STRATEGY RESEARCH PROJECT

OPERATIONAL MOBILITY CHALLENGES: ENGINEERING SOLUTIONS FOR THE FUTURE FORCE

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ABSTRACT

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As the US Army transforms to the Objective Force, it must clearly analyze the missions it will be called upon to conduct, then establish the right doctrine and force structure to accomplish those missions. In the Army Corps of Engineers, there is a historically dominant mission set unlikely to change in spite of ongoing material and digital developments: providing mobility support. Current developmental efforts in this mission set are predominantly at Division level and below. Accordingly, force structure implications at these levels center around combat engineering. This study takes the position that, while it is extremely critical to ensure mobility support at the tactical level, this focus neglects a mission set that has far reaching operational and strategic implications; one based on providing operational level mobility. The Quadrennial Defense Review 2001 addresses the issues of anti-access and area-denial strategies that counter US force projection and operational mobility. This study takes a current view of how the Army gains operational mobility and contrasts this with evolving future Objective Force requirements, with the goal of identifying critical mission sets for which future engineer doctrine, force structure, and training, are required to adequately support the Interim and Objective Force.

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PREFACE

This paper is dedicated to the engineer soldiers, NCOs, and officers, with whom I have served, both in peacetime and in conflict, who taught me the art and science of overcoming obstacles, both literally and figuratively.

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OPERATIONAL MOBILITY CHALLENGES: ENGINEERING SOLUTIONS FOR THE FUTURE FORCE

OPERATIONAL MOBILITY – THE CONCEPT

The word "mobility" is defined by the Department of Defense as, "A quality or capability of military forces which permits them to move from place to place while retaining the ability to fulfill their primary mission. "[1] At the three levels of war, tactical, operational, and strategic, there are specific applications for this term. At the tactical level, mobility applies to a military forces' ability, either dismounted or using cross country capable vehicles, to move across various types of terrain. Traditionally, supporting forces such as engineers, chemical detection units, military police, and logisticians, ensure mobility. At the strategic level, mobility applies to strategic air and sea lift assets moving major forces thousands of miles around the globe to participate in any of the full spectrum of military operations required of our forces today. But what is mobility at the operational level? By itself, this term is not defined in joint or service doctrine per se, but a related definition for operational maneuver is found in US Army Field Manual 3-0, Operations (FM 3-0).

> Operational maneuver involves placing Army forces and resources at the critical place in time to achieve an operational advantage. ... Deployment and intratheater movements are operational maneuver if they achieve a positional advantage and influence the outcome of a campaign or battle.[2]

Accordingly, a possible definition for operational mobility is that it enables forces to execute operational maneuver. This may include operational level deployment, say, from an intermediate staging base (ISB) into a theater of operations. Alternatively, it may apply to the operational level maneuver of major formations within a theater, e.g. the repositioning of VII Corps forces into position for the subsequent envelopment of Iraqi forces during Desert Storm. The means by which the operational commander ensures operational mobility is through a combination of specialty units, skills, equipment, and various sources of support, both military and civilian. Terrain, existing infrastructure, mission, weather, as well as other considerations, all impact on the capabilities of these enablers. The operational level commander must account for these when tailoring his force to ensure it will be capable of executing operational maneuver. Tailoring must adequately balance the requirements for combat power with the enabling forces needed to make that power useable. The primary purpose of this study is to illustrate future challenges to operational mobility that both the interim and objective force face, and to propose desired engineering capabilities for the future force to ensure mobility at the operational level.

Evolving doctrine for the current force, as promulgated in FM 3-0, as well as evolving operational concepts for the interim and objective forces, rely heavily on operational mobility for success. Less attention has been paid to mobility at the operational level than to strategic and tactical mobility. Accordingly, a thorough analysis is needed to determine the desired capabilities and mission sets needed to provide mobility at the operational level. This study will provide that analysis, and proposes several engineering mission sets required for ensuring freedom of maneuver by providing mobility at the operational level, in both the current and future operational environments. The views presented here may be of use to engineer and other mobility supporting branches as they pursue branch specific campaign plans in support of Army Transformation.

OPERATIONAL MOBILITY – THE REQUIREMENTS

For many decades and many conflicts for almost the past 100 years, the US Army followed a familiar pattern in expeditionary warfare. Strategic deployment assets moved required forces to lodgment areas where combat power was built and prepared for decisive combat operations. After forced entry operations, where required, necessary logistical support was stockpiled and when adequately acclimatized, forces engaged in combat, being careful to maintain sufficient connectivity with the theater support base, or COMMZ (Communications Zone) for logistic support. Throughout the Cold War, this model was used as the primary mechanism for building forces in Europe to augment forward-deployed units in event of war. The Return of Forces to Germany (REFORGER) series of exercises illustrate this. More recent examples include Desert Shield / Desert Storm. In that war, the availability of friendly ports and airfields in Saudi Arabia allowed for strategic deployment directly into the operational area. Without these, the deployment would have been much more difficult, and taken considerably more time. It was fortuitous that the US Army Corps of Engineers assisted the Saudi government in building this infrastructure during the mid-1980s (out of concern for US options to respond to a possible Soviet attack on Iran, as one of the US contingency missions of the time).[3] During the build up of Desert Shield, over 96% of the sea cargo arrived via two ports, and 78% of the air cargo through five airfields, all in close proximity to the operational area.[4] The closest viable landing options outside the Persian Gulf were in the Red Sea, or using overland routes from the Mediterranean, both of which would have considerably lengthened the time required to build up forces.

While the existence of these ports and airfields greatly facilitated the strategic deployment, it was widely recognized after Desert Shield / Desert Storm that our national strategic lift assets were inadequate.[5] Since that time, the nation invested heavily in new equipment to support the strategic leg of a major deployment, both in the way of air and sealift. Likewise, at garrison troop locations and major transportation hubs around the world, massive investments are underway to upgrade military deployment support facilities, such as marshalling areas, railheads, ammo storage depots, port facilities, and runways. These are commonly referred to as Power Projection Platforms and Power Support Platforms.[6] The development and purchase of the C17 Globemaster aircraft adds greatly to our strategic airlift capabilities, and that capability stands only to expand as the Air Force recently announced the purchase of an additional 50 aircraft to the 135 already programmed.[7] The addition to the sealift fleet of Fast Sealift Ships and larger and faster LMSRs (large, medium speed ROROs, or roll on – roll off ships) over the years since the Gulf War greatly reduced the strategic lift shortfall. Newer and even faster sealift options are currently under development with the goal to enable even faster deployment times for medium to heavy forces, as called for in Army Transformation.[8] By the end of 2002, it is projected that the US will be able to call on over 80 ships and 9.6 million square feet of sealift platform.[9] Accordingly, while the speed of deployment by air, sea, or combination thereof, continues to improve, it is safe to claim that the US possesses, or will very soon possess, a very capable and adequate strategic mobility capability. This capability, however, continues to rely on the availability of friendly controlled airfields and seaports at the ports of debarkation (SPOD).

