Logistics Distribution: Key to Operational Success

A Monograph
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ABSTRACT

Logistics Distribution: Key to Operational Success by Lieutenant Colonel Jerome Johnson, USA, 53 pages.

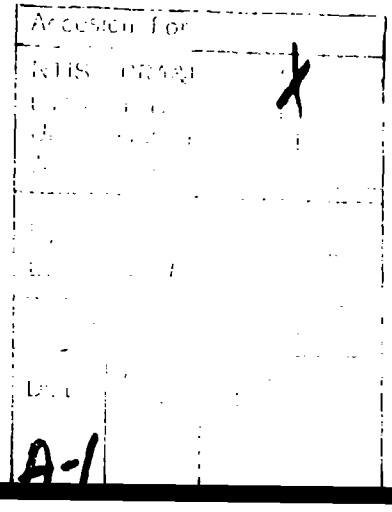
This monograph examines the extent to which logistics distribution influences operational art. The thesis is that distribution is the essential element of logistics that facilitates operational art and that secure lines of communication (LOCs) and infrastructure are the essence of the distribution system.

Theoretical, doctrinal, and historical criteria are used to analyze secure lines of communication and infrastructure to test the thesis. The analyses show the relationship they have to operational art.

These findings have several implications for operational art. LOCs and infrastructure represent real world limitations that coordinated operational and distribution planning can minimize. Secure intratheater and intertheater LOCs are essential requirements for combat operations. Securing LOCs may reduce the number of forces available for operations. Additionally, the time spent securing LOCs gives the enemy the opportunity to improve his combat preparation. When considering branches, operational planners must prepare for unsecured LOCs or the loss of LOC security during the campaign. Operational planners must also ensure the infrastructure can support the concept of operation. This is difficult, but is an essential process. Units essential to the distribution of support must be among the first to deploy in a major regional contingency.

Our army has changed from a forward-deployed to a power projection force. As a result, the importance of distribution is increasing and LOC security will be an absolute requirement. Theory, history and doctrine support this requirement. Furthermore, there is a need to increase forward-deployed logistics bases to provide infrastructure necessary to receive and distribute forces being projected into theater during a crisis. Finally, prepositioned stocks will become increasingly important for a contingency force with a strategy of power projection and crisis response.

The requirement for an effective logistics distribution system is the essence of logistics support to operational art.



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I. Introduction:

It is a historical fact that nations fight wars to secure national goals. When a nation goes to war it uses all possible ways and means to obtain its desired ends. This encompasses all elements of national power -- economic, diplomatic or political, technological, and military. Military power is but one part of national power and its use should be planned in conjunction with other elements of national power. At the strategic level the use of military power consists of planning and conducting war by the employment of the armed forces of a nation to secure strategic military objectives that support national policy by the application of force, or the threat of force.[1]

Success in war is determined at the operational level. As such, the operational level is perhaps the most crucial level of war to understand. It is the link between the strategic goal and the tactical battle. "The focus at this level is on operational art -- the employment of military forces to attain strategic goals in a theater of war or theater of operations through the design, organization, and execution of campaigns and major operations."[2] The employment of military force requires deliberate planning and organizing units for sequential action. "Operational art seeks to ensure that commanders use soldiers, materiel, and time effectively to achieve strategic aims."[3] The resources necessary to execute operational art are provided by the logistics system.

"Logistics is the process of planning and executing the movement and sustainment of operating forces in the execution of military strategy and operations."[4] It functions at all levels of war. At the strategic level, logistics is an inseparable component of national

strategy and is primarily the purview of the Department of Defense (DOD), non-DOD government agencies, the Services, and the private sector of our economy.[5] Strategic logistics focuses on mobilization, acquisition, force projection, and strategic mobility; it provides the linkage between the nation's economic base (people, resources, and industry) and its military forces.[6] At the operational level, logistics is the linkage between the strategic and the tactical level and has as its primary focus reception, distribution, and management of materiel, movements, terrain, personnel, and health services.[7] It includes those support activities required to sustain the force in campaigns and major operations.[8] Tactical logistics is the synchronization of combat service support (CSS) activities required to sustain soldiers and their weapon systems, and has as its focus the essential elements of support for tactical units and systems (manning, arming, fueling, fixing, moving, and sustaining).[9]

As our strategy changes from forward-deployed to power projection, the importance of logistics increases significantly. The distribution system -- with its complex of facilities, installations, methods, and procedures designed to receive, store, maintain, issue, and move materiel to using activities and units -- represents the heart of any logistics system.[10]

Effective and efficient distribution of logistics requires secure lines of communication (LOCs) and infrastructure.[11] They are what allow the movement of an item from port of debarkation or intratheater source of supply to the user's location. Without them, units would be limited to the extent of their on-hand stocks. "Lines of communication are all the routes (land, water, and air) that connect an

operating military force with a base of operations and along which supplies and military forces move."[12] "Infrastructure consists of the facilities, equipment, and framework that are needed for the functioning of a system, city, or region."[13] Infrastructure functions include establishing mechanisms for acquiring necessities such as shelter, food, water, sanitation, and postal services; setting up a system to acquire host nation assets; and making physical improvements.[14] Both LOCs and infrastructure must be considered by the commander when preparing to conduct combat operations. Commanders must assess the availability of seaports, airfields, power networks, road and rail networks, communications networks, natural fuel reserves, warehousing, water, and food sources.

This monograph examines the extent to which logistics distribution influences operational art. The thesis is that distribution is the essential element of logistics that facilitates operational art and that secure lines of communication and infrastructure are the crucial elements of distribution. The thesis is analyzed with theoretical, doctrinal, and historical criteria. Following the analysis with these criteria, the next section discusses the resulting implications for operational level planners and a power projection force. The final section concludes the monograph with specific recommendations.

II. Lines of Communication Analysis:

Open roads, canals, railways, and air and sea routes are necessary for the distribution of assets essential to combat operations. Many campaign plans have hinged on the commanders' ability to distribute supplies from a base of operations to their maneuver units.

Failure to keep routes open will result in decreased distribution of necessary sustainment to the force. Different modes of transportation can augment each other, depending upon availability of assets, the threat, and terrain. The options for lines of communication are air, ground, sea, or inland water routes that may further result in a choice of interior or exterior lines of support. Regardless of the preferred option, plans for altering the lines of communication are a necessity.

Interior lines radiate outward from a central point or area behind the supported force. This rearward centralization allows more efficient utilization of limited assets through increased integration, consolidation, and rapid shifting of logistical resources. However, it also increases the opportunity for enemy interdiction, since the lines of communication are consolidated at central points and only split during offensive operations.

