program several years ago. For example, multisite damage in the forward pressure fuselage skin and corrosion in cabin window frame areas were discovered and are being addressed during the normal PDM cycle of the H models. Also a program has been initiated to replace the antiquated Flight Loads Data Recorder (FLDR) with the Standard Flight Data Recorder (SFDR) microprocessor system to collect operational environment data. The SFDR will significantly increase the quality of operational environment data collected and may result in significant changes to the structural life and/or maintenance requirements. The SFDR has been successfully flight tested on several aircraft since the early 1990s. The SFDR program

is waiting for implementation funding on the B-52 fleet representative aircraft. The projected conservative annual cost of the DADTA, FSMP, IATP, FLDR, and teardown inspections is $750K.[24]

Condition Assessment/ Improvement Program

The B-52H structural integrity has been studied since it was first produced, but the aircraft functional systems—such as the avionics, flight controls, hydraulics, pneumatic, and electrical—have not been monitored as closely. In 1995, the Condition Assessment/Improvement Program (CA/IP) was initiated. This program is divided into three phases: program definition and review of existing source material, selection of candidate systems or parts, and the actual assessment of the candidate system or part. The purpose of the CA/IP is to reduce the occurrence of service revealed deficiencies that could result in the damage or loss of aircraft. The CA/IP is a proactive approach for identifying potential reliability, maintainability, or supportability problems and providing corrective action. The CA/IP consists of on-aircraft operational checks, on-aircraft inspections, and off-aircraft inspections. In addition to determining the physical, mechanical, and functional condition of systems, the accuracy and adequacy of technical order data is assessed. If funding is available, the recommended corrective action is implemented by incorporating the requirements into the PDM work specification, updating technical orders, or revising the engineering specification or drawing for the part.

The corrective actions may be costly. Since FY91, the PDM work specification hours have decreased from approximately 36,000 hours to the current 27,000 hours. Some of this decrease can be attributed to the completion of modification programs, but the remaining decrease is the result of decisions made to delete requirements from the PDM work specification. The deletion of work specification requirements, in most cases, can be attributed to funding shortfalls.

Integration of Advanced Conventional Weapons

The Bomber Road Map Study outlined the planned modernization of the bombers, development of new munitions, and integration of these new munitions on the bombers. The road map focused on adding the capability of delivering a variety of unguided and new guided weapons using GPS-aided targeting. Advanced conventional weapons will be integrated into the B-52 to compensate for its vulnerability to the enemy's integrated air defense systems (IADS). The Advanced Weapons Integration Program (AWIP) will provide the B-52 the capability to carry Joint Direct Attack Munition (JDAM), Wind Corrected Munition Dispenser (WCMD), Joint Standoff Weapon (JSOW), Joint Air-to-Surface Attack Weapon (JASSM), and Sensor Fuzed Weapon (SFW). The B-52s will utilize these precision and high-lethality weapons to maximize per sortie effectiveness and minimize attrition.

JDAM incorporates a tail kit and a GPS-aided inertial navigation system (INS) onto existing general-purpose bombs. The INS/GPS guidance provides improved bombing accuracy from medium and high altitudes and the ability to deliver free-fall munitions in adverse weather. The JDAM is accurate to within 40 feet of the target. JDAMs could be used to attack *hard* targets such as bridges and bunkers

The WCMD is a modification kit for the advanced cluster bomb dispenser that uses the inertial navigation system to compensate for high-altitude winds. This modification will be incorporated into the CBU-87 (Combined Effects Munition), CBU-89 (Gator), and CBU-97 (SFW). The guidance kit improves the accuracy of cluster bombs to within 100 feet. WCMD cluster bombs would be used to attack *soft* targets such as troops and vehicles.

JSOW is a long-range glide weapon equipped with GPS-aided INS. The JSOW was designed to provide an accurate low-cost standoff method for delivering tactical munitions. The weapon can be used in adverse weather conditions. The baseline variant will carry a combined-effect bomblet for use against area targets. The JSOW will provide standoff anti-armor capability. The follow-on variant will carry the BLU-108 Sensor Fuzed Weapon. The third variant will provide a unitary warhead and a man-in-the-loop seeker for increased accuracy and target discrimination. The JSOW can glide on small wings for up to 45 miles when launched from high altitudes.

The JASSM is a long-range missile designed to integrate standoff delivery accuracy and high lethality with technologies to ensure survivability. It can be launched outside of the enemy's integrated air defense system to attack hard, medium, soft, and area type targets. The JASSM is the follow-on for the cancelled stealthy Tri-Service Standoff Attack Missile. The JASSM will replace the conventional air-launched cruise missile (CALCM). The JASSM will utilize off-the-shelf technologies to keep the missile cost under $700K each.

The Sensor Fuzed Weapon is designed to attack enemy armor from above. SFW is a tactical munitions dispenser containing ten BLU-108 submunitions, each with four warheads. This weapon is capable of achieving multiple kills against armored vehicles during day, night, or adverse weather conditions. The development of the improved BLU-108 submunitions for SFW and JSOW began in FY96 as part of a preplanned product improvement program. The improvements include the addition of an active sensor and a multimission warhead. These low cost improvements will reduce the SFW susceptibility to countermeasures and increase the target lethality of the weapon, while reducing the impact target location errors.

The combination of JDAM, WCMD, JSOW, JASSM, and SFW will allow B-52s to attack fixed and moving targets accurately from a variety of distances. These weapons have the ability to overcome the limitations of high-altitude bombing. These weapons also make operations in adverse

weather conditions possible. However, in order to maximize the advantages of these weapons, the B-52 mission planning system must be upgraded. One drawback to these weapons is the possibility for the enemy to jam the signals of the GPS satellite.

The estimated cost of the B-52 AWIP is $77M.[25] One of the issues currently being worked by the B-52 SPD is the separation of the JSOW/JASSM Stores Management Overlay (SMO). The SMO provides for the control, targeting, jettison, and launching of weapons. The JSOW/JASSM SMO is commonly referred to as the standoff SMO. The separation is necessary because the B-52 computer capacity is limited and the JASSM growth requirements exceed the capability standoff SMO. Development and interface testing on many of the weapons has resulted in changes to requirements. These changes to the requirements have impacted the B-52 integration costs and schedule.

Reliability and Maintainability Improvement Modifications

The reliability and maintainability (R&M) of B-52 systems are a major concern and directly related to the supportability and mission capable rate. Because of the age of some of the systems, the manufacturers are no longer in business and no longer have the capability to manufacture parts. Hundreds of thousands of man-hours are expended each year to maintain unreliable and obsolete systems. These R&M problems will continue to increase as the platform ages. The Air Force has taken a proactive approach to maintaining the structural integrity of the aircraft, but the maintenance of the avionics, flight controls, hydraulics, pneumatic, and electrical systems has not received as much attention. The CA/IP takes a proactive approach to maintaining these nonstructural systems, but this program is relatively new and not funded. Two of the R&M improvement modifications the Air Force is investigating are the electronics countermeasures (ECM) improvements and the Avionics Midlife Improvement (AMI) programs. The AMI program is an R&M upgrade to replace the avionics control unit (ACU), INS, and data transfer units.

The ECM improvements are controversial because the B-52 is designated as a standoff platform. There has been much discussion about the level of ECM capability B-52s require because they will not be penetrating the enemy's integrated air defense systems. B-52 ECM funding was recently added back into the FY00 Program Objective Memorandum.

The three ACUs were installed in the early 1980s, and they are the primary processors for the B-52. These processors have limited throughput and memory capacity, and the 128K bytes of memory are not sufficient to meet growing needs. The failure rate of these processors is high, and some replacement parts are obsolete.

The spinning mass type INS was installed at the same time as the ACUs. The performance of the INS is among the best available for a pure INS sensor device, but the maintenance hours required to maintain the accuracy is excessive. Over the last few years, the technology for INS has evolved from spinning masses to a laser-based system. In the near future, sources for the repair and maintenance of the spinning mass systems will decrease, and the cost will increase significantly.

The DTU—a self-contained moving tape device for loading flight software and mission data—was part of the avionics suite installed in the early 1980s. While the maintenance sources are becoming scarce, the technology for loading flight software and mission data has improved. Low-cost devices are available with improved memory capacity.

Summary

The B-52 was first used in a conventional role in the early 1960s. Since this time, its importance as an instrument to prosecute conflicts and to encourage peace settlement has increased. It is a viable weapon platform that supports key Air Force competencies and meets the requirements of Joint Vision 2010 (JV 2010). However, to remain fully viable in the conventional role and be able to deliver GPS-aided weapons, the B-52 mission planning system must be upgraded.

Blind Spots of the Long-Range Bomber Force

There are two assumptions that could directly affect the viability of the long-range bomber force: precision weapons can compensate for the quantity and weaknesses of the bomber force, and the United States will have the research and industrial base to design, build, and manufacturer the next generation bomber. These assumptions may be valid today; however, f they are incorrect in the future, the national security and the ability of the United States to defend itself could well be called into question.

A 1994 RAND study concluded that the problem with the long-range bomber force is not the bombers but the bombs.[26] The Air Force could accomplish its mission with a force of 100 to 120 bombers if they were properly equipped with long-range standoff precision-guided missiles. However, the study did not envision the rate at which these long-range standoff precision-guided missiles would be used in future conflicts or the follow-on enforcement operations associated with future conflicts. For example, the B-52 fired more than 90 cruise missiles at Iraqi targets during the 4-day operation Desert Fox. It is estimated that the 90 missiles represented 40 percent of the CALCM inventory.[27] Now the United States is faced with the dilemma of how to replace the assets utilized. The three options are:

- Convert nuclear-armed cruise missiles to conventional missiles at a cost of $160K. Drawback: fewer nuclear missiles would be in the inventory.
- Build new missiles at a cost of $1M each. Drawback: no production facilities exist, and the cost of starting production lines would be prohibitive.
- Wait for the advanced weapons to become operational after 2001. Drawback: the range of the advanced weapons will be less than the CALCM.

This example only addresses the CALCM, but the situation is applicable to any of the advanced weapons 10 years after the production of these weapons has ceased.

There are major potential problems with substituting precision weapons for the bomber's capabilities to penetrate the enemy's airspace and elude defense systems. One problem is that the planned acquisition of advanced weapons is limited. Another problem is the number of precision weapons required to destroy a target will increase as the enemy hardens its centers of gravity against attack and incorporates upgrades into its defense system to detect and neutralized incoming military aircraft. This situation will deplete the stocks of advanced weapons before the enemy's war-making capabilities are destroyed.

The US military is becoming increasingly dependent upon technology and information superiority to locate and destroy targets. For example, the accuracy of GPS-aided weapons decreases if the GPS signal is not available. The United States needs to develop a system or procedures to ensure the GPS satellite signal cannot blocked or, if signals are blocked, minimize the decrease in weapon accuracy. Further, the limitations of technology must be acknowledged.

The assumption that the United States will have the technological and industrial base to manufacture the next generation bomber at a reasonable cost may be false. The number of defense aerospace contractors has decreased dramatically since World War II. At the same time, many of the remaining contractors have merged; others have been out of the business of producing weapons for decades. Northrop-Grumman has the most recent experience in manufacturing bombers, but that experience will be almost 20 years old when the development of the next generation is scheduled to begin. In the future, competition may cease to exist in the defense aerospace industry because of the lack of contracts necessary to keep contractors in business. Further, the cost of the next generation bomber could make the cost of the B-2 appear reasonable by today's standards. The United States needs to begin the developmental effort for the next generation bomber today in order to ensure the technology and industrial base are available in the 21st century.

What Should Be Done to Ensure Mission Capability?

The Air Force recently announced that $3.6B is being invested to upgrade the B-52 fleet over the next 10 years. The upgrades will include the integration of "advanced communication links and newer precision-guided weapons."[28] However, sustainment issues were not addressed. Funding should be provided to implement the recommendations of the Condition Assessment/ Improvement Program. B-52H structural integrity has been studied since the bomber was first produced, but aircraft functional systems—such as the avionics, flight controls, hydraulics, pneumatic, and electrical—have not been monitored as closely. CA/IP is a proactive approach to prevent the aircraft from being grounded or mission incapable because of unreliable or obsolete parts. The CA/IP would correct the deficiencies of the reprocurement data or determine a suitable substitute before the demand becomes critical for the part. Also, ASIP funding should be increased because the surveillance of the bomber should be increased. As the aircraft continues to age, structural problems will continue to increase.

Notes

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Division Aviation Support Battalion

Major Samuel J. Ford III, USA

In addition to sustaining combat capabilities, today's Army is being tasked to prepare for and accomplish missions increasingly focused on peacekeeping and humanitarian missions. As a result, commanders must routinely build task forces from a variety of units to meet mission specific requirements not available in currently configured organizations. Unfortunately, building or providing forces to a task force can render the parent organization incapable of performing its mission due to the lack of modularity of key personnel, equipment, and transportation.

The US National Military Strategy reflects the changes that have occurred in the world and political environment. However, change to the Army structure has been slow because of limited resources and a lack of focused guidance concerning both the Army's structure for 2010 and the future Army After Next.