Since the Gulf War, many observers note that while the traditional deployment and build up model was successful during this particular war, the results could have been much different had Iraq opted to counter the build up. Use of conventional forces or weapons of mass destruction (WMD) could have easily denied access to the ports and airfields in Saudi Arabia. Indeed, one of the major lessons learned from the war by our potential adversaries is that the only way to defeat the US is to not let it build up forces in theater in the first place. Once established in theater, the lethality, precision, and overwhelming technology and firepower of US forces almost guarantees ultimate victory. "If US forces arrive in force, they win."[10] In recognition of this potential counter to one of our strategic advantages, the Under Secretary of Defense for Acquisition and Technology directed the Defense Science Board to conduct a study on Strategic Mobility in 1996. The results indicated that while war planners assumed a "smart" enemy on the battlefield, they were not adequately addressing potential enemy counters to US deployments at the ports of debarkation in theater.

> Combat force and combat support planners assume a highly capable opponent who is likely to take advantage of any weaknesses in our forces or support. ... In contrast, mobility planning tends to ignore even obvious threat capabilities to disrupt mobility flow. War plans are based on the most optimistic assumptions about flow through the ports, host nation support, and in-theater infrastructure to move forces and material from ports to tactical assembly areas.[11]

An even more fundamental finding was that doctrinally, there is an underlap between maritime and land force doctrine in assigning responsibility for force survivability during the final stages of a strategic deployment. The researchers found that US Transportation Command, TRANSCOM, only addresses survivability beyond 300 miles from shore in planning. While supported Commanders in Chief (CINCs) are supposed to address force protection and survivability from that point to land, little attention was evident in most theater plans studied until after forces had already landed and started RSOI (Reception, Staging, Onward movement and Integration). Joint efforts, in general, addressing RSOI, gave "scant attention to vulnerability, assuming instead the base case of uninterrupted flow."[12] While CINCs must address this issue in major warplans, the doctrinal disconnect still exists in assigning responsibility for overcoming anti-access and area-denial type threats to our operational deployments. For example, in the 1998 Defense Science Board report on Joint Operational Superiority in the 21st Century, it was noted that while the services were making great strides towards bettering our doctrine on how we fight jointly in the future, that "emphasis clearly needs to be on the bottlenecks in mobility flow – the first five days of receipt and loading at ports of embarkation and movement ***through theater ports to the Tactical Assembly Areas*** (emphasis added).[13] Ports of debarkation, both air and sea, are particularly attractive and vulnerable targets for enemy disruption. This becomes a far greater threat as potential adversaries develop fairly inexpensive counters to the last legs of our deployments. These could include naval mines, high-speed small boats with anti-ship missiles, and quiet diesel submarines, not to mention possible area-denial strategies including chemical, biological or radiological weapons, and perhaps even nuclear weapons. Potential enemies are also developing far greater access to intelligence on our movements through commercially available imagery, "over the horizon" radar, and sea or space-based sensors.[14] In spite of these obvious threats, there is little being done to develop strategies, tactics, techniques or procedures to overcome them. For example, even with the increasing threat of naval mining in both deep and shallow water, the development of reliable and timely countermine technology in all services is woefully underfunded, and development is lagging way behind requirements.[15]

Potential enemy action is not the only obstacle to deployment. Many areas of the world lack the sufficient capacities at their ports or airfields to support a deployment even a fraction of the scale seen during the Gulf War. ROROs, for example, require a 35' draft. The port in Albania has only a 26' draft, which limited deployment craft to Mediterranean ferries, coasters, and Army watercraft during Operation Allied Force.[16] Additionally, even for a mid-sized MRC (Major Regional Contingency), estimated sea-based logistics flow could reach 20,000 short tons (ston) per day.[17] This quantity requires a minimum of eight berths, a number found only in the world's larger ports. As an example, in such potential trouble regions such as Cambodia, Columbia, Croatia, Cuba, Djibouti, Equador, Eritrea, Libya, Qatar, and Slovenia, existing ports are insufficient to support a MRC sized deployment and the subsequent logistics flow.[18] Even in much smaller operations there have been considerable frustrations with inadequate port infrastructure, like during Operation Uphold Democracy in Haiti.[19] "The presence of adequate infrastructure varies widely around the world, and Army forces have been especially stymied in overcoming transportation infrastructure obstacles in support of recent operations in Somalia and Albania."[20]

Similar problems exist for the availability of suitable airfields. Not surprisingly, however, with the shorter runway requirements of the C17 (less than 3000 feet for combat operations, including dirt surface), there are many runways worldwide on which this aircraft can land. The issue is MOG, or Maximum On Ground, which indicates the number of aircraft that can load and unload without interfering with flight operations on the runway. Conservative estimates of 5000 ston/day by air for a standard hypothetical MRC requires a MOG of 14 aircraft.[21] Very few airfields have this sort of capability save the largest military or commercial international airports. A theater commander would likely have to find multiple different fields with smaller MOGs to support requirements, but in many of the world's regions, there simply isn't that much choice.

OPERATIONAL MOBILITY: THE CHALLENGES

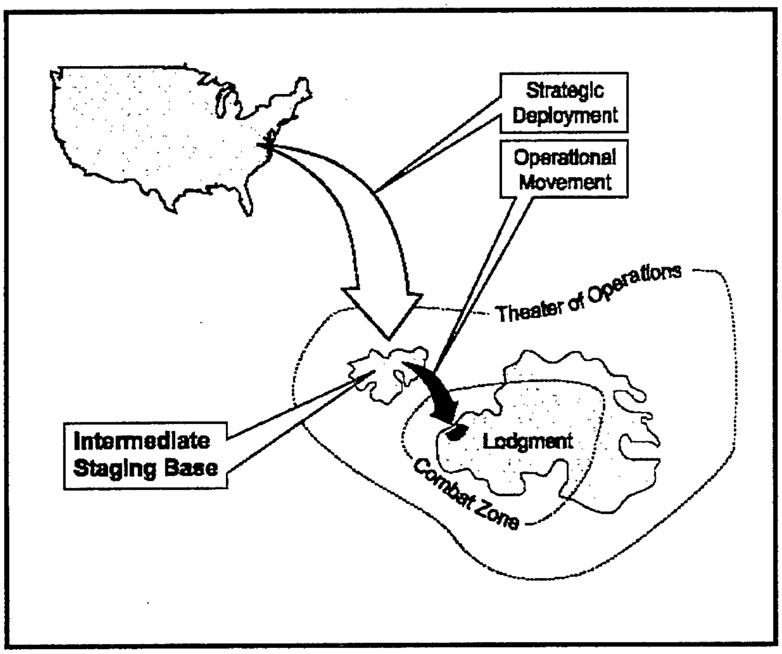
The challenges to the US Military's unquestioned advantage in force projection capability are indeed numerous and complicated. The recently published Quadrennial Defense Review (QDR) addressed the concern as one of the future force's six critical operational goals for transformation: "Projecting and sustaining US forces in distant area-denial or anti-access environments and defeating area-denial and anti-access threats."[22] A recent US Army War College publication recommends that force projection efforts "must also encompass improvements to bypass traditional ports of debarkation."[23] Evolving doctrine that applies to the current force, as well as the future interim and objective forces, addresses these challenges and presents scenarios that demand further mission analysis, especially by supporting forces. The most recent publication of these evolving concepts is the Army's new FM 3-0, Operations.