On the other hand, exterior lines converge from several points in the rear toward a centralized point directed at the enemy. Exterior lines require increased infrastructure, basing facilities, ports, and transshipment points to sustain the force. However, the enemy will have more difficulty in interdicting this sustainment structure because of multiple lines of communication.

Altering lines of communication can result in a dangerous interruption of support during an operation, if not comprehensively planned. The decision to alter a line of communication must be weighed with the impact on current operations. The distribution system requires flexibility and altering lines of communication is necessary and should be practiced, planned, and integrated into the campaign plan.

II. A. Theory:

Many military theorists provide definitions of logistics that show the importance of distribution and lines of communication. Jomini calls logistics the "art of moving armies."[15] Carl Von Clausewitz defines it as "maintenance and supply."[16] These classical military theorists agree that secure LOCs are a prerequisite to military operations. Though their experience is based on eighteenth and nineteenth century armies which required only a few items of supply and frequently lived off the land, both understood the importance of LOCs.

According to Clausewitz, armies sustained themselves by four methods: supplies furnished by households, requisition by the troops, general requisition and depots.[17] However, he also noted that some things, such as replacements and munitions, could come only from the army's home: "Communications with the homeland are essential."[18]

Jomini also rated secure LOCs among "the principals of points relating to the movements of armies," and noted that they "serve as means of communication of the army with its base."[19] Jomini was careful to underscore the importance of LOCs to bases and operations. Several of his theoretical points are linked with them. The most prominent link is made between LOCs, bases, and objectives. As Jomini stated: "The great art then, of properly directing lines of operations, is to establish them in reference to the bases and to the marches of the enemy as to seize the communications of the enemy without imperiling one's own."[20] He implies that the source of all

combat power and the capability of sustainment come from the base and the lines that carry replenishment.

Jomini and Clausewitz also indicate the importance of LOCs in their writings on strategy. They assert that LOCs should be objects of strategy. The idea is the protection of friendly LOCs and the attack of enemy LOCs. Jomini, in discussing strategy, emphasized maneuvering to "more readily seize his communications."[21] Clausewitz wrote that an army's LOCs "must not be permanently cut," and that disrupting or cutting the enemy's LOCs is the objective of enveloping or turning movements.[22] According to the theorists, bases should be established in the theater so that advantageous lines can be established with objectives. Following this logic, lines will exert great influence on the location of bases and objectives. Jomini calls this linkage (lines between bases and objectives) the "most difficult problem in operational art."[23]

Today's armies are far more complex than in Jomini's and Clausewitz's time. Logistics requirements have changed. Armies are more dispersed, require a broader spectrum of support, and have significantly increased mobility. Modern armies have a wide variety of equipment, requiring different munitions, fuels, lubricants, and repair parts. The importance of LOCs has not diminished. Indeed, B. H. Liddell Hart, a modern theorist, suggests that secure LOCs are even more important for modern mechanized forces. "The larger an army and the more complex its organization, the more prompt and serious in effect is a menace to its lines of communication."[24] The essence of Liddell Hart's indirect approach is gaining the enemy's rear, for both the physical and psychological impacts. Another modern theorist, Rear

Admiral Henry E. Eccles, makes the point that, "Arrangements and movements (logistics distribution -- LOCs and infrastructure) are the foundation of all military operations."[25]

II. B. Doctrine:

Doctrine supports the necessity of secure LOCs to combat operations and operational art. Field Manual 100-5, Operations, states that "maintaining uninterrupted logistics support throughout all phases of an operation or campaign is the central challenge of logistics."[26] As noted earlier, doctrine identifies distribution as "the heart of any logistics system."[27] LOCs provide the means to connect the critical points of the distribution system.[28] They link the theater base with the forward tactical formations to provide the continuity necessary for phased operations or campaigns. Field Manual 100-16, Support Operations: Echelons Above Corps, warns that unsecured lines of communication will "create severe logistics support problems."[29]

Joint doctrine also concurs with theory about the distribution system and LOC security. JCS Publication 4-0, Doctrine for Logistic Support of Joint Operations, says, "All logistics functional areas and hence, all sustained combat power, rely on the transportation and distribution system."[30] It further identifies secure LOCs as a key element of the distribution system: "The availability and vulnerability of LOCs affects where combat forces can be projected and supported and in what density."[31] JCS Publication 3-0, Doctrine for Unified and Joint Operations, requires the CINC include "an assessment of both intertheater and intratheater LOC security"[32] in his strategic estimate

and that the theater campaign plan "provide for opening and maintaining lines of communication."[33] Other joint publications assign specific responsibilities for LOC security and for assessing the viability of both intertheater and intratheater LOCs. For example, JCS Publication 2 assigns the Navy the responsibility to "protect vital sea lines of communication."[34] The evidence is clear that both doctrine and theory recognize that secure LOCs are an essential element in logistics distribution.

II. C. History:

Sun Tzu said, "An army that lacks heavy equipment, fodder, and stores will be lost."[35] A critical link for ensuring the necessary support is provided has been and continues to be LOCs. Almost without exception, secure lines have been a component of successful campaigns, as evidenced by Grant in the Civil War and the Allied forces in World War II. In contrast, failures to provide secure lines are a component of failed campaigns and battles. Rommel's failure in North Africa, the North Korean reversal in 1950, and the French defeat at Dien Bien Phu in 1953 all show that poor logistics distribution and unsecured lines are primary reasons for defeat in war.

The German submarine campaign during World War II affected American strategic and operational planning for the European Theater of Operations (ETO). The key to Allied success hinged on the continuous flow of troops and materiel from the United States to support the conduct of the war in Europe.[36] Constantly interdicting the SLOCs, the submarine became the focus of the German naval campaign in the Atlantic. Allies used scientific analysis techniques to

eventually thwart the underwater war.[37] However, before the problem was solved, the Allies had "a real crisis in shipping until the spring of 1943 and the British economy as well as Allied military operations were in jeopardy."[38] Although the percentage of losses was relatively low, they were not replaced until well into 1943.[39]

The insecurity of the Atlantic LOCs resulted in two decisions in the ETO. The first was that secure SLOCs were a precondition for ground operations in the ETO.[40] The second was that a convoy system was adopted to protect shipping, since the Navy was ill-equipped for anti-submarine warfare.[41] This limited the "size of the assault on the continent and its follow on support to the size of convoys that naval leaders considered within the limits of reasonable safety for escort."[42] The ground campaign in the ETO simply had to wait until the Atlantic SLOCs could supply the necessary resources and this first required their security.