Modularity enables commanders at all levels to provide a right balance of Combat, Combat Support (CS), and Combat Service Support (CSS) units to execute the mission. Modularity has the additional advantage of allowing the commander to rapidly deploy a force with the right function and capability around the globe, while the remaining portion of the organization maintains its capability so that it can deploy later or provide mission support somewhere else.[1]

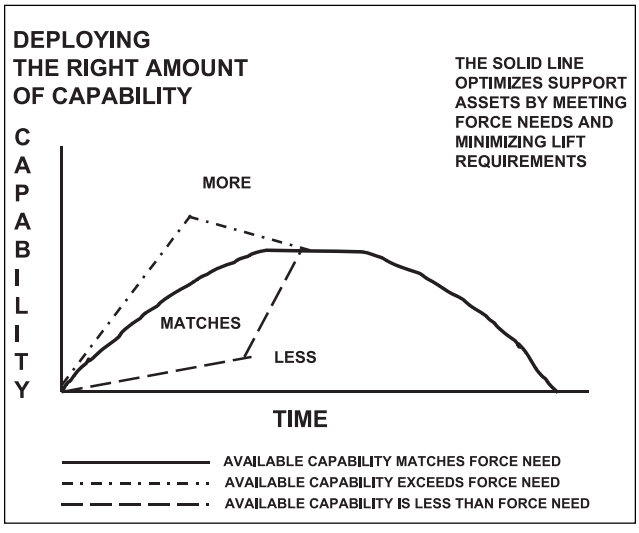


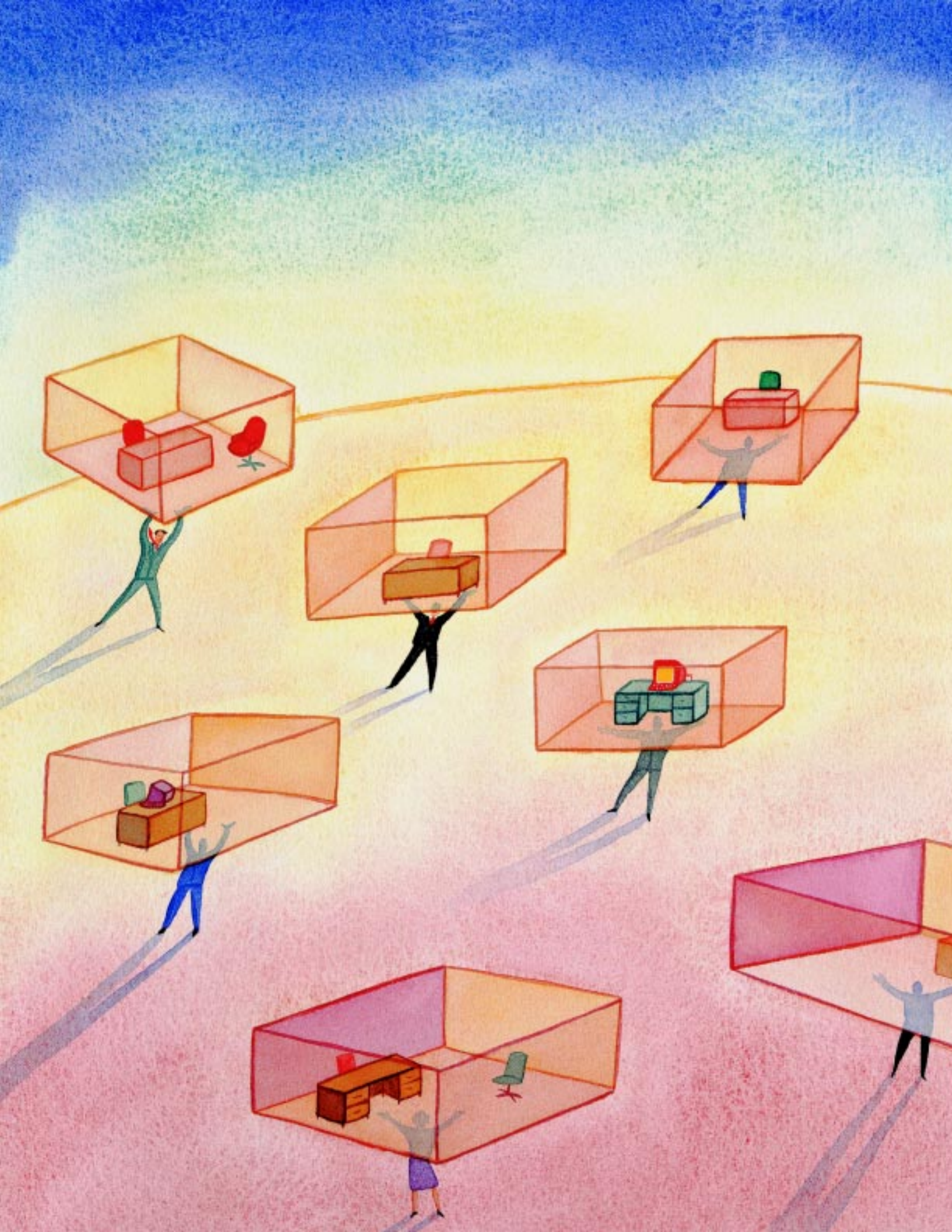
Figure 1. Deploying the Right Amount[2]

The aviation brigade (AB) is a unique organization that is challenging to support because of its capability for quick mobility on the battlefield. Further, it has several more unique characteristics that often make support problematic. First, it is the only brigade in a heavy Army division that performs aviation combat, CS, and CSS missions.[3] Second, the Army has completed the implementation of the Aviation Restructuring Initiative (ARI). This initiative restructured aviation operational units, mothballed old airframes, and increased the number of maintenance personnel.[4] Third, ARI did not take into account adequate restructuring of maintenance support for Aviation Unit Level Maintenance (AVUM) and Aviation Intermediate Maintenance (AVIM) units for split-based operations (two or more locations).[5] Fourth, the monolithic designed AVIM has a difficult time supporting the AB during split-based operations in support of operations other than war (OOTW).[6] Fifth, the Army's aviation vision to support Force XXI is focused on combat and CS roles, ignoring the requirement to modernize the CSS structure.[7]

There are other reasons for examining the Combat Support System for the aviation brigade. First, the strategic environment and aviation doctrine have evolved, since the introduction of the Division Aviation Support Battalion (DASB), from a Cold War era to an era with undefined threats and a high operating tempo (OPTEMPO).[8] Second, ARI and the advancements of modular designs may provide opportunities for improved support to the full spectrum of war.[9] And last, the Force XXI vision initiated the requirement to implement structure capabilities to execute 24-hour split-based operations.[10]

Traditional Aviation Maintenance Support

The aviation brigade of a heavy division (to include other division structures such as light and airmobile) is a flexible organization that can accomplish its mission as a pure aviation organization or task-organized force. The speed and mobility of the aviation brigade make it best suited for rapid-reaction, deep, close, and rear operations over the entire width and depth of the division area.[11] With its versatile capabilities, the rotary wing assets provide a full spectrum of responses for any operation ranging from general war to OOTW.[12] However, like its maneuver counterparts, the aviation brigade units require supplemental CSS on the battlefield because of the fluid nature of operations and the great demand for resources that characterize Army operations. The logistics system must be flexible enough to ensure that the AB headquarters can also assume the responsibilities of a task force with the ground and air forces.



Specifically, the aviation brigade must be able to man and arm tactical units, fix and fuel equipment, move the force, and sustain its soldiers and their systems.

The current structure of the DASB (Figure 2) allows it to function as any other forward support battalion (FSB), dedicated to supporting the peculiarities of its brigade. Doctrinally, the DASB locates with the AB and trains in the brigade support area. As a result, the footprint of the brigade increases dramatically. The focus of the CSS structure in the DASB is on providing support for AB units as far forward as practical.

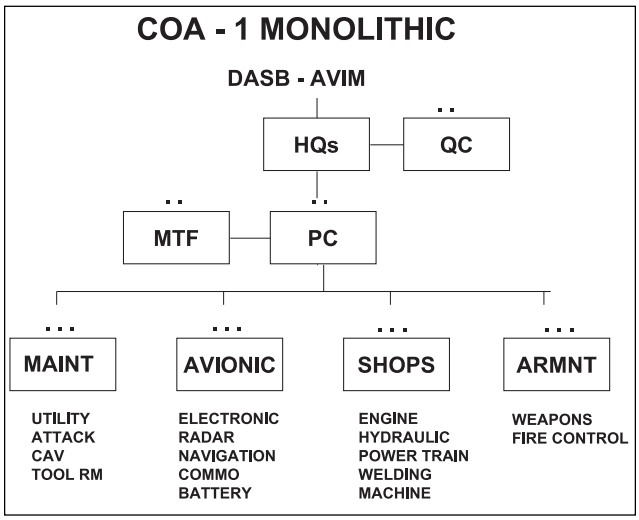


Figure 2. Monolithic DASB[13]

The DASB is a somewhat robust structure that provides the AB with a variety of aviation support capabilities. Specifically, it provides direct AVIM support, backup AVUM support, extensive component and subcomponent repair, state-of-the-art nondestructive testing, operation and management of repairable exchange, management for contractor maintenance augmentation personnel, backup aircraft recovery, and management of the division's Operational Ready Float (ORF) aircraft. Doctrinally, the DASB AVIM accomplishes its mission by *supporting forward.* Under this concept, maintenance contact teams (MCT) are developed based on the type and density of aircraft supported. These teams normally consist of mechanics (for all deployed aircraft), technical inspectors, and subsystem mechanics capable of rapidly removing, repairing, and reinstalling components. If a component requires benchwork, it is evacuated back to the parent AVIM where the necessary personnel, parts, publications, and specialized tools are available. The part can be repaired, or additional capabilities can be sent forward with the new or repaired part. It is important to emphasize that there is no set method for task organizing and operating the MCT. For example, the AVIM MCT supporting a task force might be required to deploy with special avionic repair capabilities. In that case, the MCT would mix and match test sets in avionic vans/shop sets to minimize the AVIM footprint and load requirements. Retaining the flexibility to cross-level personnel and equipment based on the mission is frequently stymied by the lack of organic transportation in the AVIM. By its organization document, the AVIM is only 50 percent mobile. With most mobility pushed forward with the first maintenance contact team, the second MCT is virtually grounded, depending on external assets.

In addition to transportation, other operational deficiencies exist in the structure of the AVIM. These deficiencies center on the limited authorization of required tools and test equipment. Under current documentation, the capability of the AVIM is severely reduced when it task organizes its systems repair and subsystem repair platoons into two or more maintenance contact teams. This specifically impacts the battery shop, standardized test sets, test equipment within shop sets and avionic vans, hydraulic test stands, and other ground support equipment. Additional impacts due to low-density authorizations are found throughout the avionic and armament repair platoons. Another deterrent to supporting multiple operations is the availability of test measurement diagnostic equipment calibration and repair tools. If the AVIM has two sets of special tools, it is very likely that one of the two sets is in calibration 50 percent of the time. These are a few examples of why adjustment of our existing maintenance structure is needed to accommodate the flexibility offered by incorporating modularity. Specifically, modularity would validate the requirement to increase the number of low-density military occupational specialties (MOS), tools, equipment, transportation, and test sets to enhance the operational capabilities of the DASB structure.[14] Modularity gives the logistics commander flexibility to package the correct balance of CSS unit elements to support the customer's ability to properly execute the mission. Today's Army is challenged with continental United States (CONUS)-based and forward-based units in force projection operations. Supporting the wide spectrum of war and OOTW requires that cope with limited strategic lift, an increased participation in joint, combined, multinational, and interagency operations. Responding to these challenges will require more efficient force tailoring capability. Modularity can provide that capability.[15] The DASB structure needs to become more modularized in order to effectively and efficiently support the aviation brigade during high-OPTEMPO split-based operations.

Historical Perspective

Operation Joint Endeavor (OJE) provided many opportunities to assess the capabilities found in a DASB. The 127th Aviation Support Brigade (ASB), 1st Armored Division deployed from Germany in December 1995 to provide CSS, including direct support supply of Class II, III, IV, VII, and IX (Air and Ground). They also provided direct support Maintenance and Aviation Intermediate Maintenance for the 27 M1 tanks, 50 M3 Bradley fighting vehicles, 41 other tracked vehicles, 815 wheeled vehicles, and 130 helicopters assigned or attached to the 4th Aviation Brigade and other Task Force Eagle (TFE) units located throughout Bosnia, Croatia, and Hungary.

The decision to deploy the DASB early allowed TFE aircraft to arrive and begin operations immediately. That decision required the DISCOM commander to rely on the 127th to establish the initial logistics support for the 1st Air Division and TFE within the area of operations (AOR). As the aviation brigade completed its initial deployment through Hungary and into Bosnia, the DASB was required to move forward, supporting split-based operations. The DASB sent 120 soldiers into Bosnia to provide the AVIM and direct support maintenance mission support, as well as the receipt and distribution management of all classes of supply (except Class I, V, VIII) for all TFE units in the vicinity of the Tuzla Valley for roughly 2 months.

The DASB forward-deployed elements in the Tuzla Valley never exceeded 25 percent of the battalion's assigned strength. During the deployment, the remaining 350 soldiers assigned to the DASB supported a maintenance *hub* and a life-support area at Workhorse International Army Airfield (WIAAF) Kaposjilak near Kaposvar, Hungary. This *hub* became the aviation maintenance center for the theater (TFE and US Army Forces, US European Command forward intermediate staging base [ISB]). This is where the 127th ASB (Workhorse) continued to juggle and improve its support for split-based operations as well as improve, manage, and secure a major base camp, maintenance facility, and airfield.

The current structure of the DASB allows it to function as any other forward support battalion (FSB), dedicated to supporting its aviation brigade. The measurement of any support battalion's success is by the maintenance rates of its supported customers. For example, TFE helicopters that deployed to OJE flew three times the normal OPTEMPO while maintaining full mission capability rates for 10 consecutive months at levels well above the Department of the Army averages. The TFE aviation units flew more than 31,000 helicopter hours due to the DASB completing 52 phase maintenance inspections on AH-64, UH-60, EH-60, OH-58, and AH1 aircraft. The DASB and contract maintenance personnel assigned to the 127th completed more than 90 percent of the phase maintenance for TFE aviation units. Additionally, the DASB mechanics and technicians completed more than 5,100 AVIM work orders during the same period. This was accomplished while both the DASB and the aviation brigade underwent modified table of organization and equipment (MTOE) changes, which required turn-in of eight AH-1s, eight OH-58Ds, and four OH-58Cs.

The DASB maintained and controlled all of the ORF aircraft deployed in support of TFE and the 1st Aviation Division, including two AH-64s, one UH-60, one EH-60, two OH-58Cs, and two AH-1s. During the deployment, 34 ORF transactions were completed. This provided great flexibility to the aviation brigade in the form of readiness and *bank time.* When the aviation brigade redeployed to Germany, it did so with higher readiness rates and more aircraft flying hour *bank time* than when it deployed.

Ground maintenance factored into the high level of aviation readiness. Ground support equipment, to include vehicles and power generators, proved to be vital in the effort to maintain aircraft availability. The DASB was very successful in maintaining the AB's 835 vehicles and pieces of power generation equipment, which allowed a constant readiness rate of 95 percent during the entire deployment and redeployment.

The Supply Support Activity (SSA) processed more than 22,000 Class IX requisitions while converting over to the SARSS-O system. The DASB supplied and handled in excess of 4.2 million gallons of JP8 without an environmental incident. The 127th operated 24-hour, four-point hot and cold aircraft refuel operation and retail vehicle fuel points in WIAAF in both Hungary and Eagle Base Bosnia. They also managed an 80,000-gallon fuel storage and distribution point at Comanche Base Bosnia, to include a fuel lab deployed in support of OJE.

The shortcomings of the DASB structure became more apparent when it supported TFE from multiple locations. It was no surprise that the identified shortfalls were limited transportation assets, low-density MOS, and shortage of tool sets/special tools. While the support provided by the 127th was significant, it highlighted the inability of the AVUM to sustain a high OPTEMPO for an extended period without a significant amount of unit level maintenance being performed by the AVIM.[16] This is an area of concern that warrants further study due to the recent aviation doctrine shift that eliminates backup AVUM maintenance support unless the AVUM is in a surge OPTEMPO.[17]

General Modularity

In the past, Army elements were expected to be a part of large land force elements operating mostly in Europe against Cold War scenarios—large force elements forward deployed in theaters that were well established and massively reinforced. Task organizing was and still is the primary means to ensure the right capability to accomplish the mission. Task organization as defined in Field Manual 101-5 is a temporary grouping of forces designed to accomplish a specific mission. However, task organizing presents re-occurring problems. First, it does not allow the Army to optimize strategic lift capability, which is more critical today with the reduction of Air Force Mobility aircraft. Second, task organizing often requires the deployment of slices from organizations. This leaves the residual portion of the unit limited in its capability to perform its mission essential tasks due to loss of key personnel and equipment.