DOCTRINE

Chapter 3 of FM 3-0 is titled "Strategic Responsiveness". It likens the theater entry missions of future forces to those used in Panama: "When fielded, the objective Army force will achieve the strategic responsiveness necessary to conduct nearly simultaneous deployment, shaping and decisive operations in a manner similar to that of Operation Just Cause, but against more robust opponents."[24] Operation Just Cause used an operational technique called a "coup de main", an "offensive operation that capitalizes on surprise and simultaneous execution of supporting operations to achieve success in a swift stroke."[25] To accomplish a mission in this manner requires operational tradeoffs, particularly when deploying a great distance from home bases. "The art of strategic responsiveness requires that commanders balance the ability to mass the effects of lethal combat systems against the requirement to deploy, support, and sustain the units that employ these systems."[26] One can deduce that the deployment of even medium weight forces requires an exorbitant quantity of strategic lift aircraft that are capable of tactical level entry in order to carry out this approach to warfare. This technique also implies sufficient reception infrastructure in the operational area to receive forces at the rates required. As already noted, infrastructure is a significant shortcoming in many potential trouble areas around the world. Accordingly, the doctrine recognizes the need for alternative methods for gaining access to the operational area.

"The availability of ports, roads, and other assets affects the sequencing of units and tempo of entry operations. Force projection may require intermediate staging bases (ISB), in-theater lodgement areas (with associated intratheater movement capabilities), or joint logistics over the shore (JLOTS) operations."[27] An intermediate staging base, or ISB, is "a secure staging base established near to, but not in, the area of operations." They are established "outside the range of enemy tactical and operational fires and beyond the enemy political sphere of influence."[28] "Upon arrival at an ISB, a force conducts limited RSOI and configures for operations. The Joint Force Commander (JFC) can then project forces ready to conduct operations immediately into the area of operations (AO) ."[29] Figure 1 below shows an ISB relative to the theater geometry.

Figure 1: Use of Intermediate Staging Base (ISB)[30]



What the doctrine implies in this statement above is that there is still a need for adequate infrastructure in the AO to receive tactical airlift for medium forces in the quantities necessary to support a coup de main. Likewise, as the enemy always "has a vote", counter-actions can be significant. "Enemies possess the motives and means to interrupt the deployment flow. Threats to deploying forces may include advanced conventional weaponry, weapons of mass destruction, and various sea and land mines. Sea and air PODs (ports of debarkation) are particularly vulnerable targets since they are the entry routes for forces and equipment."[31]

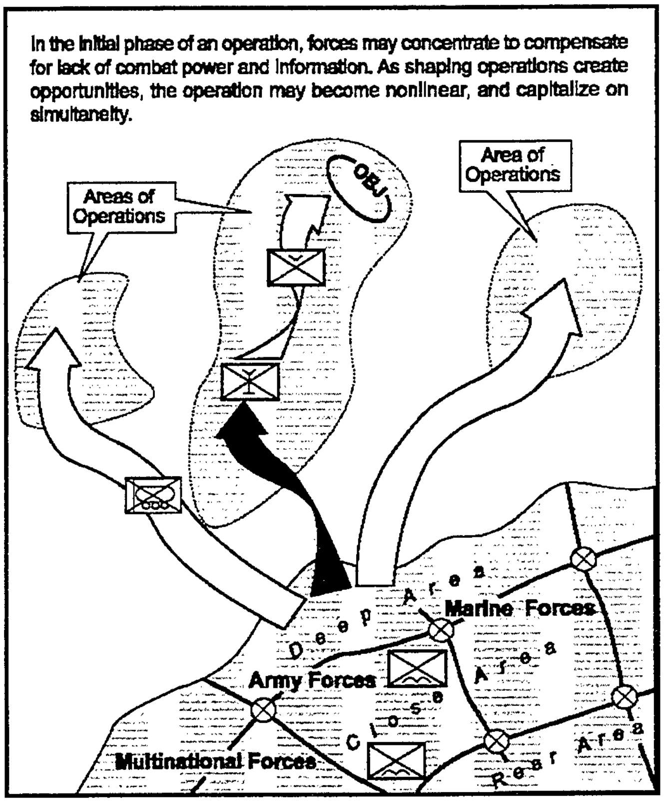
Some Objective Force employment visions anticipate entry operations entirely by air with such reduced logistics requirements that sustainment can also be conducted almost entirely by air, including by airfoils or balloons.[32] While future systems and aeronautical engineers are busily developing high-weight/volume aerial delivery systems that do not rely on fixed or rotary wing aircraft, current and near-term realities dictate that having access to ports (or secure rail) in a theater is absolutely necessary if the commander requires medium to heavy weight forces to accomplish his mission. Airfields alone may not be enough. "The volume steadily delivered by ship can often outpace the pieces delivered by air in terms of operational capability."[33] All these concepts must be taken into consideration in order to project the necessary quantity of forces and firepower to the right location in a rapid manner to overwhelm and overcome the enemy. To do so effectively requires addressing all the force projection characteristics: Precision, Synchronization, Speed, and Relevant Information.[34] As we look forward to the designs of the interim and objective forces in accordance with evolving doctrine, it is imperative that we envision how and where these forces will fight and what operational and tactical techniques they will use to be successful. We must also enable these future forces to feasibly be able to utilize these techniques. This requires a futuristic mission analysis of doctrinal concepts that identifies the required enabling capabilities, e.g. personnel, collective training techniques, specialized equipment, and concepts for employment, that must be shared across the joint community. This analysis no doubt has significant force structure implications which must be fully resourced and synchronized across the force, not only in the Army, but through our sister services, potential host nations, and the contractor organizations we have become accustomed to using during our nation's recent conflicts.