Lines of communication received similar priority in the Pacific. Security of main air and sea routes was an essential part of the 1942 program. New Caledonia and the Fiji Islands were considered decisive to secure the long SLOC to Australia. Consequently, troop movements to those islands were accelerated in January to counter the perceived Japanese threat.[43] As with the ETO, the ground campaigns were held in abeyance until LOC security was achieved.

The China-Burma-India (CBI) theater offers another example of the importance of secure LOCs, but for the first time the primary emphasis was on air. The loss of Burma to the Allies in 1942 placed Japan within striking distance of the vital Indian base and severed the land link from Rangoon through the newly constructed Burma Road to

Kunming, blocking the back door supply route to China.[44] To make matters worse for the Allies, large scale Japanese naval incursions in 1942 into the Bay of Bengal eliminated Calcutta as the main port of entry for the build-up of India as a base and as a transit point for supplies to China.[45] Aerial resupply was critical to both the Imphal-Kohima operation in 1944 and the Irrawady campaign in 1944-45. During the latter operation, Field Marshal Slim made airfields the highest priority, constructing them every fifty miles during the advance.[46] Support to the Chinese was even more dependent on air; the only way to supply Kunming was in twin and four engine transports across the so-called Hump at heights above 12000 feet. Air LOC security was naturally a vital concern and the Air Transport Command accepted longer routes with increased flying times to avoid Japanese-held areas in northwest Burma.[47]

Secure LOCs have been equally important to unconventional operations. T.E. Lawrence's campaigns with the Arabs during World War I are examples. Though his raiding parties were "independent of supply for six weeks,"[48] they still relied on communication with their bases of support. "The process was to set up ladders of tribes, giving us a comfortable route from our sea-bases (Yewbo, Wejh, or Akaba) to our advanced bases of operations."[49]

Five decades later the Ho Chi Minh Trail served the same purpose for the North Vietnamese to sustain their army and the Vietminh operating in South Vietnam. To secure this LOC, the North Vietnamese built sophisticated antiaircraft defenses and underground barracks, workshops, hospitals, storage facilities and fuel depots.[50] The importance that they attached to the trail was evident by their

violent reactions to attempts to interdict it in 1970 by an unfriendly Cambodian government and again in 1971 by US ground operations into Laos.[51] Indeed, some consider that the US inability to sever permanently the Ho Chi Minh Trail was a major operational failure of the war.[52]

Recent contingency operations also reflect the need for secure LOCs. The British expressed this concern during the Falkland Islands war when they committed badly needed aircraft to protect Ascension Island and established early warning radar.[53] Still they worried about the threat of Argentine submarine attacks and Russian spy ships and overflights in the vicinity of Ascension.[54] It is well that the British did fret over LOC security; by the war's end they had lost six ships and ten were badly damaged.[55]

During Operation Urgent Fury in 1983, LOC security was a primary concern of the US. Specifically, Cuba lay astride the principal routes to Grenada and how she might respond to US actions was unknown. Accordingly, the US devoted a tactical fighter wing and four E-3A AWACS to counter any Cuban threats to the LOCs.[56]

History appears to show that successful campaigns depended on secure LOCs. Yet the American Civil War provides at least one example of a campaign that was successful without secure LOCs -- Sherman's march from Atlanta through Georgia to close with Grant in Carolina. In his book, The Sinews of War: Army Logistics, 1775-1953, author James A. Huston suggests that this operation was possible because the army was continuously on the move, its area of operation was rich in food stores, and it could carry what ammunition it needed.[57] Sherman's army was successful because he moved toward a

secure base while carrying a base of 2,500 wagons, containing 200 rounds per gun, ten days food, and 600 ambulances.[58]

In Operation Desert Storm, commanders took risks by placing supply bases as far forward as possible to shorten LOCs. This was possible only because LOCs were not threatened by enemy air and ground forces.[59]

It is appropriate to continue the examination of the impact insecure LOCs have had on campaigns. Axis operations in North Africa in World War II are an excellent modern case of insecure LOCs, both intertheater and intratheater, directly contributing to campaign failure and the ultimate capture of an army. The British grip on the Mediterranean put the Axis intertheater SLOC from Italy under constant threat from submarines, warships, and aircraft. By the summer of 1942, "Axis shipping en route to Africa stood only one chance in four of getting through"[60] because of insecure LOCs. Malta-based British air rendered the Axis capture of additional ports, such as Tobruk, almost meaningless because shipping was simply too vulnerable.[61]

Axis intratheater ground LOCs frequently suffered the same problems as the SLOCs. After the German failure at El Alamein in August 1942, the Royal Air Force relentlessly hammered the tenuous Axis LOCs between the African ports and the German front. The exhausted Luftwaffe could offer only marginal protection and the retreat westward almost resulted in destruction of the Axis army.[62]

The North African campaign demonstrates that focusing on logistics distribution--particularly LOCs--can make the difference between success and failure. Over the course of the campaign Rommel,

surprisingly, never demonstrated that he understood the importance of secure LOCs to distribution at the operational level of war. He did not synchronize the sequencing of combat actions with the establishment of logistics bases and lines of communication to avoid culmination or to plan for operational pauses. In fact he decided to go on the operational offensive after just two weeks in command.[63]

Rommel's actions after seizing Tobruk show his lack of recognition of the importance of logistics distribution and LOCs. Instead of consolidating his gains, developing the base at Tobruk, and establishing new lines of communication he immediately went on the attack again. Rommel did not understand that the sequencing of engagements is tied directly to ensuring secure lines of communication to prevent culmination.

In fact, operations in North Africa confirm the theories of Clausewitz, Jomini, Liddell Hart and Eccles. Campaigns on both sides aimed principally at severing the enemy's communication while protecting one's own. Even Rommel understood theory though he fell short in practice. This is evidenced by the following summary from his papers, "Supply lines are particularly sensitive, hence, everything possible must be done to protect one's own supply lines and to upset, or better still, cut the enemy's."[64]

Another example of how insecure LOCs contribute to campaign failure occurred in 1950. The US invasion at Inchon succeeded in cutting the main LOC of the North Korean People's Army (NKPA), making its position on the Naktong untenable and preventing its organized retreat.[65] Even before Inchon, the NKPA logistics staff understood that they were in trouble. Stores continued to move with

commendable efficiency, but they arrived in nothing as the quantity required to satisfy great fuel and ammunition expenditure.[66] The strike against its primary LOC resulted in a withdrawal that quickly degenerated into a rout and a flight for survival.