Today's Army and the Army After Next 2025 must be able to respond to an increasing spectrum of war to include OOTW. The United States and its allies are supporting more OOTW with the military instrument of power. Current trends within the strategic environment, movement for information superiority, advancement and increased reliance on technology, and senior military leadership guidance moving us further into the 21st century require changes to structural design or enhancements.[18]

Modularity can provide capabilities needed to meet the challenges of both today and the future. With modularity,

units can participate in CONUS-based and forward-based force projection operations more efficiently. Modularity can allow a parent unit to detach capabilities in support of a force projection force with the parent unit maintaining the capability to perform its mission. Modularity will provide a force that is interchangeable, expandable, and tailored to maximize appropriate force requirements and optimize strategic lift (Figure 3).[19]

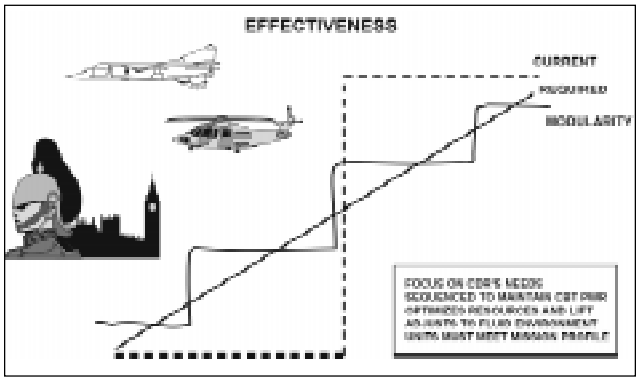


Figure 3. Effectiveness Illustration[20]

Multifunctional logistics is defined in the conceptual terms of tactical, operational, and strategic levels. The primary focus of the DASB is tactical level logistics support. Currently, the Army aviation maintenance system is a three-level system (AVUM, AVIM, and depot). Aviation maintenance occurs in some form at three levels throughout all Services. Those levels are squadron or unit maintenance, intermediate maintenance, and depot maintenance. All Services routinely deploy with unit and intermediate maintenance capabilities for their peculiar aircraft. The repair capability at the unit level is normally limited to minor troubleshooting, removal and replacement of parts and components, and daily servicing.

Intermediate maintenance provides backup support for the unit level maintenance as well as an expanded capability to perform diagnostic troubleshooting, tear-down analysis and repair, and limited rebuilding of components, to include engines. During crisis situations, the augmentation of personnel, tools, and test equipment from the theater level also provides the intermediate maintenance unit with some limited depot level repair and rebuild responsibility. Doctrinally, repairs of aircraft and components completed by the intermediate maintenance unit are usually returned to the owner.

Depot maintenance is normally accomplished only at centralized, fixed facilities (usually within CONUS) that possess an even greater teardown, analysis, and rebuild capability. The components and aircraft that are repaired at the depot facilities feed the Service or DoD supply system and may or may not be returned to the previous owner. Thus, the inclusion of some depot capability within any aviation maintenance program is critical to ensuring the operational readiness of the high-technology aircraft present within the force.[21]

However, future aircraft systems like the RAH-66 Comanche will be supported significantly different under a two-level maintenance and supply system. The transition from a three-level to a two-level maintenance system (depot, user concept AVUM/AVIM) should be relatively invisible in force structure. The transition will take place in the organizational structure design over time.[22]

Merging the right capabilities from each level of maintenance and supply support into a viable support structure that can support the specific requirements of a contingency will be the challenge. To accomplish this, the logistics capability must be modularly configured to permit responsive tailoring of the logistics support organization to match the requirement of the AB or the aviation task force and to implement aviation maintenance fix forward doctrine. Prior to modularity concepts, task organizing, and force tailoring were methods used for deploying slices from the organization. Most of the time, this left the remaining portion of the unit incapable of performing its full spectrum of missions due to the loss of key transportation, personnel, and equipment.[23] Modular designs will ensure logistics units have the depth of support (robustness) and flexibility to support an aviation task force across the full spectrum of war (general to OOTW).

The Army utilizes Table of Organization and Equipment (TOE) and MTOE databases to document the minimum mission essential wartime personnel and equipment requirements. Requirements for OOTW do not fit this definition. For OOTW requirements to be accommodated in TOE/MTOE documentation, the accommodation must be incidental to the organizational design for general and limited war. For ARI aviation brigade designs, aviation maintenance systems repair requirements for OOTW can be documented in TOE/MTOEs because they represent minor deviation from wartime requirements.[24] This is not to say that modularity would benefit only OOTW operations, but redundancy provided by modularity would also be beneficial to the full spectrum of war. The Training and Doctrine Command (TRADOC), has the mission to document the supported commanders warfighting requirements. When developing documentation, the following force structure and organizational design guidance applies:

- General War: logistics force structure and organizational designs (TOEs) will reflect requirements to support the AB general war configuration in that portion of the AB design that is a resourced total army analysis (TAA) process.[25]
- Limited War: modular designs or definition will allow rapid adjustment of the general war logistics unit configurations to match the requirements of the provisional AB task force. A provisional AB is the general war brigade reconfigured for the conduct of limited war.[26]
- Operations Other Than War: aviation maintenance systems repair requirements for OOTW will be documented in TOEs and MTOEs for ARI design

aviation units. Currently, DASB aviation maintenance subsystem repair requirements must be satisfied through task organizing (hemming the suit instead of building a suit for the requirement), using maintenance capability of units designed for general war. To help in logistics task organization for OOTW (and other unresourced aviation support requirements), contingency or supplemental TOEs can be developed.[27]

Modularity has been used to incrementally increase an existing capability within an organization or to provide an organization a capability it does not normally have. For aviation maintenance applications, modularity is intended to facilitate, at the tactical level, the task organization of logistics to support a designated aviation task force and to implement fix-forward doctrine. To accomplish this, it is necessary to link approximate logistics capability within the support organization to specific elements to be supported within the aviation task force (single Service, multinational, or Joint Task Force).[28]

Current doctrine describes a requirement for dedicated multifunctional CSS for divisional AB requirements. The force design that will provide this support is the DASB Forward. This title is designated to differentiate this organization from similar organizations designed for other concepts and studies, specifically, the DASB that evolved from the 1988 Aviation Logistics Study and its ARI variant, ASB.[29]

Previous studies on aviation requirements for the combat structure of the Army investigated dedicated multifunctional CSS for corps and echelons-above-corps (EAC) AB. However, the General Officer Steering Committee concluded that full multifunctional CSS modular support for the corps and EAC AB was too costly. The GOSC stated that area support doctrine adequately supports AB requirements.[30] This works well during general or limited war scenarios. However, the Army must again look at scenarios where the division AB supports OOTW as part of a division and a task force when the corps is not included.

The division AB will be deployed as an aviation task force operating split based in support of OOTW. The DASB must be augmented in order to support the AB because current structural design does not afford redundancy of key tool sets, shops, and low-density MOS. Task organizing within or outside the division must augment the DASB.

Doctrinally, aviation elements fight as a brigade; however, selected battalions might be deployed and organized into provisional brigades (aviation task force) for OOTW. This doctrine perpetuates the perception that the aviation battalion is an element that cannot be broken down below the battalion level to support limited war or OOTW. The facts from recent, real world operations provide plenty of evidence that provisional brigades and/or aviation task force organizations are, in fact, broken down to company level and sometimes platoon to support OOTW. In other words, current doctrine is outdated and is logically and factually inconsistent with the way aviation elements are employed, particularly in OOTW scenarios. Aviation logistics doctrine must also evolve to support aviation as it fights, not as it is organized.[31]

As an example, the Army supported Operation Able Sentry in Macedonia with four UH-60 aircraft, crews, and maintenance support. At the same time, the parent and support units were deployed elsewhere throughout Hungary, Croatia, Bosnia, and Central Germany. Fortunately, in all deployed locations, units supported only OOTW missions. However, mission support was limited due to a shortage of single density personnel and equipment (to include special tools). Personnel and equipment had to be task organized from divisional units located in and out of the 1st Armored Division.

Analysis of ARI aviation force designs concluded wartime modules should identify manpower and equipment requirements to the company level for support of general and limited war instead of battalion level. For OOTW, modular designs should focus on the smallest deployable units (SDU). For example, the AB SDUs are currently defined as follows: Attack Company (eight AH64), Air Cavalry Troop (eight OH58D), and General Support Company (eight UH60).[32] The SDU definition should include aviation elements below the company level so that modularity maintenance support can be accurately defined.

Modular Limitations

The logical alignment of essential CSS functions should be the first step in the force and organizational design process for modularity. Force and organizational designs will evolve as the respective modular concepts are tested and structure design decisions are made. Currently, AVIM units are monolithic and will remain so under the Battlefield Logistic Support for Aviation (BLSA) concept. For AVIM units, this definition exceeds the narrow definition used for modeling force structure in the TAA process. However, the AVIM force structure and organizational designs are tailored to the specific requirements of the supported force. More important, the AVIM workload is derived from the aviation programmed force. This is significantly different from the current process of developing workload projections from a designed force.[33]

Many decisions impact the resourcing of aviation force structure, and each directly influences AVIM force structure and organizational design. Perhaps most important, the resourcing decisions have an impact on the numbers and types of aircraft and aircraft composition distribution. The capability of active component logistics units must match the requirements of the aviation units they support. For the most part, the divisional units are standardized in their structure. The main reason for modular design development is that the AVIM force and organizational design seldom translates without significant change to programmed force structure or TOE/MTOE documentation (such as systems and subsystem platoons within the AVIM).[34] These conceptual designs will represent one of several battlefield configurations that can be

created by rearranging units and capabilities within units to satisfy operational requirements. The TOE should clearly identify the sub-element designed for modularity. This will assist planners in rapidly identifying minimal Army force packaging requirements for deployment and effective mission accomplishment.[35] The Unit Identification Code can be used to further identify units on the MTOE.[36]

Modular Concept

Modularity is a force design methodology, which establishes a means of providing force elements that are interchangeable, expandable, and tailorable to meet the changing needs of the Army.

Provide a means of rapidly identifying, mobilizing, and deploying doctrinally sound, sustainable, and fully mission-capable elements/organizations able of operating in a joint and combined environment.

TRADOC PAM 525-68

The BLSA concept prescribes dedicated multifunctional logistics support for the divisional AB and centralized management of all logistics operations. A variation of the traditional DASB will satisfy possible modular concepts.[37]

Under the BLSA, the AVUM and AVIM functions have been consolidated. The AVUM systems repair capability is organized as the forward support platoon with sections correlating to the supported aviation structure. The AVIM systems repair capability is documented as the system repair platoon. Both AVUM and AVIM subsystems repair capabilities are documented in the subsystems repair platoon. Limitations of the TOE format may require documentation of AVUM and AVIM subsystems repair capability with a discrete aviation structure.[38]

The purpose of the consolidation of the AVUM and AVIM capability in a single organization is to provide a single manager for all aviation maintenance and enhance operational effectiveness by allowing movement of maintenance capability both vertically and laterally on the battlefield (future digitized battlefield). In operation, the AVUM (forward support section) systems repair personnel and equipment will normally be colocated and under the operational control of the supported aviation unit. Functions associated with these units are typical of the traditional ASB/FSB organization.[39] The BLSA describes a threat of vastly varying dimensions and characteristics. The Army must be prepared to fight the high-intensity general war configuration that the DASB must be specifically designed to support.[40] The DASB TOE and MTOE documentation must be either modularly designed or contain sufficient modular definition that it can be readily reconfigured to support a provisional aviation task forces designated for the conduct of limited war or OOTW. Modular design or definition is necessary to ensure the DASB design contains appropriate redundancies in personnel and equipment to support task organizations, support aviation maintenance fix-forward doctrine, and facilitate the reconstitution and/or reorganization of logistics capabilities to match the requirements of surviving aviation capabilities. Modular design or modular definition within TOE/MTOE documentation is critical to the support of aviation task organization and operational effectiveness.[41]

In order to implement fix-forward doctrine, commanders and staffs of logistics units within the DASB will have to be familiar with the organization and capability of their respective units so they can maximize the operational flexibility inherent to their organizational designs. TOEs and MTOEs will continue to reflect the organization (personnel and equipment) necessary to support general war. At the same time, logistics commanders will no longer have to fight their units as depicted in TOE/MTOEs but will have the flexibility of rearranging organizational modules to best satisfy operational requirements. Using aircraft maintenance as an illustration, aircraft maintenance unit TOE/MTOEs will continue to document a variation of the design with systems repair and subsystems repair integrated into a single unit.[42] Added definition in TOE/MTOE documentation will link both systems and subsystems maintenance capability of this unit to the individual aviation units being supported. The logistics commander can employ the maintenance unit exactly as it is documented in the MTOE or can adjust the organization to other configurations.[43]

Modular definition within the aircraft maintenance MTOE will permit the logistics commander to adjust maintenance capability to accommodate the change from the general war configuration depicted in his MTOE to a configuration necessary to support the provisional aviation task force designated for limited war or OOTW. For deployment, the DASB commander will provide the right amount of aviation maintenance support at the right time for the deploying aviation task force.[45]

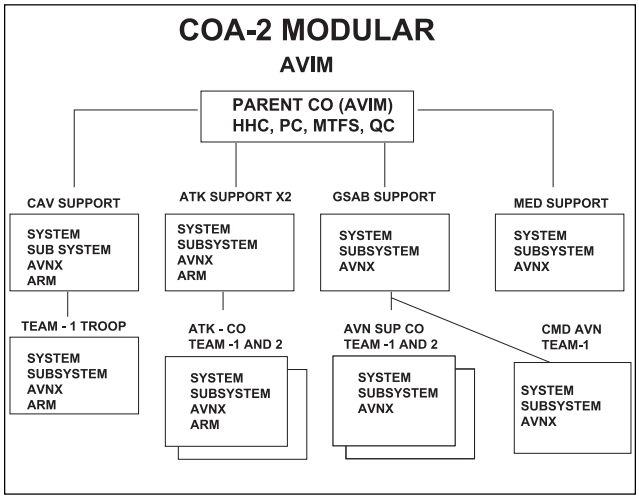


Figure 4. Modular Three-Level Maintenance[44]

Light aircraft maintenance (on aircraft systems repair) and heavy maintenance (off aircraft maintenance repair) need not remain integrated in a single organization. Modular design or definition allows multiple options. For example, it might be desirable to not deploy a subsystem repair capability and rely on the supply system and dedicated priority distribution

to meet the requirement. Another option will be to deploy the total unit capability and extract the subsystems repair capability from the unit as a section, attach it to another unit of the DASB or forward support battalion/main support battalion (MSB), or consolidate all subsystem repair capability in a separate company. This latter option effectively segregates the light systems repair from the heavy systems repair, which substantially increases the mobility of the unweighted aircraft systems repair maintenance unit (Figure 4).[46]

AVUM forward support teams for a specific aviation unit can be augmented with either of its AVIM systems or subsystems repair capability. The latter option represents fix forward doctrine in its purest sense and provides the aviation unit a repair capability comparable to the Integrated Direct Support Maintenance concept employed successfully during Vietnam.[47]

Modularity Concept Comparison

A comparison of modular concepts to the current monolithic DASB can be used to determine which maintenance system design can better support the AB during split-based operations and OOTW. Three courses of action (COA) to compare are COA 1 (current DASB Monolithic Design Three-Level Maintenance [Figure 2]), COA 2 (Modular Design Three-Level Maintenance [Figure 4]), and COA 3 (DASB FWD Modular Forward Design Two-Level Maintenance [Figure 5]).