APPLYING DOCTRINE TO THE FUTURE ENVIRONMENT

While Chapter 3 of FM 3-0 does a superb job of addressing current and near-term operational considerations, Chapter 5 truly reaches "outside the box" of what we would consider traditional Army operational techniques. Most of the futuristic concepts described in this manual rely heavily on yet to be developed technological breakthroughs, particularly in areas of intelligence, mobility, force protection, sustainment systems, and most notably, an expectation that the future force will have greatly reduced logistics requirements. Returning again to the example of Operation Just Cause, the doctrine calls for simultaneity, using agility and depth to overwhelm the enemy by presenting him with "immediate consequences throughout the AO."[35] It notes, however, that achieving simultaneity will be difficult: "In practical terms, the force size and force projection constraints may limit the ability of Army forces to achieve simultaneity. Effective operational designs employ complementary and reinforcing joint and service capabilities to achieve maximum simultaneity."[36] This simultaneity also implies a distributed operation, as objectives will not present themselves necessarily in a linear or consolidated manner. In this non-linear or noncontiguous operational area, action may follow multiple lines of operations and communications, often not overlapping either physically or logically. On a practical level, this too implies operations which require a great amount of sustainment by air.[37]

Figure 2 below is a representation of the nonlinear / noncontiguous battlefield envisioned in FM 3-0.

FIGURE 2: Noncontiguous / non-linear Battlefield[38]



As can be seen in this figure, it will be possible that units will deploy into various different locations that are not connected to either each other or to a sea based port for sustainment. Unless fully secured along its entire length by friendly forces, it is also conceivable that many of these operational "islands" will not have access to sustainment by rail or surface either. This is where the doctrine notes that "LOCs (lines of communication) often diverge from lines of operations, and sustainment operations may depend on CSS moving with maneuver units or delivered by air."[39] This concept is perhaps meant to suggest large scale "LOGPACS" (Army term for a sustainment package brought forward to units), moved en masse with adequate force protection over land and/or by air to sustain these highly mobile forces. Success in this technique will not only require adequate numbers of combat forces to escort these land based re-supply formations, but will require excellent situational understanding, both of the enemy and terrain, in order to link up with the forces needing supplies. If attempted by air, re-supply aircraft may need to ingress and egress through enemy controlled areas, greatly complicating the effort. FM 3-0 states that, "Situational understanding, coupled with precision fires, frees commanders to maneuver against multiple objectives."[40] While these capabilities are essential for the success of the combat force, it should be obvious from this discussion that they are just as necessary for the sustainment units as well.

Even if initial entry forces are capable of carrying with them enough sustainment to last through the initial phases of an operation, eventually they will require some means of bulk resupply. Although the transformation effort has brought forth many technological advances (and promises many more), the physics of mass and weight are far from being overcome any time soon. Projectiles for weapon systems based on kinetic energy still require mass to be effective against enemy armor, and ammunition traditionally takes up a great part of the logistics flow. Mobile formations of even highly fuel-efficient combat vehicles will require fuel in quantities likely to exceed conventional aerial resupply methods. So eventually, in any land operation, sustainers must establish some sort of base within or very close to the theater of operations from where they can support combat forces. "For protracted operations, CSS personnel plan for and prepare the essential theater infrastructure to establish the support base. ... Improving the theater base capabilities may require early deployment of maintenance, engineering, or terminal operating forces."[41] As stated earlier, however, the threat against these point targets, especially from enemies with weapons of mass destruction (WMD) capability, limits the viability of this approach.

Clearly the future force must be capable of not only inserting its highly mobile, agile, and lethal combat forces in noncontiguous operational areas, but must be able to do the same with its logistics forces and supplies. While a challenging prospect, there are possibilities through currently accessible technologies to meet this requirement. Some of these are addressed in futuristic operational concepts found in the Defense Science Board proceedings. Others appear periodically in "think pieces" published in defense related magazines. While sometimes considered "science fiction", we know intuitively that some of these concepts will in fact become reality sooner than we think, as evidenced by technological advances in weaponry even since the Gulf War. But technologies by themselves are only one aspect of a capability. To be of true utility to a force, the technology must be integrated into or replace an existing system in an effective way, while not detracting from the overall capabilities of the force in general. If a new technology requires too much in the way of resources to be applied widely, or is too narrow in its application to be of general use, it is merely a good idea with little relevant application. Many of the concepts put forth in the futuristic literature fall into this category. Some, however, bear closer scrutiny, and with minor adjustments to how our forces currently conduct operations, may be useful in countering some of the area-denial and anti-access threats discussed thus far.

BACK TO THE FUTURE

One of the drawbacks for a potential enemy to using WMD for area-denial or anti-access is that these weapons are somewhat limited, both in quantity, and in the areas suitable for their employment. Returning to the coup de main concept, a rapidly deploying force can, by operating in a widely distributed manner, stymie enemy efforts in targeting the use of their limited WMD assets. Likewise, if mixed in and amongst the enemy's people, it is less likely to use WMD which might threaten large portions of its own populace in order to attack US forces (not true, unfortunately, for some of our potential foes). In order to avoid enemy area-denial or anti-access strategies in anticipation of a US deployment, our future forces must be able to make full use of more austere and smaller facilities to support both initial entry as well as protracted sustainment operations. The Defense Science Board notes, "Deployment and sustainment equipment must change. Ability to deploy in underdeveloped areas under unfavorable conditions must improve."[42] As almost all parts of the world have numerous small and austere facilities, a potential enemy would be overwhelmed by the task to deny all of them simultaneously. Forced entry operations by combat forces is a capability the US military already possesses and will certainly maintain throughout transformation and beyond. While the ability to conduct forced or initial entry operations with forces heavier than our current light or airborne divisions is getting the most attention in Army Transformation, the same ability for the follow on sustainment effort is equally important. Some new concepts offer interesting possibilities.

Three new concepts for deploying and supporting forces in an anti-access or area-denial environment are explored in this study. While there are many more in the literature, these offer the most promise in alleviating problems associated with sustaining medium forces once landed. One uses airfoils to deliver high weight cargoes from a distance, another explores high speed theater sea lift for use at multiple "over the shore" applications, and the third looks at Super Short Takeoff and Landing, or SSTOL aircraft. For these to be viable in the environments described thus far requires both service and joint adjustments to existing logistics and engineering capabilities, both in equipment and personnel. Unfortunately, there are no "magic bullet" solutions with zero impact on force structure or force mix to these very real problems.