The French defeat at Dien Bien Phu in 1953 is an example of a failed campaign resulting primarily from insecure LOCs. The Vietminh severed the single French ground LOC from Laos early in the campaign and stopped aerial resupply almost six weeks before the battle's end.[67] French failure from that time on was inevitable. "Dien Bien Phu, like almost all other besieged fortresses, eventually died from its own supply deficiencies."[68]

II. D. Lines of Communication Summary:

History clearly shows that secure LOCs have been an essential precondition for successful ground campaigns of modern armies. Consequently, LOCs have frequently been the object of attack and their security a primary aim of defense, verifying theory. History supports current US doctrine as well. Projection of combat forces is at extreme risk without secure LOCs. The continuity of operations demands assured communication. Secure LOCs are no guarantee of victory. However, unsecured LOCs can promise defeat.

Sustainment of armed forces requires more than secure LOCs. Sustainment requires infrastructure for distribution. The extent to which an infrastructure is necessary to accomplish the task of distribution is the next subject of analysis.

III. Infrastructure Analysis:

The JCS support planning model assumes that intratheater means of distribution exist. Although Service component commanders provide logistics resources, it is the Combatant Commander's responsibility to develop the overall plan for using these resources in such manner that they support the theater concept of operations. JCS Publication 4-0 uses the term "power grid" as a framework on which to build theater logistics and describe the transportation and distribution system.[69] LOCs, ports, bases, and airfields as well as the units responsible for operating them are identified as key elements of the power grid. JCS Publication 4-0 includes infrastructure as a consideration in developing a power grid, saying, "Because the power grid is an integral element of combat power, specific provisions must be made for its security."[70]

Infrastructure provides the means that permit the forward movement of supplies. This analysis will test the association between logistics distribution and infrastructure using theory, doctrine and history.

III. A. Theory:

Nineteenth century European armies depended largely on local supply for subsistence, which was by far their biggest challenge. Consequently, Clausewitz[71] and Jomini[72] measured the infrastructure mostly by its agricultural productivity. Nonetheless, both offered advice applicable to modern theaters. Clausewitz gave importance to improved roads, rivers with prepared docks and bridges, and "busy coastal areas." Clausewitz concluded that the larger the army, the

greater the requirement for a well-developed infrastructure.[73] Jomini offered similar advice when he pointed out that it is not enough to assemble immense provisions, the necessary means must exist for them to follow the army.[74] The means, he said, are "portable provisions," light but solid carriages in large numbers, improved roads, and rivers with developed infrastructure. Thus, the classical theorists gave credence to the necessity of the facilities that enable movement of supplies and soldiers.

III. B. Doctrine:

Modern doctrine likewise links the distribution system with the theater's facilities and broadens the meaning of infrastructure to include the organizations required to operate the permanent facilities. JCS Publication 4-0 says that, "All logistical functional areas and hence, all sustained combat power, rely on the transportation and distribution system."[75] Field Manual 100-5 directly associates infrastructure (the availability of ports, airfields, depots and transportation facilities) and the units needed for its operation with the ability of combat forces to initiate and sustain operations.[76] The availability of warehousing, water and food sources is crucial to planning at the operational level. The presence or absence of infrastructure will affect the operational tempo.[77] For example, local transportation networks can make an enormous contribution to force movement, maneuver, and logistics.[78] Additionally, if a combat force cannot rely on existing infrastructure within a country and long resupply lines develop, robust operations will be limited.[79] Limited

infrastructure will also make regeneration of forces more difficult.[80] At the tactical level, the same concerns apply.[81]

Field Manual 100-16 echoes these requirements, stating, "Care must be taken to frontload adequate terminal and motor transport equipment to off load and move supplies."[82] The importance of infrastructure is illustrated by the requirement for the CINC to include an assessment of the facilities and units for distribution in theater's sustainment estimate.[83]

III. C. History:

History demonstrates the requirement for an infrastructure, as doctrine defines it, to sustain mechanized army formations operating over extended land distances. The Allied build-up and execution of Operation OVERLORD and the operations that followed through the summer and fall of 1944 illustrate the infrastructure's importance to campaigns.

Though England was a highly industrialized, well developed and relatively secure country, its infrastructure could barely support the build-up of forces from 1942 through 1944. Port clearance was such a problem that 400 freight locomotives were brought from the US to increase clearance capacity.[84] During the final stages of the build-up, port congestion caused the British to reduce their import program to free berths.[85] Only careful and sometimes ruthless allocation of facilities permitted the build-up of forces and supplies required by OVERLORD.

Planning for the invasion revolved around issues directly related to the continental infrastructure. One of the primary concerns was the

early capture of deep-water ports to build up and sustain the ground forces. The selection of Normandy for the assault was due in part to its proximity to Cherbourg and the Seine and Brittany ports.[86] Planners recognized that ports lacking sufficient rail outlets would be the little use.

Another of the planning concerns was the support for the units ashore before the ports opened. Provisional units (formed to organize and operate over-the-shore distribution) accomplished supply distribution. Engineer special brigades that included transportation, quartermaster, ordnance, medical, military police, chemical and signal personnel were charged with "the continuous movement of personnel, vehicles and supplies across the beaches."[87] Their success at Omaha Beach was obvious after two weeks when activities "resembled the operations of a major port."[88]

Despite the intense planning, the infrastructure stymied the pursuit across France. The bottleneck was the transportation of supplies, particularly fuel, from ports to the front.[89] As of the end of July, only 94 of 130 truck companies scheduled were on the continent. On 25 August, the Communications Zone pooled its motor transport resources to form the Red Ball Express.[90] This enormous effort was only a stopgap, however, and "the result was debilitating to the logistic structure and the effects were to be felt for several months to come."[91]

The planning and execution of the build-up and invasion of Europe show the absolute necessity of a mature theater infrastructure -- both facilities and units -- to initiate and sustain operations of large Army formations. The infrastructure presented limiting factors at each phase of the operation. Nonetheless, the attention given the

facilities and units for supply distribution undoubtedly contributed to the overall success of 1944 Allied operations in the ETO.