COA 1 provides both AVIM level and backup AVUM level direct support maintenance to the aviation brigade. Under COA 1, the AVIM company supports a fixed structure of specific aircraft types and quantity. The DASB is part of the three-level maintenance system that includes AVUM, AVIM, and depot.[48] COA 2 proposes a modular concept that also provides AVIM and AVUM level DS maintenance to the aviation brigade. The modular concept supports the aviation brigade by built-in sections for specific aircraft types. For example, if one of the battalions sends forward two general support aviation battalions to be part of an aviation task force, the DASB AVIM can send modular sections of AVIM for each company.[49] Finally, COA 3 thoroughly integrates the DASB FWD Modular Forward Design into a two-level maintenance system supporting specific airframe types. The other half of the AVIM is in the division rear or corps support area performing AVIM and depot level maintenance.[50]

Each COA provides the same mission support capabilities, direct AVIM support to the aviation brigade, backup AVUM support, extensive component and subcomponent repair, state-of-the-art nondestructive testing, operate and manage repairable exchange, management of contractor maintenance augmentation personnel, backup aircraft recovery, and management of the division's ORF aircraft.

The criteria used to measure the structure designs for COA comparison are the logistics functions continuity, integration, and responsiveness. In addition, cost and command and

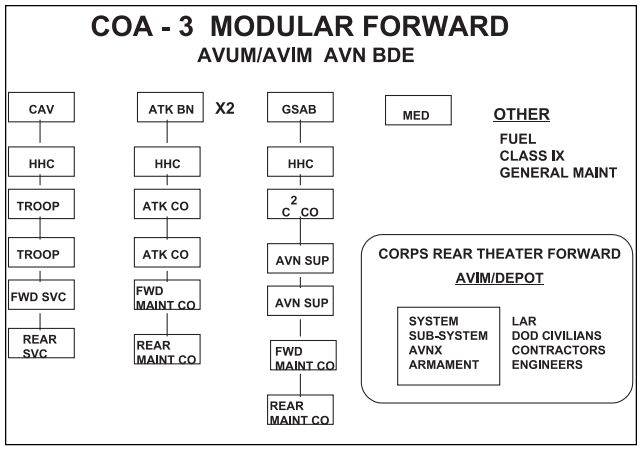


Figure 5. DASBFWD Two-Level Maintenance[51]

control will be measured in the COA comparison along with the chosen logistics functions. In order for a COA to be considered, each COA must meet the criteria of suitability, feasibility, acceptability, distinguishability, and completeness.[52] Each COA must meet TRADOC 525-5 Army Force XXI guidance. It is important to remember that the vision of Force XXI requires aviation units to be capable of sustaining split-based (two separate locations with company size units) 24-hour operations. In order for the current DASB design to meet Force XXI guidance, the DASB would need to eliminate critical low-density MOS and equipment. Current documentation of Force XXI TOEs are the same as ARI with one exception, one attack battalion instead of two in the AB. This puts us back at levels below MARC and moves the Army backward to the same structures used during the Army of Excellence (a move in the wrong direction). If we could eliminate critical single density equipment and MOS, COA 1 could be the least expensive way to achieve split operation capability.

The Force Design Update (FDU) 95-2 proposal for the heavy division DASB recommended $2.3 million for equipment and seven personnel slots to meet Force XXI guidance.[53] However, FDU 95-2 was disapproved by the Department of the Army in March 1996 because it was considered too costly.[54] Because the current DASB (COA 1) does not meet Force XXI guidance, it is not feasible or an adequate COA. Both COA 2 and COA 3 designs qualify for COA comparison by meeting Force XXI guidance. For purposes of design comparison, the criteria will not be weighted for concept comparison.

Assumptions and facts are included to set the parameters that surround the issues that are related to the DASB environment. Some of the assumptions were identified from policy decisions that are inherent to Army aviation. The assumptions are:

- The division conversion to the DISCOM support structure is complete within the heavy division, which includes the support structures of the MSB, FSB, and ASB (DASB).
- The DASB ARI conversion is complete within the heavy divisions.

- The heavy division AB ARI fielding is complete.
- The AB deploys as a brigade size during general war, brigade to less than a brigade for limited war (possible three or less battalion size task force), and brigade to less than a company aviation task force supporting OOTW.
- The SDU is defined down to the company level.
- Both COA 2 and COA 3 can sustain split based 24-hour operations in separate locations with company size units.
- COA 2 and COA 3 by design can support the AB SDUs.
- The current DASB design does not adequately support split-based operations and OOTW.[55]

Facts are based on doctrine and the way AB customer is supported. The facts to be considered are:

- The heavy division only supports the AB.
- The AB battalions all have their own AVUM support.
- The DASB is the only support battalion within the heavy division that provides both ground and air maintenance support.
- The AB generates 100 percent of the DASB Class II, IV, and IX requirements.
- The aircraft types currently found in the heavy division AB are AH-64, UH-60A/L, EH-60, and KWOH-58D.
- The DASB C2 relationship falls under the DISCOM, not the AB.
- The heavy division by definition is armor, mechanized infantry, and cavalry.[56]

Continuity, integration, responsiveness, cost, and command and control will be used to compare COAs. Continuity is the ability to provide uninterrupted logistics support. Continuity is the lifeline of combat operations. Continuity is measured by the number of levels a unit's requisition must pass through in the division under the SARRS objective supply system (unit tech supply, SSA, DMMC, and NICP) in order to receive a needed part. Requisitions that pass through the supply system more direct with the NICP should get a quicker response time receiving parts. The least number of levels a unit's requisition must pass through is rated best. A requisition that passes through more levels is rated worse.[57] Comparing requisitions sent through COA 2 and COA 3, COA 2's requisition passed through four levels of supply to get to the NICP (unit tech supply, SSA, DMMC, and NICP), and COA 3 passed through three levels of supply (SSA, DMMC, and NICP). The best COA when measuring continuity is COA 3.[58]

It is important that a unit has the ability to integrate logistics and operation concepts during planning and execution. Knowledge of existing logistics capabilities and limitations are important for successful support of the concept of operations. There are many instances where a unit must integrate with another unit to meet a mission requirement. Integration is measured by the number of units that must be integrated when task organizing or tailoring to meet mission requirements. The least number of units to be integrated the better. COA 2, once coordinated, has built-in sections that allow it to support forward-integrating AVIM maintenance support sections with deploying ATF AVUM maintenance. COA 3 has both AVUM/AVIM maintenance sections integrated to provide maintenance support to deploying ATF. When comparing the number of units with which both COAs must integrate when providing AVIM maintenance support, COA 3 is already integrated into a tailored maintenance sections and COA 2 integrating between two units. The best COA when measured against integration criteria is COA 3.[59]

Responsiveness is the ability to react quickly to a crisis through effective organization, strong leadership, effective training, and thorough planning. This is true when preparing for a deployment tailoring the right amount of support at the right time to meet customer requirements. Responsiveness is measured by the ability of the DASB to prepare itself in the number of hours it takes to provide capable support to the aviation brigade. Comparing each COA against responsiveness, both COA 2 and COA 3 were determined to take 12-24 hours to respond and provide maintenance capability.[60]

The structure and design that is the least expensive to operate is an advantage. A costly structure and design are considered a disadvantage. In comparing each COA with the cost of personnel and equipment, the COA 2 structure cost $28.237M and COA 3 cost $18.655M.[61] COA 2 was an increase of 10 percent over the original DASB monolithic design ($26.145M) due to an increase in equipment and personnel that reduces low-density MOS, equipment, and added modular structuring. COA 3 decreased loss by 31 percent from the original DASB monolithic design because of the splitting-up of the DASB AVIM, with half integrated into the aviation brigade and half into the corps in the form of AVIM and depot. Based on cost, COA 3 is the best alternative.[62]

The DASB has a unique C2 relationship within the heavy division. While the DASB supports the divisional AB, it remains under the command of the DISCOM commander. To perform its C2 functions, the DASB must develop and maintain a variety of relationships with both the DISCOM and the AB. The DASB C2 relationships are with its higher organization, the DISCOM. Lateral relationships include the MSB, FSB, and corps logistic task forces. The DASB relationship with supported organizations is the AB. Within the DASB, the internal relationship is with the subordinate DASB companies.[63] It is important to streamline C2 structure to ensure that the best support is provided to the AB while maintaining flexible control and lines of communication with supporting organizations. The measurement for C2 is the organization structure that can effectively implement *fix-forward* doctrine and achieve the enhancements to operational effectiveness to task organize maintenance support incrementally in the conduct of general and limited

war, to include OOTW and split-based operations. Using C2 as criteria for COA comparison is a topic of controversy. COA 2 would meet current doctrine because AVIM C2 falls under the DISCOM. COA 3 AVUM/AVIM command and control is aligned with the aviation brigade. Whether the AVIM belongs to the DISCOM or aviation brigade is an old argument. The current DASB falls under the DISCOM. However, future AVIM modular designs may require it to move under the AB command and control.

Based on all comparisons, the DASB FWD modular design (COA 3) is the best method for providing CSS to the AB during split-based operations. It is a modular concept that provides the most continuity, cost-effectiveness, integration, responsiveness, and best C2 support. Just as important, COA 3 meets the Force XXI requirements for sustained 24-hour split-based operations in separate locations. COA 3 can be affordable by combining AVUM/AVIM forward with brigade aviation units. This COA combines theories of DASB doctrine with the reality of providing enhanced forward support to the aviation brigade, to include SDUs, during split-based operations in support of OOTW.

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The Logistics Constant Throughout the Ages

Fuels

War often conjures pictures of combat and large armies moving to the field inspired by a clash of political ideologies or ambitions. Indeed, the intriguing twists and nuances of the strong political current sweeping every conflict forward or the intricate strategy and battlefield tactics that vie for positional dominance can hold one's attention to the exclusion of all other aspects of war. Yet, the bulk of a commander's considerations involve the logistical limitations that drive changes to strategy and tactics in order to keep forces supplied and moving. All manner of logistical supplies are necessary to carry on military operations. However, fuel (fodder for animals or petroleum, oil, and lubricants [POL]) holds a special importance in that its supply has influenced and often dominated strategy as long as nations or states have fielded armies.

Transportation of supplies and materiel preceding modern day machines relied on some form of pack animal, principally horses. The horse's need for fodder dictated to the commander the terrain through which he could campaign as well as the campaign seasons.

Following World War I, new modes of warfare made the use of pack animals obsolete; however, armies still employed them on a much smaller scale to move supplies. Technology—manifested in aircraft and mechanized vehicles birthed in the First World War and nurtured during the interwar period—required a new type of fuel in the form of POL. During World War II, in the European Theater, massive armies raced across battlefields, and mechanized equipment greatly increased the spectrum of strategic possibilities. However, commanders still had to account for logistical considerations that would influence their tactics. Increasingly, POL dominated their strategy and tactics. Further, POL products accounted for the majority of supplies shipped into theater during the war.

Regardless of its modern connotation, POL's intrinsic equivalent throughout history has been fodder.

Military Campaigns, Strategy, and the Need for Fodder

Most great commanders in ancient times, such as Alexander the Great, attempted to limit the number of horses on the campaign by ordering the troops and their attendants to carry many of their own supplies.[1] Yet, historian Donald Engels notes that pack animals were still necessary to carry "the army's noncomestible supplies, such as tents, hammocks, medical supplies, the ambulance, siege machinery, firewood, booty, and perhaps some of the women and children."[2] Though Alexander managed to significantly reduce the number of pack animals, Engels estimates that Alexander's army probably had about 6,000 cavalry horses and 1,300 baggage animals. Under the most favorable conditions, where the army campaigned in areas abundant in fodder and only needed to carry 1 day's supply of grain, they still needed approximately 1,100 pack animals to carry 269,000 pounds of grain, if each horse carried 250 pounds.[3] Engels notes that if an army traveled through an area devoid of fodder the number of pack animals needed to transport the grain and fodder requirements for 1 day would jump to 8,400 carrying approximately 1,260,000 pounds.[4] Noted historian Martin van Creveld, in *Supplying War*, similarly describes a generic premechanized army in which "the 40,000 animals accompanying an army would, therefore, require 800 acres per day."[5] Horses were imperative in a campaign, yet their subsistence greatly strained an army's resources.

Prior to the 18th century, few improvements were made to ease the fodder supply problem in Europe. In fact, the French made the problem worse by bringing extra men on the campaign to forage for fodder in the army's immediate vicinity. Historian John A. Lynn estimates between "4,000 and 10,000 men [were]

necessary to mow forage for an army of 60,000"—each day a horse required approximately 24 pounds of dry fodder.[6] Interestingly, the French did maintain a magazine system to store troop provisions; however, the need to keep moving to find more fodder tended to cause the army to move too far and too fast away from this system of supply.[7] The ever present need to forage for more fodder forced the French Army to constantly move even when strategy dictated that it should not.

Strategy had to be adapted to account for horses' needs. Most historians agree the challenge of providing for the pack animals overshadowed the troops' provisions. Accordingly, the fodder requirement restricted an army's area of operations to regions that could sustain a high fodder intake. During the winter months when cold weather made fodder impossible to secure, armies were unable to campaign, and military operations necessarily became a seasonal activity.[8] Notably, in the 13th century, the Mongols possessed horses that could find food under the snow, so their timeframe for waging war was greatly increased.[9] Early conquerors bypassed cities and only occasionally conducted sieges, as fodder in the immediate area quickly ran out.[10] Intuitively, the massive effort required to forage dictated strict precautions to prevent being surprised while gathering fodder. Though other factors also influenced strategy, the need for fodder dominated both strategic planning and military operations.