AIRFOIL RESUPPLY

The airfoil concept was proposed in the 1998 Defense Science Board document on Joint Operational Superiority.[43] It envisions a capability to resupply forces via large, remotely piloted airfoils or lightly powered variants (like ultralights), which can traverse up to 50 kms from point of release. Theoretically, these devices can carry up to a 10,000 lb. payload (about one third the capacity of a C130), making them ideal for dense supplies such as ammunition, water, or fuel. Just as a point of reference, 10,000 lbs. is same as 1200 gallons of water, 1500 gallons of fuel, or 460 cases of MREs (meals, ready to eat). Depending on climatic factors, it is feasible that as few as five of these devices a day would be sufficient to sustain an 1800 man brigade for short periods (main variable being rate of fuel and ammunition consumption). Use of these devices would greatly reduce exposing limited theater lift aircraft to risk during ingress and egress for sustainment runs. While they cannot entirely replace theater airlift, they can significantly augment it. There will be times, for example, when weather precludes their use. Back haul of delivered systems is also a consideration, as well as evacuation of wounded or critical maintenance requirements. But during periods of time when the mobile force does not have access to a theater lift capable airfield, these airfoil systems can fill the gap for inbound requirements. In spite of many drawbacks, this idea is worth exploring. Not addressed in the concept is how these devices are to be put aloft. This will likely have force structure implications, not just for the soldiers and units to operate these devices, but for the infrastructure preparation required for their use, both at launch and reception ends. For example, a land based launch system might consist of a long straight track and a tether attached to a tractor to get the airfoil up to altitude before releasing. The landing sites need be nothing more extravagant than what light construction engineers currently construct for LAPES (Low Altitude Parachute Extraction System) zones (a capability no longer organic to Divisions other than the 101st Air Assault or 82d Airborne Divisions). This assumes that the guidance systems can steer the device to the landing site and land without damage to the cargo.

THEATER SUPPORT VESSEL

Another developing concept is the Theater Support Vessel, a fast sealift ship designed for short distance trips that can operate in austere environments.[44] This ship is of most utility where the operational area demands that sustainment flows through the enemy controlled littoral, but also has application where the littoral is in a friendly or neutral third country. All these areas are generally subject to enemy interdiction or sabotage (e.g. if we used ports in Pakistan for overland sustainment to forces currently operating in Afghanistan). The ship's draft requirement is only 13 feet, which means it can load and offload in a wide variety of smaller ports, or even at a typical fishing village wharf. It carries 1250 stons and up to 350 soldiers at speeds exceeding 40 knots. Download time is less than 1 hour, assuming cargo is rolling stock. Sustainment ships of this type can land at any number of unprepared piers, or only slightly enhanced shore facilities, making potential enemy anti-access efforts at countless locations in his own littoral a daunting task. Sustainment operations can be synchronized to link up these resupply ships with land based reception forces at multiple locations simultaneously, for short periods in time and space, after which the landing locations can be surrendered back to neutral, or even enemy, control. While it is more efficient and desirable to maintain continuous control over a fixed port or landing site, using this technique removes this as a requirement. Using this multiple landing site technique for resupply allows for adequate sustainment without continuous access to secured port facilities. This can suffice until the overall mission and control of the AO advances to the point where the force can afford to develop a less temporary approach to its sustainment throughput. Fortunately, this vehicle already exists commercially, and new militarized versions are approved for inclusion in TAA (Total Army Analysis) 09.[45] What is left unstated in this concept is how supplies and equipment move inland from these hasty landing locations. Additionally, while these ships can utilize austere ports, they are large vessels and the discharge points and land ingress routes will likely require preparation work. The equipment and personnel for this work can be sea or land based, but must be able to complete preparations quickly as to not lose the element of surprise and unpredictability. Intelligence and reconnaissance assets must prepare the battle space for these operations, from both an enemy resistance and infrastructure support point of view. Both these aspects require some adjustments to current force structure and mission sets to enable this technique.

SUPER SHORT TAKE OFF – LANDING AIRCRAFT (SSTOL)

The third emerging capability is super-short take off and landing, or SSTOL aircraft. Studies have shown that the lift and leg (distance) capabilities of aircraft increase significantly if allowed even a short runway of 600' on which to land and take off, vis-a-vis a vertical landing aircraft such as a helicopter or vertical take off and landing (VTOL) craft, such as the Osprey.[46] Accordingly, it is likely that, if developed, this would be the aircraft of choice for the future, as it would enable the lift and sustainment of medium weight forces directly into the operational area. The ability to land in 600' or less opens up a wide variety of options, from local crop dusting airfields to suitable stretches of improved surface roads, to serve as initial entry airfields (this is about one-third the required runway length for a C130 Hercules). For heavier loads, it may be necessary for initial entry forces to install an arresting device on an improvised runway. Most significantly, the "capability to land on unprepared landing sites enables access to more landing sites than the enemy can afford to target," greatly reducing the area-denial and anti-access threats.[47] As with the littoral example, these landing areas are not likely to be used for any great length of time, as the maneuver forces receive their supplies and move on. While rugged, it is unlikely that these SSTOL aircraft can land on totally unprepared surfaces. Most concepts for the Objective Force only include a small engineer capability to enhance mobility, with no organic earthmoving or construction capability in its primary fighting formation, or the Unit of Action (roughly equivalent to today's battalion or brigade).[48] The ability to rapidly improve the airfield or roadway surface necessary to enable SSTOL operations, as well as the rapid establishment of the required MOG platforms, is an engineering mission set for the Objective Force requiring further development.