The Axis experience in North Africa and the German invasion of Russia demonstrate how the lack of an infrastructure can promote campaign failure. The North African theater, with its scarcity of ports, railroads, and roads, presented the opposing armies with immense sustainment problems. The limited capacity of the ports available to the Axis, principally Tripoli, "not only determined the largest possible number of troops that could be maintained, but also restricted the size of convoys"[92] introduced into the theater. Furthermore, with no adequate railroad running east from Tripoli, the Afrika Korps was heavily dependent on motor transport.[93] As the ground LOCs extended during the 1942 offensive, the Germans' lack of motorized vehicles was telling. Rommel lamented, "Supply difficulties, particularly getting the stuff up overland is a great headache."[94] By the Battle of El Alamein in October, the Afrika Korps was starved for all classes of supply. Fully one-third of its stocks were at Benghazi, which was hundreds of miles from the front and unable to be moved for want of motor or rail transport.[95] The infrastructure, both the North African fixed facilities and the German logistics transportation system, could not support Rommel's operational design.

The German lack of motor transport similarly affected Operation Barbarossa. The fast armored formations on which operational success depended lacked reliable means of supply.[96] The absence of roads across the Russian frontier exacerbated the problem, rapidly and drastically reducing the Grosstransportraum's motor transport capability.[97] The rail system was also broken. The

Eisenbahntruppe could not convert Russian rail to German gauge fast enough to keep up with the offensive. Establishment of reloading points to move cargo from German to Russian trains was a disaster; huge bottlenecks developed.[98] In November 1942 Army Group Center received barely half of its daily requirement of supply trains.[99]

The infrastructure problems made lines of communication a critical factor in the failure of Operation Barbarossa. The Germans were unable to move stocks by rail which led to increased delays and subsequent supply difficulties during the assault on Moscow.[100] German General Paulus had documented LOC problems in pre-war maneuvers, but Hitler and the German General Staff failed fully to appreciate the distribution problem caused by lack of roads and railroads in Russia.[101] Interior lines of communication became a problem with the expansion of frontage as the German forces approached Smolensk. This required flexible use of LOCs, which was not possible due to infrastructure problems (e.g., difficult terrain and the poor transportation network). The assertion that additional trucks could have contributed to the support of operations is questionable. The German's petroleum production capability could barely maintain assigned vehicles. In fact, there were occasions when stocks were at railheads and resupply vehicles had no fuel.[102] No plans had been made for alternate delivery means with the exception of limited aerial resupply. Forward staging of supplies was planned for, but failed to reach acceptable proportions because of lack of movement along the LOCs. The transportation problem was further complicated by a German division of authority between the Quartermaster General and the Chief of Transportation.[103] This is a serious deficiency, has

tremendous impact on logistics distribution and was noted as one the key reasons Napoleon's campaign into Russia failed.[104] As in North Africa, German neglect of the infrastructure's capabilities contributed significantly to operational failure.

These historical examples lead to the anticipated conclusion that campaigns involving large, mechanized formations require an infrastructure in the classical sense. The essentials of the supply distribution system in such a theater are airfields, ports, railheads, the units to operate them, and motor transport over a decent road network. However, other types of theaters dictate different considerations in the means of supply distribution. Specifically, history shows that maritime and undeveloped areas of operation substantially change the composition of the required infrastructure.

The Pacific theaters of World War II typify the differences between the infrastructures in continental and maritime theaters. The ETO relied on trans-Atlantic deliveries to a fairly limited number of ports. Reloading and transportation resources therefore could be concentrated to distribute supplies. In the Pacific, "Army shipments from the United States were going to some seventy destinations" by 1944.[105] Units for port operations were spread thin. Complicating the problem was a general lack of rail and highway networks to move cargo from ports to combat units.[106] Ships backed up at ports, aggravating an already severe shipping shortage.[107]

Planning and improvisation eventually overcame the inherent deficiencies of the Pacific infrastructure. At times, ships were used as floating depots, metering supplies ashore as discharge capacity became available. This solution was expensive and increased turn-around

times, further intensifying the shipping shortage. Interservice coordination improved to synchronize ship arrivals with port availability and discharge capacity.[108] Introduction of an amphibious two-and-a-half ton truck (DUKW) provided a means of ship-to-shore cargo discharge "at ports having inadequate facilities, or over coral beaches."[109] Getting supplies inland often depended on sheer muscle. During the Leyte Island campaign, for example, amphibious vehicles or Navy vessels put cargo ashore as close to combat units as possible and, from there, soldiers and Filipino civilians hand-carried supplies forward.[110] Though the Pacific theater required an infrastructure for supply distribution, the emphasis was less on permanent facilities, such as ports and railroads, and more on units with amphibious capabilities and simple labor.

The British confronted many of the same challenges in the Falkland Islands. Their plan was to create a base for ground operations at San Carlos, the initial landing location, using logistics-over-the-shore and helicopters. The build-up was painfully slow, however, because the Argentine Air Force virtually shut down daylight operations and ships were poorly loaded.[111] Also, three of four Chinook helicopters sank on the Atlantic Conveyor on 25 May, leaving only the remaining Chinook and sixteen smaller utility helicopters to support both ship-to-shore operations and movements ashore.[112] The best the local infrastructure could offer during the approach to Port Stanley was one tractor and trailer, which the British used the haul heavy equipment.[113] As in the Pacific theaters of World War II a largely undeveloped island required means of supply distribution and

transportation that differed considerably from traditional doctrinal thought.

Undeveloped infrastructures are not limited to maritime theaters, as evidenced by the CBI theater of World War II. Previously noted is Field Marshal Slim's emphasis on airfield construction. He gave equal attention to building railroads and roads. Slim notes that large numbers of labor, administrative, technical, and non-combatant units are unavoidable in a country where every road, airfield, and camp had to be made from virgin jungle or rice field.[114] Even with this recognition, the Fourteenth Army frequently depended on cart paths and airdrops and, more often than not, lived on a shoestring.[115]

The US operations in Operation Desert Storm show the impact that both the physical and logistics unit infrastructure can have on logistics distribution. The US responded to the Iraqi invasion of Kuwait by deploying hundreds of thousands of troops with their equipment and supplies into Saudi Arabia from August 1990 to January 1991. The host nation had adequate ports and airfield capacity to receive the forces. However, the operational logistics challenges once in country were significant.

Transportation Command (TRANSCOM) could deliver bulk shipments to Saudi Arabian port facilities with air and sea transportation means. However, the intratheater infrastructure was poor. The few roads that existed had limited capacity and railroads and in-land waterways were nonexistence. As a result, logistics distribution was constricted, causing a backup at the port.

Contributing to the problem was the decision to deploy combat units before support units in the first three months of the campaign.