Throughout the first millennium AD, the Muslims were adamant about incorporating knowledge of terrain and vegetation when planning raids. Muslim planners devised contingency plans dependent on the seasons in that, during February and early March, their raids only lasted 20 days so they could get the horses back to Muslim territory to graze. Spring campaigns could only last 30 days, while summer ones were to last 60 because of the availability of fodder.[11] However, the Muslims were also sufficiently organized to set up a series of warehouses near their eastern frontiers over which they campaigned. Reports of these warehouses came in the 7th century and again in the 10th century relating the existence of ready supplies, "including grain and fodder [and] located where defensive or offensive action tended to repeat itself."[12] Despite the Muslim's successes, by the 18th century, few countries had adopted a suitable fodder magazine system except for the French and Prussians.[13] The French and Prussian magazine system, as well as the earlier Muslim warehouses, gave the respective forces the advantage of surprise and a greater measure of flexibility by allowing them to mobilize and attack more quickly.

As mentioned earlier, Alexander the Great grappled with the fodder problem throughout his farflung exploits across Europe. Alexander realized the problems posed by bringing along numerous horses and pack animals, so he attempted to minimize their numbers by requiring his men to carry packs.[14] He also understood that excessive work and not enough food would wear out his cavalry and pack animals and he would not be able to nurse them back to health.[15] Welfare for the horses dictated that he slow his army's pace so the horses and pack animals could graze. The need to move faster, therefore, motivated Alexander to look for new ways to reduce his dependency on horses. His massive fleet helped alleviate this problem by transporting large fodder supplies from port to port, though this locked him into a dependency on the Mediterranean coastline or large navigable rivers, especially during winter.[16] The need to provide fodder for his horses forced Alexander to work within increasingly narrow boundaries as he moved farther away from Macedonia. Alexander's campaigns provide one of the earliest recorded examples of logistical handicaps.

As long as armies required horses for cavalry and carrying supplies, the need to find fodder restricted flexibility and operations. In 1775, during the American Revolutionary War, American forces under General Philip Schuyler planned an invasion of Canada. However, lack of rain made for a hot, dry summer, and General Schuyler could not move up enough fodder to feed the horses needed for a full invasion. Instead, the lack of fodder forced him to wait until late summer when adequate rain nourished the grass enough to supply the invasions.[17] Winter quickly set in after Schuyler experienced early successes and cut him off from all resupply. The "inadequate forage in June and July was not the only reason for the failure of the Canadian campaign, but it surely was one of them."[18]

Fodder further affected flexibility during the American Revolution when free fodder became hard to obtain and the Colonial Army had to compensate farmers for using their land. Wartime prices steadily rose as good pastureland became less available. However, like Alexander, the American commanders understood that without adequate fodder their limited supply of horses would dwindle. Colonial commanders could send the cavalry away from the army to find cheaper fodder, but they needed the pack animals to stay close and often paid high prices for their nourishment."[19] Without the pack animals, the army could not transport its supplies and conduct operations for very long.

The US Civil War (1861 to 1865) demonstrated the importance of using a rail system to increase strategic flexibility by more efficiently supplying armies. Trains and rail lines came under attack as both sides sought to cripple the other's access to them and prevent valuable supplies from reaching their intended forces. Armies still required cavalry and pack animals to move their food and supplies while in the field and, therefore, continued to need fodder. However, with the locomotive's introduction into warfare, fodder and other supplies could be loaded onto trains and brought to depots within the army's proximity. Established supply lines could then be used to retrieve the materiel. The Civil War became the first conflict in which armies used the new technological innovation to improve logistics, especially resupplying fodder, and to alleviate the need to constantly change camps to find more fodder.[20] In fact, historian James A. Huston, in *The Sinews of War: Army Logistics 1775-1953*, relates that shipments of forage during the winter months averaged $1M. He goes on to say that fodder continued to dominate supply considerations, in that "for tonnage and bulk the item of daily supply that was even more important than

food for the men was food for the animals."[21] Trains permitted armies to receive more fodder while maintaining their positions and simultaneously allowed an army to keep more horses.

The period between the Civil War and World War I was filled with advances in technology, which were not fully taken advantage of by the European powers. Further, the dominant powers in Europe (France, Prussia, England, and Russia) failed to truly understand the lessons that could have been learned from the Civil War. Cavalry charges and long baggage trains of horse-drawn wagons persisted, and with that returned the age-old need to feed the livestock. In many ways, the First World War resembled all past wars. However, its rapid consumption of supplies, especially ammunition, dictated that the times and ways of war were changing. But for the moment, it was remarkably similar to the past, in that during the war, Great Britain shipped 5,253,538 tons of ammunition to France as well as the greatest single item shipped, which was 5,438,602 tons of oats and hay.[22] Fuel for horses continued to be a dominant factor.

Regardless of the lessons the Germans should have learned from the past, during World War I, they placed a huge emphasis on cavalry and did not prepare for their maintenance in the field. The German high command ordered commanders to feed their horses off the land as a result of the army's sheer numbers of horses. Van Creveld relates that any attempt to supply the army from home bases would have been impossible.[23] As the Germans moved into France early in the war, luck appeared to be with them as the land was rich and the grain had just been harvested. However, much of the grain was still green, causing many of the horses to become sick and die very early in the campaign. A critical shortage resulted in fodder, and by the time of the Battle of the Marne, where French and British forces engaged and halted the German advance, most of the horses were too weak to keep up the pace.

The German invasion plan, known as the Schlieffen Plan, depended on the speed of the invasion, yet the horses employed in reconnaissance and pulling the heavy artillery were so poorly fed that they could not keep up the pace. In fact, many died before the Germans crossed the border into Belgium. By 11 August 1914, preceding the Battle of the Marne, cavalry forces ordered a 4-day halt to find food for the mounts.[24] By the Battle of the Marne, the starved horses pulling the German artillery, which was the only arm that had a distinct advantage over French forces, could not keep up the pace. "By this time, too, one German army at least was finding that the states of the cavalry seriously interfered with operations."[25] The German high command's severe oversight of properly feeding the horses proved to be a decisive factor in the failure of the Schlieffen Plan.

Following the offensive stall after the Battle of the Marne, the consumption of supplies reached proportions unmatched by any previous war. However, this consumption rate could not have been maintained if the front had not stalled and remained stationary throughout the war.[26] Supply movement via horses would have been inadequate given the war's immense scale. Toward the end of the war, both sides began to introduce motorized transport on a very small scale and began to argue that "complete motorization of local transportation and the widespread use of combat vehicles would restore mobility to the battlefield."[27] Petroleum products, then, came into demand, and by the war's end, more than 759,000 tons of gas and oil had been shipped onto the Continent. Warplanners deemed the horse obsolete in favor of the more economical and faster moving petroleum-based machines.

Military Campaigns, Strategy, and the Need for POL

Following the First World War, armies began nurturing the technological innovations employed at the end of the war and subsequently developed a strong dependency on petroleum products by the beginning of World War II. POL significantly differed from fodder in that POL had to be manufactured away from the battlefield and then shipped to the battle area.[28] For the most part, fodder as a source of fuel for horses quickly became a thing of the past as armies became fully mechanized. The new machines could be worked harder and go farther and faster, and most important, the time of the year and the route taken by the army did not affect its fuel supply. Commanders could expand their range of strategic operations immensely and do more with less.

However, challenges quickly attached themselves to the new machines and their fuel supply. If army quartermasters did not constantly provide the machines with enough fuel, operators could not normally just forage for it. In this respect, commanders lost a measure of flexibility, and the situation forced them to further employ technology to devise ways to overcome the new problems. The result involved underground pipelines and the Red Ball Express, in which a constant stream of trucks traveled distances of up to 400 miles to supply Patton's Third Army.

The beginning of World War II saw the Germany Army still reliant on horse-drawn transport. Hitler neglected to fully mechanize his transport vehicles, though he dramatically increased the number toward the end of the war.[29] Historian Julian Thompson relates that the Germans only possessed three motor transport regiments for the whole army capable of carrying 19,500 tons, whereas in 1944, the Allies in northwest Europe could transport 69,400 tons to support 47 divisions. Thompson goes on to state, "Hitler's failure to build up the necessary capacity to provide the transport essential for mobile warfare was one of the principal reasons for the failure of the German invasion of the Soviet Union (Operation Barbarossa)."[30] Regardless of the German Army's deficit in mechanized transport, the Second World War became the pioneering conflict to be predominantly affected by fuel in the form of POL.

Following Germany's invasions of Poland and France, POL's role became readily apparent, and Allied strategists sought to cripple the Axis' ability to effectively employ fuel with US entrance into the war. Plans got under way to target

the Ploesti oilfields in Rumania as strategists estimated that the fields had the capacity to produce 9 million tons of refined oil per year, though it only produced 4 million. Allied strategists understood well the Germans' primitive transportation system and the fact their small fleet of motorized transport vehicles had become extremely overburdened by the war's rapid geographic expansion.[31] Accordingly, the Allies did not attack Ploesti in the hopes of crippling the Axis refining capacity. Instead, they were more interested in destroying Ploesti's refining capability so Germany's limited transportation system would have to move the crude oil from the Ploesti area to other refining sites in Germany or France. The war had already severely taxed the Axis transportation system, and the Allies believed the extra strain would cause supply to other areas to fall apart.

The Allies launched the first Ploesti raid on 1 August 1943 and estimated that the Axis oil supply had been reduced by 3 or 4 percent.[32] It was originally believed the raid had destroyed about 40 percent of 6 months of Rumanian refining capacity or a loss of 1.8 million tons of refining capacity as a result of closing the refining facilities from about 1 week to several months.[33] However, the raid's after action analysis indicated that Rumanian oilfields possessed twice their estimated production capacity, so subsequent raids would have had to destroy about 3 million more tons of refining capacity to begin really limiting Ploesti's actual refining capacity.[34] Though the mission proved to be successful, the Army Air Forces sustained a 30 percent loss, making a follow-up raid impractical.[35] The Allies moved on to other targets, and the Germans managed to quickly rebuild the facilities.

Evolving into a strategy to attack the entire Axis oil industry, the raid, despite its heavy losses, fueled an intense bombing campaign that managed to strike every major oil refinery in German controlled territory. Ambitiously, the United States and Great Britain set out to severely damage the German oil industry and keep it subdued. Like Ploesti, the Allies' goal was to reduce the German refining capacity as well as the number of refineries available to cannibalize in order to rebuild larger, more productive refineries.[36] They wanted to present Germany with only two options: transport the crude oil to old unattacked refineries near Marseilles, France, where they were highly vulnerable, or stay in their present locations and attempt to rebuild in between raids.[37] The Germans chose the second option, and the Allies timed return missions to prevent refineries from going back on line.[38] As German oil production suffered, so did its armed forces as lack of aviation grade fuel kept the Luftwaffe on the ground and forced the army to heavily dip into rapidly dwindling reserves.

The Germans failed to completely think the entire war effort through and suffered from inadequate fuel reserves. The German Oil Association advised the government that the oil reserves would only last for 5 months given the high rate of consumption. Germany made the reserves last a lot longer by robbing from the civilian sector, but the effects of the Allied bombing after 1943 made the situation critical. Germany's aggressions in 1939 and 1940 were rewarded with its victims' oil reserves. A US investigation following the war relates, "in January 1941 aviation gasoline stocks were approximately 500,000 tons. When Germany conquered the Netherlands, Belgium, and France, about 1 million tons were secured."[39] However, by January 1944, aviation gas had been reduced to 240,000 tons, and by January 1945, it was almost nonexistent.[40] By May 1944, fuel shortages resulted in drastic reduction in training hours, and operational time was limited strictly to air defenses.[41] The situation had become so critical that the Luftwaffe could provide little opposition to the Allied invasion on 7 June 1944. By 1945, it could not support German ground forces in the Battle of the Bulge after a successful ground offensive.

Germany's lack of fuel reserves also manifested itself in ground operations as the combined bomber offensive and the Allied advance prevented German recuperation. Following victory in North Africa and a successful invasion of Sicily, the Allies drove up the Italian peninsula until stiff German opposition along the Gustav Line halted their advance. The Allies initiated Operation Strangle from 19 March to 10 May 1944 to cut the Germans off from resupply and deplete their fuel reserves. Generally successful, Strangle did not dislodge the Germans, and Operation Diadem got underway on 11 May 1944 to increase German fuel consumption while reducing their resupply through interdiction.[42] Strategically, the Allies planned to dislodge the Germans while strategic bombing would prevent resupply in hopes they would run out of fuel.

Operation Diadem went according to plan, and by mid-May, 14 fuel depots had been critically depleted, and "the mobility of the entire army had been called into question."[43] German fuel was adequate to compensate for the defensive maneuvers necessitated by the Allied advance at the beginning of the operation. Yet, by early June, the effects of the campaign presented a very hard reality. The German armies had been in retreat for a week, and the American Fifth Army presented a constant threat.[44] Though this defense suited the mountainous terrain and the situation, it required a lot of fuel that the army did not possess. "By June 6, the army was making its moves piecemeal—a unit would move, exhaust its fuel, and wait for resupply."[45] Defensive maneuvers, the mountainous terrain, and movement at night saved the German Army from total defeat, but fuel's use in strategy and its subsequent effect on Germany strategy was enormous.

On 6 June 1944, the Allies launched Operation Overlord, and the invasion of Eastern Europe began. Original plans called for the Allies to steadily push the German Army toward the Rhine and then force surrender. However, after a massive aerial bombardment on 25 July, the Allies forced a gap in the German lines and then exploited it by pouring through armored divisions.[46] New tactical opportunities to quickly defeat the Germans presented themselves instead of the originally planned methodical push to the Rhine."[47] Patton's Third Army raced through southern France consuming an average of 350,000 gallons of fuel each day.[48]

By 7 August, the Third Army had exhausted its fuel reserves, though it managed to maintain the rapid advance for another 3 weeks. Fuel supply reached critical levels from 20 to 26 August when both the First and Third Armies, pursuing the retreating German Army, consumed an average of more than 800,000 gallons of gas a day.[49] However, the supply lines had not yet become so long as to be unmanageable by theater logisticians, and the Allies had enough fuel to enter Paris on 24 August.

Pre-invasion planning called for the Allies to halt and wait for the logistical network of communications and food pipelines. However, their shipping successes and rapid advances into Paris with little German resistance called for a reevaluation of the plan. General Bradley, commanding the First Army, was quoted as saying, "armies will go as far as practical and then wait until the supply system in [the] rear will permit further advance."[50] Basically, he proposed to move forward, taking as much ground as possible, until they ran out of gas. Once again, fuel requirements dominated strategic decisions and operational action.

Since World War II, POL has become increasingly important to keep an army going in the field. The past 50 years of technological advance have only optimized modes of transportation, not lessened the impact of fuel on strategy, tactics, and operations. While technological advances may reduce the amount of support equipment required for military operations and the size, lethality, or amount of munitions—all of which will further reduce lift requirements—similar advance is seen as unlikely for fuel. Arguably, fuel will remain the dominant logistics factor that limits strategic and tactical planning as well as actual operations for the foreseeable future.