IMPLICATIONS FOR ENGINEER FORCE STRUCTURE AND CAPABILITIES

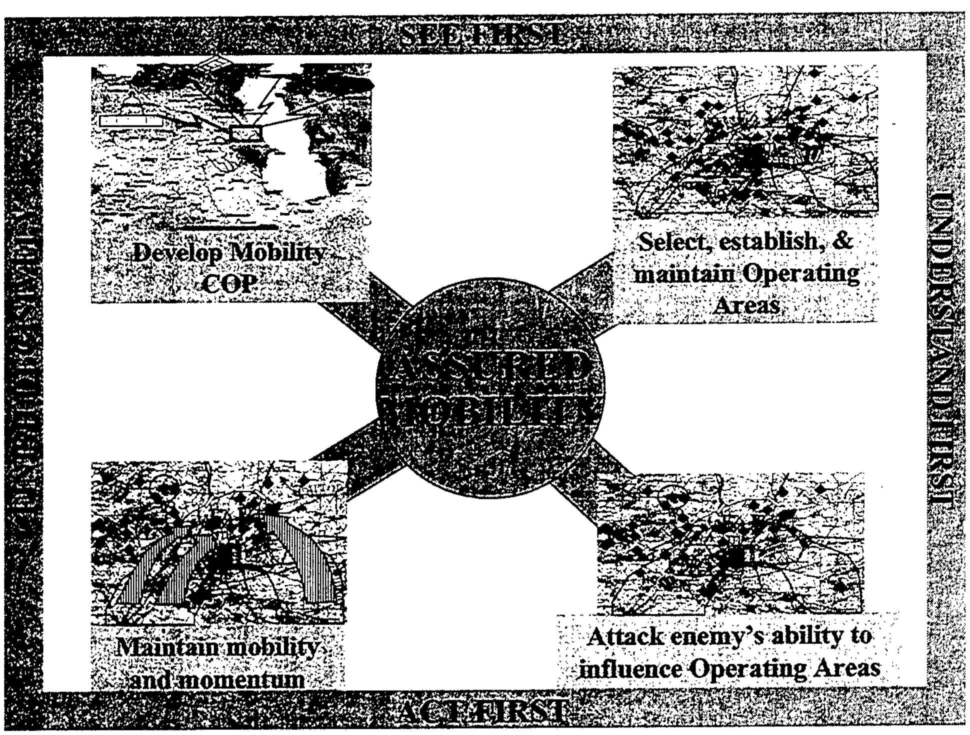
The preceding sections of this study address some of the operational mobility requirements of future warfare in a non-linear, non-contiguous environment, with deployment and combat operations occurring simultaneously. Many enablers from different battle operating systems are under development to make this concept a doctrinal reality. In the area of military engineering, new enabling capabilities must be identified or existing ones enhanced. The Army Corps of Engineers is responsible for engineer training, doctrine, force structure, and development for the existing force as well as the future one. In his strategic guidance to the branch, while serving as the Commandant of the U.S. Army Engineer School, the current Chief of Engineers, Lieutenant General Robert Flowers, instructed engineers that, "Even with changes to our structure, equipment, and technologies, our core functions of battlefield engineering and infrastructure support remain central to our missions."[49] These are indeed the core competencies of the branch, although infrastructure support has been emphasized less over the past fifteen years. The focus instead has been on heavy divisions, the Combined Training Centers (CTC), and combined arms obstacle breaching, which dominates the branch's doctrinal and training efforts, material development, and intellectual energy.[50] An exception to this has been operationally mandated developments in peacekeeping and stability / support operations to support engineer missions in Bosnia and Kosovo since 1995. Meanwhile, forces most suited to theater construction and maintenance of critical infrastructure have either been eliminated or moved to the reserve component. Even in smaller scale contingencies, such as Bosnia and Kosovo, the major construction work was completed by Logistics Civil Augmentation Program (LOGCAP) contract engineers, primarily Brown and Root, rather than military engineers. While this approach has reaped great benefits in the way of efficiency and cost, it is becoming apparent that it is feasible only in permissive environments. It is unlikely to be useful, for example, in Afghanistan, for quite some time, if ever.

This metamorphosis of the branch over time, for good reasons, as well as external factors not relevant here, has resulted in a military engineer force of general sappers. While these combat engineers have a wide variety of capabilities for multiple missions, they are primarily focused today by Mission Essential Task Lists (METL) on emplacing and breaching obstacles. Obstacle capabilities are indeed getting very advanced, with the advent of scatterable mines, area-denial weapons (such as HORNET and RAPTOR, wide area munitions with the capability to detect, discriminate, and attack targets), and eventually the ability to switch minefields "on and off". This aspect of military engineering has received great emphasis, and development of future systems to provide these capabilities are well in hand. There are also improvements in the works for tactical bridging capabilities, enabling units to cross multiple dry and wet gaps with minimal specialized training. Digital terrain support, both product and dissemination, is a growing field that has been greatly emphasized and is rapidly advancing. There are also mission equipment sets being developed for use in stability and support operations where friendly forces require area mine clearing capability. All these are necessary capabilities, both now and in the future, but they do not address the additional operational mobility mission sets anticipated in the future operating environment. Specifically these include infrastructure support required to provide the deploying force multiple and simultaneous entry locations, mobility throughout non-contiguous operations areas, and continuous rapid sustainment requirements.

MISSION ANALYSIS

To provide force mobility at the operational level, US forces must be able to overcome area-denial and anti-access techniques meant to defeat our strategic advantage of force projection. As many of these techniques assume that US forces will follow the predictable methodology of seizing a number of large APOD and SPOD (aerial and sea ports of debarkation) facilities, we must develop an operational strategy that avoids these bottlenecks. This strategy must be feasible for both combat forces and the sustainment efforts that follow. It must take advantage of our superior intelligence collection capabilities that feed situational understanding. It must be rapid, applicable in a wide range of geographies and operational areas, and mobile. It must take 'coup de main" to the next level, with the ability to rapidly place forces and their sustainment into the operational area in multiple locations simultaneously, to confuse, overwhelm, and defeat the enemy's ability to resist. Forces of the future must be equipped to land in smaller packages across multiple locations and use superior digital connectivity to link up either forces or effects. These entry operations and the following sustainment LOCs cannot succumb to the dangers associated previously with similar operations, i.e. the large scale airborne and glider insertions of OPERATION MARKET GARDEN in WWII. This picture of future warfare is not unique, and many senior Army leaders discuss it as the natural next step in our capabilities.[51] Credit belongs to the US Army Engineer School for attempting to formalize these and similar concepts into a vision for support that enables future Interim and Objective Force operational mobility. BG Randy Castro, Deputy Commandant of the Engineer School at Fort Leonard Wood, Missouri, is developing a concept called "Assured Mobility". It addresses some of the issues raised in this study. At Figure 3 is a recent version of the "Assured Mobility" concept briefing.[52]

FIGURE 3: Engineer School Concept of Assured Mobility



What specifically does a force capable of this look like and how do engineer forces organize to support it? While the following discussions address what may seem to be tactical techniques and procedures, they are appropriate to discuss if the current force structure does not have the capability to perform them. If accepted as desired capabilities, they then become requirements that must be thoroughly developed, with all the implications across doctrine, training, leader development, organizations, material, and soldiers (DTLOMS). This is clearly an operational, if not strategic, action for the Army's senior leaders, who set the course and azimuth for the Army as we move towards Transformation.