During this period, the Army and Marine Corps were unable to maintain visibility over arriving equipment and supplies and had to have host nation and coalition support to operate ports.[116] Once logistical support units began to arrive in the theater and the supply system graduated from a "push" to a sustainment mode, the supply units began to establish visibility over the supplies and equipment being stored at the ports and logistics distribution improved. Logisticians had to receive incoming equipment, supplies, and personnel, support the combat units that were deployed, and build a logistical infrastructure in an austere environment.[117] Building this infrastructure was a demanding job. It included establishing mechanisms for acquiring necessities such as shelter, food, water, sanitation, and postal services; setting up a system to acquire host nation assets; and making physical improvements, especially to unpaved staging areas.[118] There were valid concerns that if the war had gone longer, logistics distribution would have been a significant limiting factor -- namely, that sustainability could have become a major problem for the Army's air and ground systems had the ground war continued for a protracted period.[119]

III. D. Infrastructure Summary:

Theory, doctrine and history agree on the necessity for an infrastructure to support combat operations. Indeed, the capabilities of the infrastructure largely determine the type and number of forces that can operate in a given theater. Plentiful fixed facilities, such as in Europe, supported mechanized formations in World War II. Less developed infrastructures generally limit the use of mechanized

combat forces and are historically more reliant on raw manpower, engineer, and other special service units than fixed facilities for logistics distribution. History also confirms that infrastructure deficiencies, whether in facilities or service and transportation units, can impede operations. Successful operations overcame these problems though comprehensive planning, ensuring the infrastructure could support the scheme of maneuver and, adding or creating necessary logistics organizations to supplement existing the infrastructure. Unsuccessful operations were hostage to inadequate infrastructure.

IV. Analytical Summary:

Analysis shows that secure LOCs and sufficient infrastructure are two absolute requirements to sustain joint forces in a unified command's wartime campaign. It also shows that "sufficient" infrastructure varies considerably between theaters. For LOCs and infrastructure to be integrated into an efficient distribution system the following must be considered:

a. A solid logistics command and control structure with access to the operational commander is required.

b. Logisticians must participate in the planning process. Intelligence preparation of the theater must include the lines of communication and infrastructure -- all the way back to the rear boundary of the commander's area of interest.

c. Solutions to problems of securing LOCs, obtaining sufficient infrastructure, distributing supplies and managing transportation require integrated, system-oriented solutions. The amount of supplies

needed drives the transportation requirement, but LOCs and infrastructure determine the density that can be moved, stored, issued, and maintained.

d. Modern war requires logistics planners anticipate and push support forward, based on the operational commander's intent. Higher echelon battle staffs must be proficient in planning and controlling logistics activities to ensure LOCs and infrastructure to support the commander's intent are not overlooked as in Operation Barbarossa. Secure LOCs and the provision of infrastructure will allow the types of units and amounts of supplies that are needed. This reinforces the need for logisticians to participate in the operational planning and decision making process and for an effective logistics command and control system to reduce the risk of losing precious logistics assets or being out of position to provide timely support the battle.

e. Future operations may occur in areas where there are no preexisting agreements for host nation support or in areas where host nations either do not have the ability or the willingness to provide this support. This indicates a need for logistics units to be deployed early in these contingencies. It also requires logistics units to be versatile and agile to meet the growing spectrum of operations. Additionally, the smaller military of the future will be less able than in the past to afford all the required support forces needed and will be more dependent on reserve units. This emphasizes the need for operational planners to factor in the limitations that LOCs, infrastructure, and time (to get support units from the reserves) will place on campaigns in the future.

The findings have several logistics implications for operational planners. This is the subject of the next section.

V. Logistics Implications:

The preceding analysis indicates that planners at the strategic and operational levels need to carefully consider logistics distribution, particularly LOCs and infrastructure, when developing campaign plans. While there is uncertainty over the nature and extent of future threats facing the United States, there is recognition that planning for US defense requirements is no longer dominated by a Soviet threat. The United States no longer has a largely defensive mission on a relatively small, well-defined front with well-established LOCs and infrastructure; the strategic landscape is now global.

Recent experiences, ranging from the relatively small actions in Grenada and Panama to the large-scale deployment in Operation Desert Storm, show how diverse US military contingencies can be and the impact secure LOCs and infrastructure can have on combat operations. Those operations would have been significantly more difficult without secure LOCs and without infrastructure (including Saudi ports and airfields). The challenges would have been at least as difficult as the intratheater problems the US faced once reaching Saudi Arabia.

The linkages between secure LOCs and a theater infrastructure are so close that operational implications cannot be considered independent of the strategic and service-related concerns. Accordingly, the discussion that follows will concentrate on operational concerns, but will also present strategic level concerns. Implications for joint

forces as the US military strategy assumes a power-projection versus a forward-deployed posture are presented separately.

VI. Operational Implications:

At the operational level, logistics distribution, particularly LOC security and infrastructure, is a joint/combined force consideration. Planners must integrate all service components into the distribution system. An integrated logistics distribution system is necessary to have an uninterrupted flow from the source to the user.

For example, the Army Posture Statement requires the deploying, from CONUS, of a tailorable five-division corps, capable of forcing entry into an overseas theater.[120] The lead brigade of this force must be on the ground in four days and the lead division in twelve days.[121] Two additional divisions (Armored, Mechanized, or Air Assault) must close within thirty days and two divisions with supporting elements, to include thirty days of sustaining materials, must close within seventy-five days.[122] This effort requires joint integrated operations. For example, the Army must prepare, move, and load its units for transportation by Air Force and Navy strategic lift. The lift must be coordinated by TRANSCOM. The Air Force and Navy must also secure the air and sea LOCs necessary for movement. All services must ensure that the necessary operational infrastructure is in place to receive these forces. All the distribution implications of such a move cannot be covered here, but the following should be considered:

a. At the strategic level, (1) The Navy and Air Force must procure the strategic lift necessary to move such a force in the times

outlined; (2) the Army must field the necessary logistics units to provide the support; (3) and prepositioned materiel must be procured and moved.

b. At the operational level, the commander must: (1) ensure units are sequenced properly so that the right mix of combat and logistics units are available to secure LOCs and provide the infrastructure to receive deploying units; (2) plan intratheater distribution, once the force is deployed; and (3) be flexible enough to adjust to any number of unplanned events.