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Logistics and Airpower
A Failure in Doctrine

Air Commodore Peter Dye, RAF

To an external observer, it must seem axiomatic that the delivery of airpower is entirely dependent on adequate logistics and infrastructure arrangements derived from and, in turn, sustained by the nation's technological and industrial base. In this regard, the individual weapons platform (and its crew) embodies the collective investment of both industry and the Services over a considerable period of time. As and when the first Eurofighter engages in combat, it will do so on the back of not only the single most expensive procurement programme in the history of the United Kingdom (UK) but also a comprehensive support and training programme across the aircraft's entire operational life that represents an equally large national investment.[1] The scale of this undertaking, as well as the evident difficulty in divorcing the air weapons from such complex support arrangements, is as much a defining characteristic of airpower as are *height, speed, reach, ubiquity, flexibility, responsiveness,* and *concentration.*

This all-embracing view of what comprises airpower is by no means novel. Many years ago, Sir John Slessor wrote that airpower "is a compound of air forces and all those things on which air forces directly or indirectly depend, such as a flourishing industry and Civil Aviation, a good meteorological service, secure fuel supplies and so on."[2] The Royal Air Force (RAF) doctrinal document AP 3000, in addressing the same question, consciously rejects the wider perspective in favour of what it terms a *purely military concept of airpower*.[3] When one reads on, it becomes clear this is not so much a more cautious appreciation as it is a narrow definition that focuses almost exclusively on the nature of air vehicles. This seems a debatable strategy, even given the seminal role of the manned aircraft in the creation of the RAF. It is the equivalent of the army describing its doctrine in terms of the tank or the navy, the surface ship.

The blurring of the distinction between aircraft and airpower permeates the remainder of AP 3000 but is particularly noticeable in the debate about airpower's relative strengths and weaknesses. AP 3000 explains that the characteristics of airpower can be divided into primary strengths (*height, reach,* and *speed*), secondary strengths (*flexibility, ubiquity, responsiveness,* and *concentration*), limitations (*impermanence, payload,* and *fragility*), and other considerations (such as cost and dependence on bases). According to Sir John Slessor, the simplest definition of airpower is "the use of the air to enforce the national will." Even if we substitute AP 3000's more pedantic description— "the ability to use platforms operating in or passing through the air for military purposes," it is difficult to understand how *height, reach,* and *speed* are contributory characteristics. They are, in fact, terms that help describe the lack of friction potentially available when operating in the air compared to the sea or land. In themselves, they do not and cannot define airpower and, equally, should not be thought of as strengths or, indeed, weaknesses. *Fragility* and *impermanence* may be regarded as the other side of the coin in that there is a reciprocal relationship between friction and fragility. To exploit the air, we need to develop and support, often at great distances, a level of technology significantly greater than that needed to operate at sea or on land in an environment that is intrinsically more hostile. Crudely put, reduced friction has been gained at the price of greater fragility. In fact, this is a truism across the entire operating spectrum of land, sea, air, and indeed, space.

The secondary strengths of *flexibility, ubiquity, responsiveness,* and *concentration* are in reality enablers—good practices for air forces in the delivery of airpower. This was certainly how Sir John Slessor saw them, sensibly adding mobility for good measure.[4] As far as the limitations are concerned and putting *fragility* to one side, it is possible to argue that *impermanence* is as much a strength as a weakness seeking discrete and proportionate military action. This

is why airpower is used so often as the weapon of choice by the United Nations and the North Atlantic Treaty Organization to achieve their policing and coercive aims. As to other considerations, the limitations represented by cost or *dependency* on bases seems to be about as relevant to the debate as recording the tank's vulnerability to attack helicopters in a discussion on the nature of land doctrine or stressing the high cost of nuclear submarines when examining maritime power.

In sum, AP 3000 takes an extremely narrow and confused approach to the question of what airpower is, while at times, the argument can appear defensive and self-serving. In the process, the opportunity is lost to focus on the enablers that permit air forces to deliver airpower. The result is a distorted emphasis on the weapon rather than the environment with little attention to the wider constituent components, particularly logistics. Why this has come about is not particularly important, although it could be that it derives partly from a belief the manned aircraft is in itself the embodiment of airpower (rather than the final link in a complex chain of processes) and partly from a historic aversion to any suggestion that the support area has a warfighting role. What is important, however, is the fact that warfighters have inflicted on themselves a definition of airpower that is largely divorced from reality.

So what is reality? The truth is that air forces, by their very nature, consume vast resources. It was Britain's wealth, industrial capacity, and technological development that enabled airpower to be exercised so effectively on the battlefield of the First World War. Without a ready supply or aircraft and trained aircrews

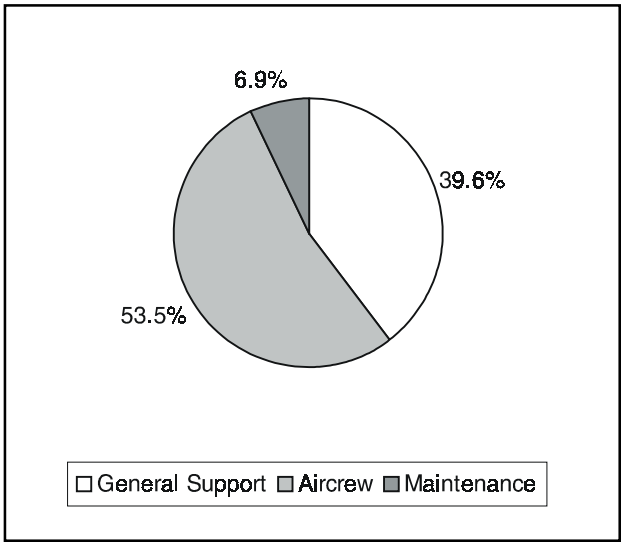

Figure 1. RAF—France 1918

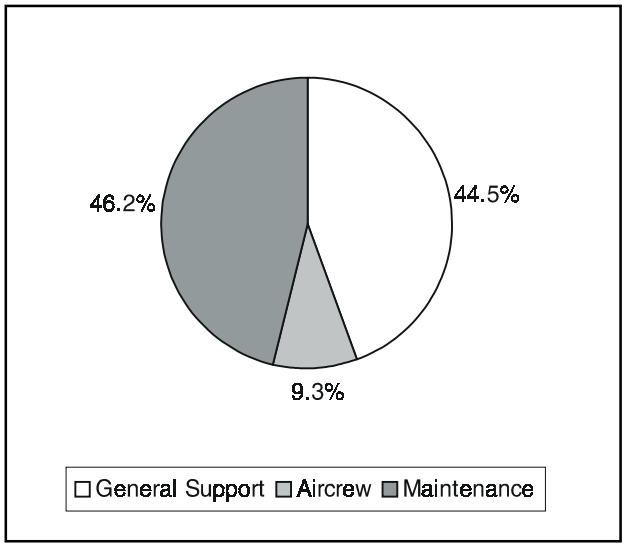

Figure 2. RAF—France 1944

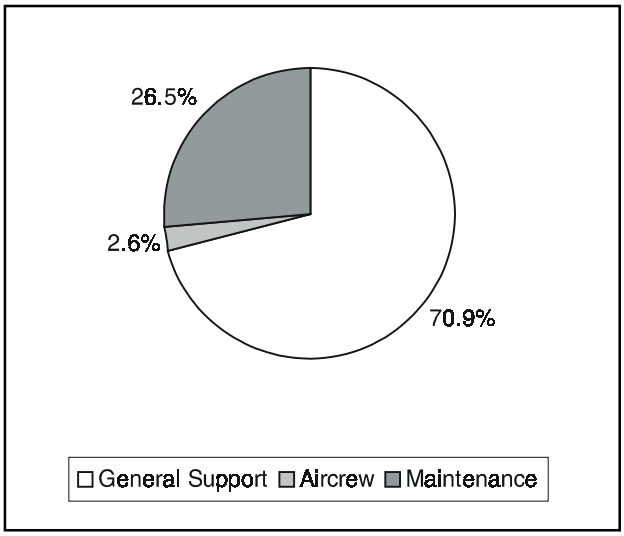

Figure 3. RAF—Gulf 1991

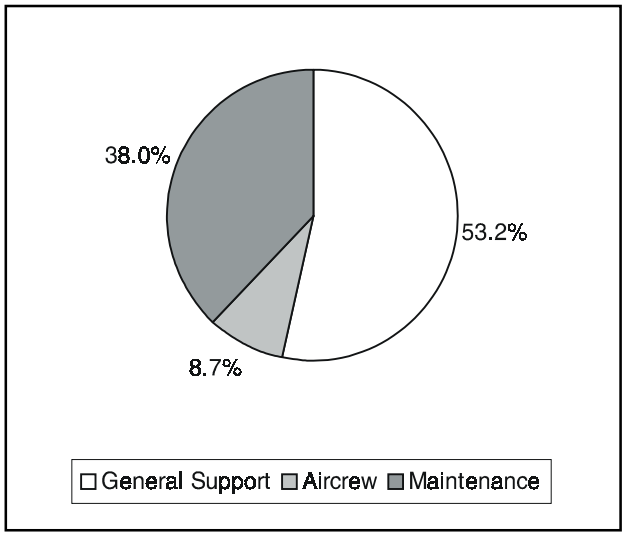

Figure 4. USAF—1991

and the infrastructure to support both, the RAF would have been stillborn. A vast and complex organisation was created at home and overseas to allow the air war to be prosecuted, in effect, linking industry to the front line. This was not a simple one-way pipeline but a series of complex, interrelated processes encompassing repair, overhaul, modification, testing, development, and training that saw materiel and manpower move continuously between the home base and the front line in response to technological advances and operational circumstances.

This picture of immense national collective effort, harnessed by the purpose of delivering airpower, is as true today as it was in 1918. If one looks simply at the human resources required to support aircraft in the field over the last 80 years, a familiar pattern emerges. The RAF deployed 54,000 people to France in 1918 and more than 87,000 to support the 2d Tactical Air Force in France and Belgium in 1944. The following graphs indicate how these operations compared with the Gulf War (including the US Air Force).

Interestingly, the number of direct maintenance personnel appears to have remained much the same, at about 10 to 20 per airframe. The higher support total in 1944 reflects the large numbers involved in airfield construction and the demands of a highly mobile campaign. Even allowing for errors of interpretation and the differing scale of individual campaigns, it is clear that airpower is and always has been a maintenance-intensive business.

This is equally true of supply. The RAF not only was the world's largest air force in 1918 but also possessed the largest range of stores ever managed by a single organisation. The total number of different items held in stock was in the region of 100,000. Simply organising the purchase and handling of this stock, in the vast quantities required to support the front line, was an achievement in itself.[5] In the intervening years, the challenge has become even greater as aircraft have inexorably grown in complexity. By 1945, the RAF was struggling with more than 800,000 separate line items, and at the time of the Gulf War, it was probably well over 1 million. Provisioning and storing this immense range of spares would be difficult enough without a high rate of modification action (even before the Tornado entered squadron service, more than 5,000 modifications had been approved, and the total is now probably closer to 15,000) and the overriding concern for airworthiness. In short, it is a task very different in scale and intensity to the management of the 25,000 different food items found in the average supermarket[6] and, incidentally, the 410,000 separate items held by Boeing to support the world's largest commercial aircraft fleet.[7]

Evidence for the broader interpretation of what constitutes airpower can be found by turning the question around and looking at the composition of an air force's center of gravity. Colonel John Warden, USAF, writing in 1988, argued that the enemy's vulnerability lies in the equipment chain, from manufacturing to employment, and other similarly interdependent systems such as fuel or pilot training. He noted that logistics (in this context, supply) might well constitute the real centre of gravity but also added that other targets (or enablers)—such as airfields, personnel, and command and control—might be suitable for attacks aimed at destroying an enemy's airpower.[8] This echoes Sir Basil Liddell Hart's assessment in 1934, when he noted that the large ground organisation of a modern air force was its Achilles' heel.[9] Interestingly, this was written before rearmament saw RAF expenditures reach some 35 to 36 percent of total defence spending (much of it on infrastructure) and an expansion programme that demanded the lion's share of the available manpower. By 1942, 750,000 personnel were allocated to the RAF and the Ministry of Aircraft Production alone, as great as the navy, the shipbuilding industry, the army, and the Ministry of Supply put together.[10]

A central characteristic of airpower—a thread that has run through the RAF's entire existence—is the provision of a sophisticated and comprehensive logistics system. This is not to suggest that repair and overhaul are somehow more important than any other activity undertaken by air forces. The fundamental point is that we should see airpower as the sum of a series of complex processes stretching over time and across organisations, including flying training stations, repair depots, and industry. In its current form, AP 3000 fails to provide this understanding and, in so doing, presents a flawed picture of airpower.

Why should this be a cause for concern? First, by focusing on the weapon system, we deny ourselves a balanced view of what comprises airpower. When difficult resourcing decisions have to be made, people are inclined temperamentally to favour platform numbers at the expense of enablers, such as combat support, training, and logistics. If the latter is not recognised as proper constituents of airpower, the continuity of experience that provides valuable lessons for support requirements cannot be exploited. Appearing to argue that fixed bases and complex logistics support arrangements weaken airpower is

confusing and creates the impression the logistics tail is something to be embarrassed about. The idea has been fostered, at least in the minds of external observers, that logistics and airpower are separate entities somehow enmeshed by inefficiency and outdated ways of doing business. As a result, there seems to have been a wider willingness to embrace efficiencies in the support area in the belief the risk is self-contained. That this is not the case has been amply demonstrated over recent years as the hollowing out of logistics has rapidly bitten in the form of falling frontline availability. The effective delivery of airpower is evidently not about teeth or tail; rather it depends upon how we managed the continuum that links the industrial base with the front line.

There is further danger, arising from this doctrinal confusion, in the softening of the distinction between operational and business logistics.[11] If the former can be separated from what comprises airpower, then it is a relatively easy step to conclude that the commercial world provides a template for how we should organise our support arrangements. This has particular implications for our ability to maintain the capacity for surge. Once resilience is perceived purely in terms of the overhead involved (because logistics processes are not an integral part of how we deliver airpower), it will inevitably fall victim to the pressure to cut costs.