ENSURING MOBILITY FROM THE AIR

Operational or strategic maneuver from an ISB, or directly from the APOE (aerial port of embarkation), via air into the operational area, requires airfields with sufficient capacity to support the size force required for the operation. In the non-contiguous battlefield, this force could be as small as a company, or as large as a division, but the most likely sized force is a brigade. This aligns with most published versions of the Objective Force Unit of Action. After forced entry operations by airborne, Ranger or special operations forces (SOF), if needed, the airfield must be rapidly improved to provide the required throughput capacity. As noted earlier, with the right enabling technologies, it may be possible to make use of very short primitive runways or stretches of improved roadway for initial landing operations. If reconnaissance indicates that locations have been denied through area-denial or anti-access techniques, such as area mining or Chemical, Biological or Radiological (CBR) contamination, then the force can bypass these for alternate ones, provided it has adequate in-flight planning capabilities. For minimally denied locations, engineers must quickly make whatever repairs are necessary to enable insertion of follow-on medium forces via air in SSTOL aircraft, followed by more robust improvements to enable C130 and C17 landings. Most critically, engineers must emplace matting, or other surface preparation material, to provide the required MOG for the operation. Landing zones must be prepared for airfoil resupply operations if conventional aircraft corridors become too risky. This is all in addition to the traditional tasks of constructing force protection or survivability positions, employing obstacles for countermobility, providing mobility, and initiating general engineering tasks to support the initial force lodgment. All this capability must be mobile, as the force may choose to quickly relocate to a new position based on METT-TC (mission, enemy, troops, terrain, time, and civilians-on-battlefield). Potentially, early on in operations there will be no ground LOCs, and based on the concept of the operation and the capabilities of the future force, there may never be. Accordingly, engineers moving with the force must be capable of repeating the tasks above, on order, with materials on hand or found in theater, anywhere the commander takes the force. The force may maneuver to locations with existing airfields or suitable roadway strips, or these facilities may have to be made entirely from scratch. Either way, the engineer force must enter the operational area with these rapid construction capabilities and retain them with the force as it maneuvers, ensuring the force does not lose its ability to maneuver for the lack of an aerial resupply capability. Alternatively, a special engineer task force can move ahead of the maneuver force, via air, to emplace the necessary resupply facilities and protect them until link-up with the maneuver force takes place, after which it moves on to the next anticipated location. This technique has the disadvantage of limiting a commander's maneuver options and diluting combat power due to split force protection requirements. Whichever way the engineer capability is used, it is certain that the future force must maintain this capability for any mission environment, suggesting at least some of this capability should be organic to the engineer force that either belongs to or habitually supports the maneuver brigade. At a minimum, this capability could be provided through a modular engineering enhancement package from a higher echelon that is routinely exercised in training, similar to what is already practiced in XVIII Airborne Corps and US Army Europe (USAREUR).[53]

Several engineer organizations capable of providing a good part of this capability already exist, i.e. the 618th Light Airborne Equipment Company, at Fort Bragg, NC. New ones need development within the Objective Force framework. Current airfield matting is heavy and cumbersome. A new matting capable of rapid transport and emplacement needs to be developed. The same is true for a rapid spot runway repair or stabilization for an existing airstrip or roadway. Maximum use should be made of new advanced lightweight materials, as well as strong expanding fillers such as polyfoam. Construction equipment must be lightweight and mobile, yet capable of moderate earthwork. Not having a mobile engineer capability such as this creates significant mobility risk for any force. Even the US Marines, whose current Light Armored Vehicle (LAV) equipped medium forces somewhat resemble the Army's interim brigades, were tied to the existing airfields in Afghanistan in the initial operations there in late 2001. Camp Rhino was set up on the first airfield seized by the Rangers, and the Marines occupied the main airport in Kandahar. If the Marine's mission required maneuver across the plains of Afghanistan as an autonomous force, it would need the capability to construct its resupply airstrips as it went, a capability both it and the Army does not currently have in sufficient quantities in its active force. Our observant future enemies will learn this lesson from our current conflict, just as they learned of our strategic mobility vulnerabilities from the Gulf War.

ENSURING MOBILITY FROM THE SEA

As with the airfield examples above, the availability of existing ports for entry operations that are suitable for our large strategic lift ships steaming directly from SPOE (sea port of embarkation) is questionable in this new environment. Accordingly, use of ISBs, with the final leg of deployment handled by Theater Support Vessel (TSV) type craft, will allow multiple and distributed landings at most any small pier, breakwater, or beach. Selecting landing locations must be a joint effort between the maritime component, with its combat and geographic intelligence of the littoral, and the land component, with its land knowledge of enemy situation, overland routes, and operational distances. For initial entry operations, traditional amphibious landings may be required (Marine mission most likely, but not solely), followed by the landing of a ground force that moves in-land to an operational area, which may or may not maintain physical contact with the landing area. Accordingly, unless otherwise feasible, it may not be necessary to hold the original landing area under friendly control. Only when logistics support packages are required does the force need to reopen landing areas, be they Logistics Over The Shore (LOTS) operations or via small existing ports. Based on the enemy situation, a ground force and sustainment force can link up at predetermined locations to conduct resupply operations. By frequently changing locations and schedules for these supply operations, the force can thwart enemy attempts at area-denial or anti-access strategies. For this to work, however, the landing area must meet the physical requirements of the TSV, both in the surf area and in the trafficability of the routes away from the shore in-land. Local conditions can be verified by ground reconnaissance using Army or Naval engineers before the site is activated. Likewise, the force traveling to the supply link up must have adequate mobility, force protection, and combat power to fight through enemy controlled areas while maneuvering to and from the link up sites. It must also have the engineering capability to make final site preparations to facilitate the supply landing operation. This could include anything from clearing vegetation or rocks on the beach line to reinforcing a small bridge that leads away from a small fishing pier. These general engineering tasks could be provided by forces that travel with the ship based resupply unit or by the ground forces conducting the link up. This suggests then that standardization and operational agreements need to be made between Army and maritime component engineers who might be involved in such operations. This particular type of operation will most likely be joint, and some of these considerations are addressed in the Joint LOTS manual, although service interoperability is not readily apparent in its text.[54] Doctrinal responsibilities between maritime and land components at the land-sea interface are not well defined in the joint literature either, and must be designated by a joint force commander.

Engineers attempting to make use of small, existing port facilities should be augmented with limited vertical construction capability (mechanics, electricians, and carpenters) to take maximum advantage of existing facilities and equipment, i.e. cranes, forklifts, etc. Once the enemy situation is under control, forces may decide to take over larger ports and resort to more traditional SPOD operations. If these facilities are denied however, at least initially, the capability is needed to overcome that denial by choosing multiple landing sites that are more immune to enemy efforts at area-denial and anti-access. This concept is only feasible, however, if we build the right kind of engineering capability into the force to make it work.