The analysis has validated the requirement for secure LOCs to a unified command's operations. However, it also clearly demonstrates that the condition is often difficult to achieve. Secure LOCs is an assumption that continually appears in operation plans. A similar assumption in the early days of the Atlantic and Pacific theaters of World War II would have been invalid. Even after the Allies won the Battle of the Atlantic, serious concern continued because no one was willing to assume that sinkings would not continue at a high rate.[123] The security of LOCs depends primarily on the ability of one's forces to make them so. At the strategic level the US depends on the Navy and Air Force, operating under a supporting CINC, for intertheater LOC security. Intratheater LOC security is the supported CINC's responsibility. He must achieve LOC security through campaign design, including allocation of forces for that purpose if necessary.

LOC security is more complicated than simply defining the theater boundary and assigning one side intertheater responsibility and the other side intratheater. Securing the SLOC to Australia in 1942 demanded close coordination and cooperation between the Pacific

Ocean Area and the Southwest Pacific Area, especially concerning several island chains that lay near or astride the theaters' mutual boundary.[124] Today, security of the long SLOC to the US Central Command requires similar coordination. Fortunately during our more recent operations, (e.g., Operation Desert Storm) LOC security was not a problem. Still the operational planner must continue to ensure LOC security is a prominent factor in campaign plans.

Also complicating LOC security is the overlap that now exists between intertheater and intratheater LOCs, particularly ALOCs. Army supply procedures describe maximum throughput, with deliveries directly from CONUS to divisional direct support units if facilities permit.[125] At some point, the intertheater LOC becomes a theater concern to secure. Close coordination among strategic, theater of war and theater of operations planners is mandated.

Even if intertheater LOCs were solely a strategic responsibility, their security is still a concern of operational planners. The Atlantic and Pacific theaters demonstrate how joint campaigns may be affected by the battle to secure the LOCs. First, securing the intertheater LOCs may draw away resources otherwise available to ground operations. Accelerated troop movements to New Caledonia and the Fiji Islands in 1942 to provide LOC security meant a reduction in combat power for the campaigns that followed. Second, the time required to secure the intertheater LOCs provides the defender additional time to prepare. Certainly the French coast was not as well defended in 1943 as it was in 1944, but the Allies first had to secure their LOCs.

The threat of LOC interdiction can have similar effects. The British committed aircraft to guard Ascension Island that were badly needed in the Falklands. The air forces that the US committed to LOC security during Operation Urgent Fury likewise were unavailable for other missions.

The essentially of LOC security has at least three implications for operational planners. First, the operational planner must coordinate the security of LOCs, since it requires an integrated joint service approach from the strategic to the tactical level of operations. The planner should plan for at least two contingencies -- an incorrect assumption at the beginning of hostilities and the loss of LOC security during the campaign -- if the theater campaign plan assumes intertheater LOCs are secure.

The second implication is that operational planners play a part in intertheater LOC security and have major responsibilities for securing intratheater LOCs.

A third implication is that securing LOCs may take combat resources away from the operational planner while concurrently allowing the enemy time to strengthen his position.

Implications about the theater infrastructure are obvious. The clearest implication is that operational planners, through intelligence preparation of the theater, must have a complete understanding of the characteristics of their specific theaters to support logistics distribution. For example, the methods used in Europe during World War II would not have worked in the Pacific theaters. The German North Africa and Russia theaters required proportionally more motor transportation than in Europe because differences in gauges meant the

Germans could not use the rail networks. The British had to rethink their methods of logistics distribution in the Falkland Islands war. The diversity of theaters in which today's forces may fight makes careful analysis of the infrastructure's capabilities an imperative. Rapid force projection from CONUS, extended lines of communication and potential forcible entry into logistically bare-based areas of operation require planners more than ever before to have a comprehensive view of the theater infrastructure.

Analysis has shown that an objective area's infrastructure is a key command consideration, since an immature, bare-based, or nonexistent infrastructure can affect the vitality of a campaign. The operational planner can take one of two approaches based on the infrastructure. One approach is for the planner to determine what the existing facilities, services, and transport units will support and structure the combat forces within those restraints. This is similar to the method the Allies employed in the ETO, with the exception that special units were employed to modify portions of the infrastructure. The opposite approach is for the planner to determine the forces required or available to accomplish the mission, then create the infrastructure -- the facilities and units -- that will support the concept of operation. The British Fourteenth Army displayed this method in the CBI theater. While successful, Field Marshal Slim's margin of error logistically was often infinitely small. The "right" answer for situations probably lies somewhere between the two extremes. Probably the best answer for the operational planner is to follow Thorpe's advice: "In planning the employment of any particular

military force, it is not only necessary to decide what is desirable, but what is possible."[126]

There are indicators to suggest which approach the operational planner should take. A well developed infrastructure with fixed facilities generally will support mechanized formations; a high density of troops distributed throughout a geographically large, contiguous land theater; and sustained high-intensity operations. A theater with a less developed infrastructure favors lighter forces with specialized units. These are generalizations, not answers. There is no simple solution. The threat will drive the force mix which, in turn, will determine the infrastructure requirements. For example, in World War II the Allies use Provisional Engineer Brigades to work infrastructure in the ETO, the most infrastructurally mature theater of the war. In Burma, the most immature theater, the Fourteenth Army used tanks, despite the lack of roads and railroads. If ever the operational level logistician is an artist, it must lie in marrying infrastructure capabilities with operational concepts; his job is to make the concept work, not identify reasons it cannot.

In order to establish the logistics distribution system and to facilitate the movement of combat forces, the port operation, engineer, and transportation units should be among the first introduced to a theater. This represents significant problems for US operational planners, since our logistics capability must sustain contingency and reinforcing units over an increasingly shorter time-frame and many of the logistics units required to establish an infrastructure are in the reserve components. The operational planner must factor the reserve component readiness and deployment time into theater plans.

The time provides the enemy additional opportunity to strengthen his positions, as does waiting for LOCs to be secured. This is particularly critical if forced entry is required as in the ETO and many Pacific islands during World War II. The operational planner also must recognize that any infrastructure has limiting factors and those factors may change over time. The Allied build-up in England was first limited by port discharge capacity. When that was fixed, port off-load capacity impeded the accumulation of supplies. During the initial days of OVERLORD over-the-shore discharge capacity fell behind the requirements. Shortages of motor transport units later became the limiting factor. Similar restraints appeared during US operations in the Pacific, the Axis North African campaign, the German invasion of Russia, British operations in Burma, and more recently on the Falkland Islands and Operation Desert Shield/Storm. The art for the operational planner is to anticipate the next limitation and plan for its reduction. The implication is that the planner must understand the effects of limiting factors on operational planning and make necessary adjustments.