Not surprisingly, business has little experience of reverse logistics (the flow of materiel back to depots for repair, modification, and reissue) and even less of attrition. All the evidence to date indicates that the ability to cope with surge is equally questionable, witness the well-publicised problems confronting Boeing. Having adopted a streamlined production process, optimised on the principle of *just in time*, the company discovered that it faced immense difficulties in attempting to double its commercial production rate to meet an unplanned and sudden increase in demand.[12] It was only by halting the production line and, incidentally, recording its first loss in 50 years that the situation was recovered. Not all the contributory problems were production related, but material and parts shortages played a significant role in exacerbating the situation. As one senior executive put it, "we did not have the resiliency to absorb a series of things that happened to us, none of which was individually big." A similar but less well-known incident occurred when a 29,000-ton forging press producing aero engine components in Houston broke down. This single failure threatened to disrupt not only engine production at three separate manufacturers but also final assembly at Boeing and Airbus. Off-loading work to competing companies was complicated because of dies and proprietary processes. Self-evidently, optimisation of the supply chain not only reduces the ability to respond to short notice requirements but also creates a greater vulnerability to *shock*. It is these very dangers that a military logistics system should be designed to counter.

Turning for a moment to a specific issue, it is fair to say the present ambivalence regarding the place of logistics in delivering airpower has made the argument for the retention of third line (depot-level) maintenance facilities more complicated than it should have been. With a clear commitment in doctrine to the principle of managing the logistics chain as an entity—from industry through the depots and on to the front line—there is a risk in seeing what should be a holistic process reduced to a collection of suboptimised and ill-focused activities. Aside from the obvious damage this would inflict on an organisation built around the efficacy of its logistics system, such an outcome would also deny the opportunity to develop the many potential synergies that exist across the support chain. All the evidence indicates there is considerable scope for innovative partnership arrangements between air forces and industry—*smart support* for want of a better phrase—once the role of in-house facilities and the wider place of logistics in airpower doctrine has been clarified.[13]

If technology lies at the heart of war, then the support chain lies at the heart of an air force. The processes and interdependencies that comprise this continuum can only be managed effectively in a holistic manner. Indeed, the Integrated Logistics Support concept, pioneered by the USAF and RAF, is based on this very principle. However, we need to move beyond optimising logistics support to developing a strategy that embraces the entire process, from industry to the flying squadrons, seeking to develop synergies and reduce vulnerabilities. To do this successfully will require the development of appropriate mechanisms and suitable metrics—the latter focusing on not only readiness and availability but also sustainability and resilience. Finally, we must examine how our airpower doctrine relates to the other Services and environmental doctrines and, in the case of logistics, with the integrated approach implicit in the decision to form the CDL organisation.

None of this is to argue that the RAF's logistics system can avoid change or that there is no scope for improvement. Business practices do have a place in the defence environment. The budgetary pressures that demand more effective ways of supporting the front line cannot be escaped. On the other hand, unless there is a proper understanding of how collective efforts contribute

to the use of the air to enforce national will, there is a risk of weakening this very ability in the name of greater efficiency. The aim should be at creating a robust and coherent airpower doctrine that transcends both aircraft and air forces.

Notes

1. The British share of Eurofighter development and production costs is reportedly in excess of £15B. However, the life-cycle costs will certainly match, if not exceed, this sum. (*Daily Telegraph*, 5 September 1998.)
2. Air Chief Marshal Sir John Slessor, *The Past Development of Air Power*, RUSI, 1986.
3. AP 3000, *Air Power Doctrine*, 13-17.
4. Sir John Slessor, *The Great Deterrent*, London: Cassel & Co., 1957, 259.
5. Beyond the immense increase in the output of airframes and engines, huge numbers of spares were provisioned. In November 1918 alone, the output of turnbuckles and bolts was 1.2 million and 10.5 million respectively.
6. On a typical day, some 3,500 lorries head for TESCO's 22 depots. (*The Times*, 5 November 1996 and 3 November 1997).
7. Boeing's Spare Parts Distribution Center has more than 410,000 different part numbers in a total inventory of more than 20 million items. (*Overhaul & Maintenance*, July/August 1966, 48-49).
8. Colonel John A. Warden, *The Air Campaign*, Pergamon-Brassey's, Washington, 1989, 34-38.
9. Sir Basil Liddell Hart, *Thoughts on War*, London: Faber & Faber, 1944, 54.
10. John Terrane, *The Right of the Line*, London: Hodder & Stoughton, 1985, 602-603.
11. *Logistics Spectrum*, Spring 1985, includes a thoughtful article on the difference between military and business logistics and, while agreeing that there has been some convergence, concludes that the disciplines retain unique objectives and characteristics.
12. Boeing, which was building ten 737s in early 1997, was producing 21 a month by early 1998 and was scheduled to be producing 24 every 30 days by the end of the year (*Aviation Week*, 16 March 1998).
13. The US Air Force has pioneered a similar approach under the Lean Logistics label.

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The potential effect of cultural differences in a culturally diverse workplace

Diversity?

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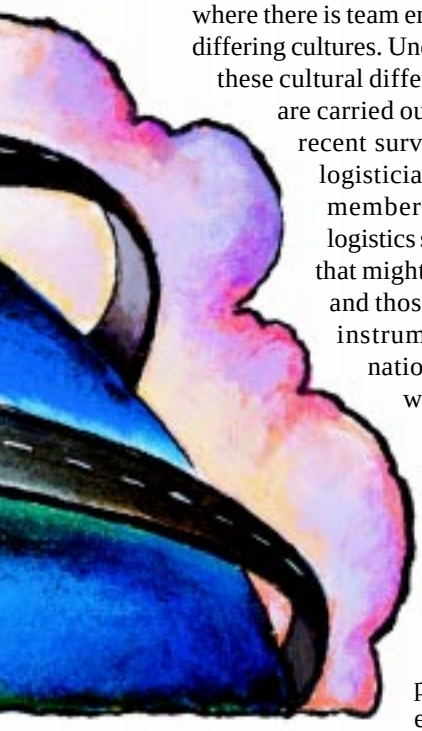
On the eve of the 21st century, the challenges facing organizations are quite different than they were just a few short decades ago—change has become more rapid and more complex. A recent survey revealed American managers feel that coping with this rapid change is itself the most common problem facing them and their organizations today.[1] Experts tell us that organizations are facing the specific challenges of global competition and see a need for organizational renewal, finding strategic advantage, maintaining high standards of ethics and social responsibility, supporting diversity, and managing the new employee relationships that emphasize empowerment and team.[2]

Each of the specific challenges mentioned above is impacted by culture. The way these challenges are addressed and resolved can differ significantly from culture to culture. The cultural differences that exist cause people to see the same problem from different perspectives, be motivated by different forces, and arrive at different solutions in resolving a problem. This can be especially significant in situations where there is team emphasis and members are drawn from differing cultures. Understanding and being able to adjust to these cultural differences can affect how the team duties are carried out and its mission accomplishment. A recent survey solicited the views of a group of logisticians from various countries, who are members of an international professional logistics society, to identify cultural differences that might exist between American logisticians and those from foreign countries. The survey instrument was designed to determine if national cultural differences could in any way be reflected in the respondents' conception of the *ideal* job, their internalized values, and the demographics of people in the logistics profession. An understanding of any culturally based differences gives organizations an opportunity to develop a proactive program for preparing its work force to operate effectively in various circumstances. This can reduce anxiety and frustration when dealing with an unknown and culturally unfathomable situation, and it should result in improved performance.



Logistics is an area that extensively utilizes information technology (IT) in the daily performance of logistics tasks. IT is a critical element in the control systems established by organizations to ensure effective performance and efficient use of resources. Advanced information technology has been defined as involving the generation, aggregation, storage, modification, and speedy transmission of information made possible by the advent of computers and related devices.[3] More simply, "information technology refers to any processes, practices or systems that facilitate processing and transporting information."[4] It has dramatically changed the way people perform their assigned tasks and interact with each other and how organizations are managed. Globalization has resulted in organizations having people and facilities located in many culturally diverse countries. Experts estimate that 25 to 50 percent of an employee's job behavior is culturally determined. Thus, culture does affect perception, performance, and understanding of job requirements. Managing cultural differences can significantly impact how effectively these culturally diverse team members mesh.

Culture is an extremely broad concept because it includes almost all socially learned behaviors. Much of the complex behavior of humans is inexplicable on the basis of innate proclivities and can only be explained on the basis of culture. Simply, culture can be defined as a set of shared ideas or customs, beliefs, and knowledge that characterize a way of life. Sir Edward Tylor, the 19th century British anthropologist, defined culture more fully as that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society.[5]

Culture is behavior learned from others rather than from individual experience. Culture is responsible for most of the personality traits that were once carelessly attributed to race. People become American, Irish, or Korean because they absorb the culture of American, Irish, or Korean society. A society is any organized group of people with a distinct identity, territorial area, and distinctive way of life (a culture). A society is, therefore, nothing more than a group of people with a common culture.[6, 7]

Culture evolves over time in response to the needs of society's individual members. Cultures are not accidental. They are composed of provisions for human biological, economic, and even psychological well being. Culture permits humans to adapt much more readily to various living conditions. Without the benefit of learning passed down from their ancestors, each new generation would have to reinvent societal responses to life's situations and problems. Human beings' almost total reliance on learned behavior, rather than on instinctive behavior, is what makes them different from and superior to other animals.[8] As time has passed, the patterns of life that we call culture have grown more complex and become the means of adapting to a wide variety of environments.[9] These are the learned behavioral patterns that people bring with them when they become members of an organization.

An example of how cultural differences in various societies are reflected in their respective societal value systems was provided in a 1993 study by Trice and Beyer. This study examined the distinctive national organizational cultures that have evolved and are currently typical of Japanese and American firms.[10] The differences that have developed resulted from history and geography. Japan's culture is based primarily on Confucianism and Buddhism. It has a history of protecting its borders from foreigners, which has led to homogeneity of the Japanese population and a fear and mistrust of foreigners. The United States, on the other hand, has been influenced by the Protestant ethnic, and it has had a history of open borders and heterogeneity. The diverse immigrant groups coming to America have brought with them their unique ethnic and national cultures.[11] Table 1 portrays these differences.

Culture at the organizational level is more complicated when a firm operates and draws its personnel from the global environment or finds its personnel working in concert with those of other organizations or nations in a team context on a joint, cooperative effort. The recent trend toward globalization of business makes it imperative that organizations recognize these national cultural differences. If an organization is to develop a strong, homogeneous culture, it must find a way to bring its employees under the umbrella of its own unique organizational culture and resolve initial disparities. Organizational culture has been defined as the sharing of philosophies, ideologies, values, assumptions, beliefs, expectations, attitudes, and norms that knot a community together. All of these interrelated psychological qualities reveal a group's agreement, implicit or explicit, on how to approach decisions and problems.[12]

Put a bit more succinctly, organizational culture is the set of shared values that control organizational members' interactions with each other and with suppliers, customers, and other people outside the organization.[13]

Culture at this level provides members with a sense of organizational identity and generates a commitment to the firm's beliefs and values that are larger than the employees themselves. Culture serves two very critical functions for an organization. First, it integrates members so that they understand how to relate to each other. Organizational culture guides working relationships, communications, what constitutes acceptable versus unacceptable behavior, and how status and power are allocated. Second, it helps the organization adapt to the external environment in meeting goals and dealing with outsiders.[15] Organizational culture is critical for the effective functioning of the firm.

In a seminal monumental 1980 study of more than 116,000 IBM employees by the Dutch social scientist Geert Hofstede, he discovered four basic dimensions along which work-related values differed across cultures: power distance, uncertainty avoidance, masculinity/femininity, and individualism/collectivism.[16] Later work by Bond resulted in a fifth dimension, the long-term/short-term orientation. Some of these terms need additional explanation. Power distance refers to the degree to which society's members accept an unequal distribution of power. Uncertainty avoidance relates to the extent to which people are uneasy with ambiguous and uncertain situations. Masculinity/femininity refers to how clearly culture differentiates gender roles, supports male dominance, and stresses economic performance. Individualism/collectivism focuses on the amount of stress put on independence, individual initiative and privacy versus interdependence, and loyalty to the group. Finally, cultures that have long-term orientation stress and emphasize persistence, perseverance, and thrift and pay close attention to status differences, while those that emphasize short-term orientation stress personal steadiness and stability, face-saving, and social niceties.[17] Hofstede used this information to produce some very interesting cultural maps that show how countries and regions cluster together in pairs of cultural dimensions. For example, Canada and the United States are close on the small power distance and high individualism dimensions, while Mexico falls into the area of countries with large power distance and low individualism. In another cultural map, Canada and the United States still tracked very closely together when all five dimensions were considered, and Mexico was still significantly different from them on all dimensions.[18]

Japanese Culture Emphasizes	American Culture Emphasizes
1. Collectivism & Groups	1. Individualism
2. Family & Respect for Authority	2. The Individual & Youth
3. Cooperation & Harmony	3. Competition, Conflict & Confrontation & Differences
4. Patience & Long-Term Results	4. Immediacy & Short-Term Results
5. Humility & Austerity	5. Self-Promotion & Material Wealth

Table 1. Japanese Versus American Organizational Cultures[14]

An important message that comes from Hofstede's cross-cultural study of values is that organizational behavior theories (leadership and motivation, for example), research, and practices from one country might not translate well to other societies, even ones in close proximity like Mexico is to the United States. For instance, managers from the United States and Canada tend to encourage a moderate degree of worker participation in job-related decisions. This represents the low degree of power distance valued in those countries. Attempting to translate this particular leadership style to other cultures, like Mexico, that value high-power distance might prove unwise and disastrous. In these high-power distance cultures, people would be much more comfortable deferring to the boss's decision. That would make it extremely unlikely that a very open and highly participative company like Ben and Jerry's Ice Cream could successfully translate its lower power distance approach to all its overseas locations. Similarly, in North America where individualism is stressed, focusing attention on one's own accomplishment is expected and often rewarded in organizations. On the other hand, in more collective South American or Asian cultures, individual success is downplayed, and it would make more sense to reward the group rather than the individual. Finally, in highly masculine cultures, the integration of women into leadership and management positions might require some special sensitivity and timing along with intensive training.[19] One of this study's findings regarding gender differences in the number of female professional logisticians represented in non-American versus American respondents illustrates the point.

Fifty-six percent of Americans believed people worked together when their joint contribution was necessary to accomplish the task, while 57 percent of non-Americans felt that people worked together because the collaboration was personally satisfying, stimulating, or challenging. This indicates that Americans are more task oriented while non-Americans are more relationship oriented. The second question related to legitimacy of control. Fifty-six percent of Americans believed it was legitimate for one person to control another's activities if the role prescribed that the person was responsible for and had authority to direct the other person. Among non-Americans, a majority could not agree on a single answer. Only 43 percent agreed that it was legitimate for one person to control another's activities if the person being controlled accepted the situation in the belief the help or instruction being given would contribute to learning and growth. The indication here is that Americans recognize formal authority related to role or position, while non-Americans recognize direction if the person accepts it voluntarily and perceives it as potentially personally beneficial.