ENSURING MOBILITY IN DOMINANT MANEUVER

Operational maneuver in the non-contiguous battlefield will take forces over unfamiliar terrain where the only reconnaissance may have been electronic. Regardless of the degree of situational awareness or understanding that our digitization is likely to gain for us, the physics of terrain and obstacles, natural or manmade, will continue to plague maneuver forces for the long term. While some capabilities exist in engineer units to provide maneuver forces the mobility they require to accomplish missions, in general, research and development is far behind in generating or delivering systems capable of countering emerging threats, such as area-denial or anti-access strategies.[55] Unfortunately, overly optimistic faith in the new situational awareness systems and the presumed enhanced mobility of the future combat system vehicle fosters an Army wide naivete about these challenges. A recent engineer commander, who led the engineer unit digitization efforts at Fort Hood, Texas wrote:

> "Unfortunately, the assumption used in the Army After Next process has been that combat vehicles will be 'perfectly' tactically mobile; that is, they will not require engineer assistance to cross or breach natural and man-made obstacles. Such an assumption is patently absurd. Pursuing this assumption for too long will lead to retarded development of engineering capabilities to support the future battle force."[56]

This is the challenge engineer force developers and combat systems analysts are attempting to meet at Fort Leonard Wood, Missouri. Unfortunately, funding does not permit many concepts to get to the development stage. The engineer branch's projected share of the Army's R&D budget through FY06 is 6/10ths of 1%.[57] Serious work needs to be done, for example, in the area of rapid theater bridging and route and area demining, in addition to enhancing the systems that currently provide mobility, countermobility, and survivability capabilities to the force. While "the breach" through prepared enemy obstacles with over-watching fires will continue to be the most difficult, dangerous, and risk laden mission engineers perform, it will become the least likely choice of maneuver for our future forces. Mapping, marking, and dissemination are likely to play far more important engineer roles. Engineer force structure, training and intellectual focus, must expand to include these other more likely missions that ensure mobility throughout the spectrum of challenges anticipated in the non-contiguous battlefield.

One possible approach to ensuring mobility throughout the non-linear battlefield is to establish Engineer Task Forces. While the combat forces introduced into an operational area focus on enemy objectives, Engineer Task Forces would focus on the enabling objectives that ensure mobility and freedom of maneuver for the overall operational mission. These forces would have a wide variety of engineering capabilities, built on modular component units from echelons above division (or the Unit of Employment for the Objective Force). As they would potentially operate independently in the operational area from the primary combat forces, they would require adequate combat power for force protection, and be able to attack and destroy enemy forces blocking access to key mobility targets, i.e. airfields, port areas, bridges, tunnels, or key rail facilities. Their mission would be to ensure operational level mobility for the greater force by anticipating maneuver and sustainment flow requirements, and upgrading existing facilities to handle the flow. They can also sweep or mark anticipated maneuver corridors for mines and unexploded ordnance, especially in operational areas where these obstacles are pre-existing from previous conflicts. This is a large consideration, as over 72 countries worldwide currently have mines in the ground from current or past conflicts.[58] These places are by nature the most likely locations US forces will deploy to in the future if we can judge from the past decade. For this operational concept to become feasible, we must increase research and development for countermine technology, both in detection and neutralization. Many advances have been made in these technologies, and the US Army already possesses a first generation set of countermine equipment suitable for area demining in low direct threat areas, but not in quantities sufficient to support a large force operating in a country like Afghanistan, for example. An Engineer Task Force, equipped to accomplish a wide variety of operational level mobility and survivability missions across the wide operational areas envisioned in future warfare, becomes an enabler for operational mobility. This reflects a return to the core competency of the Corps of Engineers espoused by its Chief: battlefield engineering and infrastructure support.

CONCLUSIONS AND WAY AHEAD

This study attempts to portray one vision of the future operating environment of the rapid, mobile, lethal force being developed by the US Army through Transformation, and the challenges the engineer force will face in providing operational mobility. Potential enemies realize from examples of this past decade that, while US forces are becoming more mobile and lighter than their Cold War era forbears, they still rely on the presence of ports and airfields for entry and subsequent sustainment operations. Accordingly, they realize that an effective defense against such forces includes area-denial and anti-access strategies to prevent US forces from gaining a foothold in the operational area to begin with. This is the basic thesis of this study, and it concludes that an engineering capability organic to the future force is essential to overcoming evolving US operational mobility vulnerabilities. Distributed operational level force insertion and distributed subsequent sustainment is an effective way of bypassing our traditional reliance on existing ports and airfields. To facilitate this technique, however, requires an enhanced engineer capability; designed, equipped and trained to provide the operational mobility that our future forces require to be successful. While future force designs call for a much reduced logistics requirement and an enhanced inherent mobility capability for each new combat system, there is a physical limit to such reductions and enhancements. This mandates that the enduring missions of battlefield engineering and infrastructure support will continue to be an engineer core competency and an overall force necessity well into the future of both the interim and objective forces. The mission sets described here are new not in kind, but in application. Their implications for engineer force structure are not radically different from that already described in current engineer literature. But the implications for the overall force's viability if it does not embrace the challenges of operational mobility, is perhaps a new concept, and could, if shared properly, provide the impetus for a more robust and appropriate inclusion of engineer force considerations in the interim and objective force designs. It is clear to most engineers that failure to incorporate these capabilities into our future force will lead to the potential failure of that future force. Since the beginning of warfare, engineers have cleared the way, and it is unlikely that new concepts in warfighting or new technologies will ever make that mission obsolete.

Word count = 8966

ENDNOTES

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[12] Ibid., 54.

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[22] U.S. Department of Defense, Quadrennial Defense Review Report (Washington, D.C.: U.S. Department of Defense, 2001), 30.

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[24] DA, Operations, 3-4.

[25] Ibid., 3-53.

[26] Ibid., 3-14.

[27] Ibid., 3-34.

[28] Ibid., 3-56,57.

[29] Ibid., 3-58.

[30] Ibid., 3-56.

[31] Ibid., 3-55.

[32] Author's notes from DARPA Visit, USAWC Transformation Course Trip, 5 February 2002. Details "non-attribution."

[33] DA, Operations, 3-44.

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[35] Ibid., 5-45.

[36] Ibid., 5-46.

[37] Ibid., 5-49.

[38] Ibid., 6-55.

[39] Ibid.

[40] Ibid., 5-50.

[41] Ibid., 12-16.

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[43] Defense Science Board 1998 Vol II, 18.

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[45] Ibid.

[46] Defense Science Board 1998 Vol I, 78.

[47] Ibid.

[48] DARPA trip.

[49] Major General Robert Flowers, "Prioritization Paper for Engineer Future Capabilities," 18 June 1999; memorandum for the engineer branch in the "One Voice" papers distributed electronically and available from <http://www.wood.army.mil/eschool>; Internet; accessed 16 December 2001.

[50] Based on author's personal experience as a former divisional engineer battalion commander and a two time attendee of ENFORCE (1999 and 2000), the annual Engineer School conference attended by senior engineer officers intended to synchronize doctrine, training, and focus across the branch.

[51] The ideas in this section are based on remarks made by various speakers participating in the USAWC Commandant's Lecture Series.

[52] Brigadier General Randy Castro, "Objective Force CONOPS: Assured Mobility," 7 Nov 2001; available from <http://www.wood.army.mil/eschool/CofC/Assured%20Mobility.ppt.>; Internet; accessed 14 January 2002.

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[55] Prevailing view from unidentified engineers and scientists at various Army research facilities visited in February 2002 by the author as part of an Army Transformation study trip.

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