Fifty-seven percent of Americans believed a good organizational member gives first priority to the task's requirements for skill, ability, energy, and materiel resources. Sixty-one percent of non-Americans agreed. The remaining 43 percent of Americans all thought that good organizational members gave first priority to the duties, responsibilities, and requirements of their role and the customary standards of personal behavior, while non-Americans were spread over all the other possible choices. So while Americans and non-Americans are basically in agreement on the importance of task, to Americans, role considerations are almost equally as important. The vast majority of both Americans (92 percent) and non-Americans (93 percent) agreed that the basis for any job assignment should be predicated on the resource and expertise requirements of the job to be accomplished. The differences here, however, occurred in that none of the American respondents thought personal wishes, learning needs, or individual growth should influence the assignment, while non-Americans believed neither the needs or judgment of those in authority nor the formal division of functions and responsibilities of the system should be considered. Finally, 61 percent of Americans believed organizational success comes to those who are technically effective and competent with an accompanying strong commitment to getting the job done. Fifty-two percent of non-Americans believed organizational success came to those who are effective and competent in personal relationships and have a strong commitment to the growth and development of people.

Question Stem Related To	Chi-Square Value	Mean
1. Good Boss	.364	.288
2. Working Together	.049	3.34
3. Purpose or Competition	.167	2.76
4. Organizational Conflict	.848	3.15
5. Decision Making	.848	2.78
6. Appropriate Control & Comm Structure	.133	2.91
7. External Environment	.567	3.00
8. Good Subordinate	.311	2.78
9. Good Member of Organization	.085	2.65
10. Treatment of Individual	.116	2.81
11. Control and Influence of Individual	.379	2.80
12. Legitimacy of Control	.046	2.73
13. Basis for Job Assignments	.084	2.94
14. Reason Work Performed	.966	2.62
15. Success in Organization	.087	2.71

Table 2. American Versus Non-American Beliefs

Table 3 contains the results of the analysis of the survey section on the ideal job. Thirty percent of non-Americans felt higher earnings were the most important characteristic of an *ideal* job, while only 19 percent of Americans felt the same way. Eighty-six percent of Americans felt that having sufficient time left for family or personal life was a very important characteristic of the job compared to only 67 percent of non-Americans. Of far more interest on this section of the survey is an examination of the top five ranked characteristics for each of the two groups. Both Americans and non-Americans placed challenging tasks, making a contribution, working relationships, and freedom to adopt their own approach to the job in the top five,

American			Non-American		
Characteristic	Chi-Square Value	Mean	Characteristics	Chi-Square Value	Mean
1. Challenging Tasks	.360	1.69	1. Make Contributions	.268	1.78
2. Make Contributions	.268	1.73	2. Work Relationships	.860	1.79
3. Time for Family	.098	1.84	3. Challenging Tasks	.360	1.88
4. Working Relationships	.860	1.89	4. Cooperative Workers	.315	2.01
5. Freedom to Adopt to Own Job Approach	.432	1.97	5. Freedom to Adopt to Own Job Approach	.432	2.03
6. Cooperative Workers	.315	2.08	6. Opportunity for Higher Earnings	.044	2.06
7. Opportunity for Higher Earnings	.044	2.14	7. Time for Family	.098	2.12
8. Employment Security	.294	2.22	8. Advancement Opportunity	.721	2.19
9. Job Variety	.603	2.25	9. Job Variety	.603	2.33
10. Advancement Opportunity	.721	2.28	10. Be Consulted	.842	2.45
11. Be Consulted	.842	2.41	11. Employment Security	.294	2.54
12. Help Others	.166	2.58	12. Good Working Conditions	.860	2.63
13. Good Working Conditions	.860	2.72	13. Help Others	.166	2.87
14. Serve Your Country	.187	2.83	14. Serve Your Country	.187	2.93
15. Work With Clear Directions	.729	2.92	15. Work With Clear Directions	.729	3.10
16. Little Stress and Tension	.434	3.23	16. Work for Successful Company	.254	3.15
17. Work for Successful Company	.254	3.38	17. Little Stress and Tension	.434	3.28

Table 3. Ideal Job Characteristics Rank Ordering

although their specific ranking differed to some extent. Americans did not rank having cooperative workers in the top five grouping, while non-Americans omitted having sufficient time for family and personal life. The most important characteristic for Americans was having challenging tasks to perform, but non-Americans believed making contributions was the primary characteristic. These findings are consistent with those in the values section where Americans leaned toward task and to a lesser extent role, and non-Americans were inclined toward self with some emphasis on task.

The results of the final section of the survey, which solicited demographic information from both groups, are presented in Table 4. Non-American logisticians classified their jobs as managerial in 82 percent of the responses, while only 56 percent of Americans stated that they occupied a managerial role. Again, this is consistent with the fact that many non-American cultures regard membership in a professional society, such as the Society of Logistics Engineers, as a prestige item, and firms will only sponsor and fund management personnel for such membership. Twenty percent of non-American respondents were employed in the logistics field for 6 years or less, while only 11 percent of Americans had this low level of experience. Additionally, non-American logisticians tended to be younger with 61 percent of respondents being 49 years old or younger, while 52 percent of Americans were older than that. A higher proportion of Americans, 92 percent to 83 percent, possessed undergraduate degrees, and 22 percent of Americans held a specialized graduate degree in logistics as opposed to only 10 percent of non-Americans. In summary, American logisticians were a little older than their foreign counterparts, but they were more experienced, had a higher educational level, and had more specialized graduate logistics training. They were also more likely to be female.

While there are a great many similarities between American and non-American logisticians in spite of their cultural dissimilarities, there are also some significant differences between the two groups. In order to highlight these differences and portray them more clearly and succinctly, Table 5 was constructed. The object here was to present the significant cultural values and beliefs, the key characteristics of the *ideal* job, and the important demographic dissimilarities in one consolidated table so a profile of the most important culturally influenced differences between Americans and non-Americans could be depicted and understood. The inventions, like information technology, that a culture has created or borrowed from other cultures are that culture's technology. Changes that occur

Category	Chi-Square	Degrees of Freedom
1. Gender and Marital Status	.022	3
2. Age	.490	5
3. Undergraduate Degree	.322	2
4. Graduate Degree	.267	3
5. Professional Certification	.148	2
6. Prior International Logistics Conference Attendance	.924	1
7. Managerial Status	.001	1
8. Type Organization Employed By	.579	2
9. Number of Years Employed in Logistics	.077	3

Table 4. Demographic Data

in the available technology can significantly alter the balance of forces that maintain an existing culture. Media technology has had a major impact on cultures around the world (for example, microchips and software). It has altered and extended sensory capabilities to communicate across time and over long distances. Media are defined as any technologies that extend human ability to communicate beyond the limits of face-to-face contacts. Media technologies influence people's perceptions about other cultures and members of those cultures they come in contact with through these media. Media-generated stereotypes have important consequences for the processes and outcomes resulting from intercultural communication.[20] Thus, individuals working in a team environment with those from other cultures could experience misperceptions, miscommunications, and misunderstandings because of existing cultural differences. The findings detailed in Table 5 show the differences between American and non-American logisticians that could lead to problems in implementation, utilization, and acceptance of IT initiatives and other types of operations within the organizational context.

The study confirmed that there are significant differences in orientation and motivation based on cultural values. For example, the study results were consistent with the widely held stereotype of Americans. This view portrays American culture as placing a strong emphasis on personal choice and achievement. Hence, Americans are seen as independent, aggressive, and focused on goal or mission achievement. The survey section devoted to values and beliefs demonstrated that task was the primary focus for Americans in all five areas. Thus, Americans seem to concentrate on task in order to ensure that the job gets done and the goal and mission are accomplished.

In contrast, many non-American cultures are stereotyped as placing the heaviest emphasis on the needs, demands, and accomplishments of groups such as families, clans, villages, or countries. In these cultures, the individual defers to the group and its welfare. The study is again consistent with this stereotype. Three of the five belief-and-value areas for non-Americans had a self-orientation with a fourth emphasizing task but with a self-aspect. It is important to remember that the self-questions were constructed so that self-considerations occurred in the context of relationships. Finally, Americans believe individuals should be rewarded and recognized on the basis of personal achievement. This would further explain the task focus results from the study. While some criticize this belief in reward for individual accomplishment and feel it has had a detrimental effect by pressuring people to compete for success, it has encouraged individual talents and skills that may not have been recognized or utilized in more stratified societies. More tradition-bound societies and cultures emphasize group reward for group effort. This, too, is consistent with the study results for non-Americans.

The study concluded that, although there are many similarities between American and non-American logisticians, there are also several culturally based differences. American beliefs and values are heavily influenced by their orientation toward task and to a lesser extent role, while non-Americans are more influenced by self and more minimally task oriented.

The American version of the *ideal* job focuses on time for family and personal life with only minor interest in the opportunity for higher earnings, while non-Americans reverse the emphasis.

American logisticians are more likely to be female, nonmanagerial, more experienced, and better educated than their non-American counterparts.

Successful organizations have learned to blend the values of the headquarters' corporate culture with those of nations

	Chi-Square Score	American Orientation	Non-American Orientation
Beliefs and Values			
1. Working Together	.049	Task.	Self.
2. Legitimacy of Control	.046	Role.	Self.
3. Good Organizational Member	.085	Task with very strong role emphasis.	Task.
4. Basis of Job Assignment	.084	Task without considering self.	Task without considering role or boss.
5. Organizational Success	.087	Task.	Self.
Ideal Job			
6. Opportunity for Higher Earnings	.044	Only 19% believe it a most important characteristic.	30% felt it a most important characteristic.
7. Time for Family or Personal Life	.098	86% said this was a most or very important characteristic.	67% said this was a most or very important characteristic.
Demographic			
8. Gender and Martial Status	.022	22% of respondents were female.	Only 4.5% of respondents were female.
9. Managerial Status	.001	56% were managers.	82% were managers.
10. Years Employed in Logistics	.077	89% for more than 6 years.	81% for more than 6 years.

Table 5. Summary of Differences

that host their overseas operations and from which they draw their personnel. This requires a delicate balancing act. The firm must export its overall corporate culture and philosophy and then tailor it to the local needs, customs, and values of a country. National Semiconductor, a US-based firm, has a very systematic technical decision-making process. However, in Israel, where it has a facility, the culture tends to be far more informal and collective than in the United States. Therefore, in its Israeli operation, the firm has developed a hybrid decision-making process. It is still very systematic, but it incorporates a team-oriented and participative style. This meets the overall corporate cultural need and also respects the existing societal cultural values.[21] This is not only a wise approach but also a necessary one. Culture can be changed, but it is not an easy process. A phenomenon called ethnocentrism makes it difficult. Ethnocentrism is the belief the customs and practices of one's own culture are superior to those of any other culture.[22] Thus, adapting the organization's culture to existing local cultural differences while maintaining its essential features is a far more sensible approach with a higher probability of success. As the study showed, cultural differences do exist and must be dealt with.

The results of the study indicate that the wisest course of action for any organization that operates in other cultures, has personnel assigned to work with members from other cultures, or has a culturally diverse work force is to explicitly recognize that cultural differences exist and need to be addressed. Personnel need to able to recognize, understand, and function in a culturally diverse environment. Specifically organizations need to:

- Provide information and training to personnel assigned to a foreign country or work directly with members from other cultures in a team environment.
- Be flexible and sensitive to how existing technology applications, procedures, and uses could affect, conflict with, or alter other cultures.
- Understand and view its operations in the context of the various cultures it or its personnel will operate within.
- Export its overall corporate culture and philosophy to operations in or its personnel participation within other cultures but deftly tailor them to the local needs, customs, and values of each culture within which it or its people operate.

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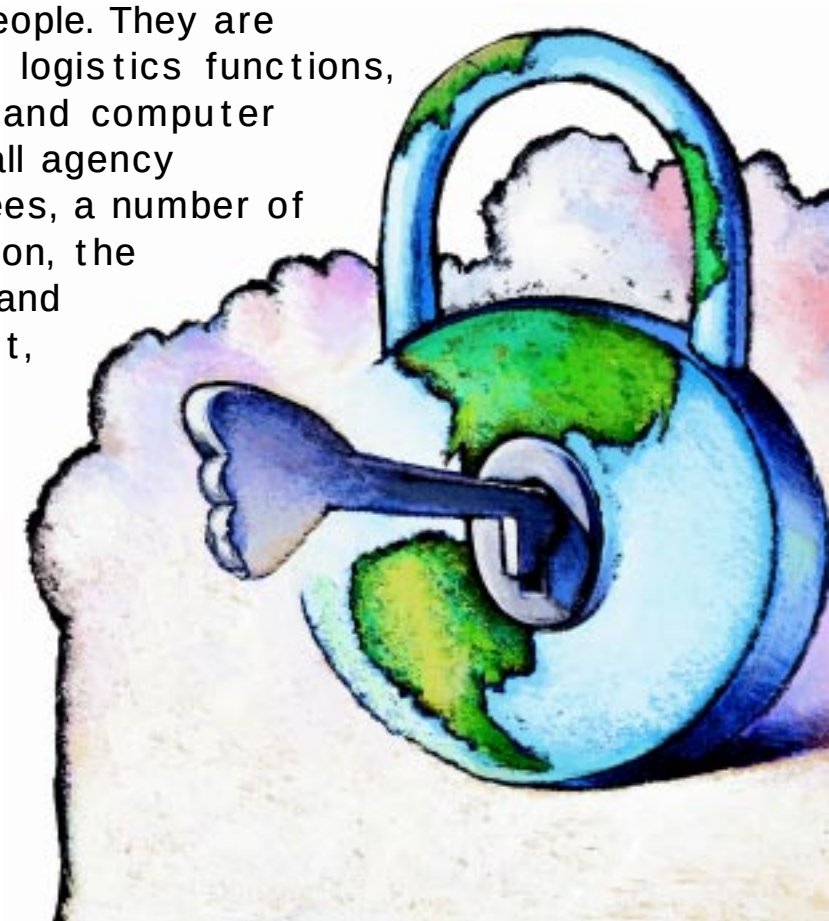
What is the Air Force Logistics Management Agency?

Using a broad range of functional, analytical, and scientific expertise, the Air Force Logistics Management Agency (AFLMA) tackles the Air Force's toughest logistics problems and produces solutions that improve both combat and war-winning capability.

The agency's mission is to increase Air Force readiness and combat capability by developing, analyzing, testing, evaluating, and recommending new or improved concepts, methods, systems, policies, and procedures to enhance logistics effectiveness and efficiency. The AFLMA's main goal is to solve today's logistics problems with a dedicated commitment toward shaping tomorrow's logistics environment.

AFLMA's key strength is its people. They are handpicked professionals from logistics functions, operational analysis sections, and computer programming shops. Virtually all agency personnel have advanced degrees, a number of which are doctorates. In addition, the AFLMA has state-of-the-art and leading-edge computer support, analysis, and simulation capabilities.



This combination of skilled people, advanced equipment, and analysis capabilities gives the agency the competitive edge in tackling the toughest Air Force logistics problems.

Air Force Logistics Management Agency