In summary, the requirement for an infrastructure drives the operational planner to, first, make a comprehensive analysis of the infrastructure's capabilities to support the campaign plan. This is perhaps most difficult, but is an essential for any planner. The second implication is that the units essential to the distribution system should be among the first to deploy. Finally, the planner must recognize the infrastructure's current and future limiting factors, work towards their reduction, and adjust the campaign plan as necessary.

LOC security and sufficient infrastructure both impose operational limitations that can not be overlooked by the operational planner. Theory, doctrine, and history all demonstrate that the absence of either contributes significantly to failure. Successful campaigns have delayed the start of combat operations to secure LOCs and establish infrastructure, even when the delay had a negative impact on relative combat power. One reason US forces are forward-deployed is to speed their operational employment. Thus, the requirements for secure LOCs and a theater infrastructure have special implications for a power projection contingency force.

VII. Implications for a Power Projection Force:

At the strategic level, deploying and sustaining combat power requires improvements in the capability of strategic airlift, fast sealift, and mobility. To compensate for deployments to areas with poor infrastructure, more use must be made of high technology to improve support.

At the operational level more active duty logistics units should be retained in a forward-deployed status to provide infrastructure for deploying units and to maintain forward-deployed stocks. This will also permit global-sourcing support requirements, allow distribution along multiple LOCs, and reduce in-theater infrastructure requirements. Procedures need to be developed to speed the mobilization time for reserve logistics units.

A centralized command and control organization is needed to manage the logistics activities in theater. These activities are performed by a range of strategic and operational organizations such

as Army Materiel Command, Defense Logistics Agency, Military Traffic Management Control Agency, and numerous units assigned or attached to the theater. A centralized logistics commander can prevent duplication, enhance effectiveness, and, most importantly, give the Joint or Combined Force Commander one point of contact for support operations.

Prepositioned materiel on land and afloat in likely force projection areas can significantly reduce infrastructure and reduce LOC security requirements. Without prepositioned materiel, forces must deploy with their equipment from CONUS and all except light infantry and airborne units would rely primarily on sealift. This makes SLOC security a primary concern of deploying forces. Time is also a critical element; based on the analysis, securing SLOCs is a time-consuming task during major conflict with an opponent capable of interdiction. As the Army changes from a forward-deployed to a power-projection, crisis-response posture, its global commitments make prepositioned equipment even more essential for timely action.

Deployment will still require secure ALOCs, but not necessarily air supremacy. The Navy and Air Force can open corridors for airlift transit that will permit timely introduction of units. This is obviously not without risk, but time constraints may make it necessary.

The increased significance of prepositioned stocks carries further implications. Security of those stocks from terrorists, special forces, and other threats will become even more important. Access to prepositioned stocks -- roads and transportation from points of debarkation to prepositioned stock sites -- also assumes greater significance. Theater operational planners may need to add resources

to secure these areas if the equipment is to be available to deploying units upon their arrival in the theater. Secure access may also require relocation of some prepositioned stocks to improve their accessibility.

LOC security will have a greater impact on the Army in a power projection force. The Army can expect to commit forces to secure land LOCs in most theaters. In World War II the Pacific theater Army forces were diverted to islands critical to the SLOCs. Multiple regional contingencies present other problems. It is conceivable that a theater could lose planned reinforcements to another contingency. Such diversions significantly upset operational plans and could complicate LOC security. In an environment of unsecured LOCs, planning flexibility will be at a premium.

The infrastructure requirement implies that tooth-to-tail ratios may need adjustment -- in theaters such as Korea -- with forward-deployed forces. Rapidly reinforcing these theaters requires in-place transportation and quartermaster capabilities based on the planned reinforcements. These requirements will change every little. Thus as the total number of forward-deployed forces decreases, those units which are critical to the reception of reinforcing units will see no corresponding decreases in their wartime missions. Failure to retain these capabilities in a forward-deployed posture may limit the flow of reinforcements into the theater during the critical early days of war.

The requirement for secure LOCs and "sufficient" theater infrastructure has three implications for the Army as it withdraws forward-deployed forces. One, prepositioned stocks will become increasingly important as operational planning relies more on power projection and crisis response. Two, diverting reinforcements for

another regional contingency could have significant impact on LOC security and operational plans. Finally, since withdrawal of forward-deployed combat units will not substantially change the wartime mission of the logistics units, the proportion of logistics units withdrawn should be reduced. Otherwise, ground operations during the war's initial phases are at risk or may be delayed.

VIII. Conclusion and Recommendations:

The findings of this monograph validate that distribution facilitates operational art and leads to two recommendations that should be considered by a power-projection force. The findings also provide several recommendations for operational planners.

The findings make it clear that sustainment of joint forces requires secure intertheater and intratheater lines of communication and a theater infrastructure for logistics distribution. While other conditions must exist for the logistics distribution system to perform -- such as sufficient air and sealift -- Joint Force Commanders require these essential in-theater preconditions to commence campaigning.

The recommendations for a power-projection force are both related to the reduction of forward-deployed forces. As the military reduces its forward-deployed forces, the significance of secure LOCs and infrastructure increases, making prepositioned stocks and in-theater logistics units more critical. Prepositioned stocks provide the most timely means of introducing large, mechanized units into regional crisis and in-theater logistics units are necessary to provide the infrastructure to receive and sustain units during the early stages of

deployment. Prepositioned stocks should be increased -- both in-theater and afloat -- to improve response time and flexibility.

The second recommendation is that the military retain active duty support units in-theater and shift some missions from the reserve to the active component to meet the early support requirements of its contingency force. The logistics requirements to support power-projection argue against reducing in-theater logistics capabilities in proportion to reductions in combat forces. However, Congressional interests in preserving reserve roles and continuing budgetary pressures dictate that the military carefully weigh decisions that would shift additional missions from the generally lower-cost reserves to its active force. The military should develop reconstitution plans for creating additional support units in the reserves and speeding their mobilization to ensure that its distribution capability can be readily increased.

The findings provide the following recommendations for the operational planner:

a. The operational planner must take a positive role coordinating the security of intertheater LOCs.

b. Campaign plans should consider enemy LOCs and infrastructure -- both intertheater and intratheater -- as targets, while protecting friendly LOCs and infrastructure. The operational planner should consider delaying the campaign until secure intertheater LOCs and "sufficient" infrastructure have been established.

c. The operational planner should plan to tailor the logistics infrastructure to suit the theater's particular geographic and military

characteristics. This ensures that the proper combat-to-logistics ratio is maintained during deployment.

d. The infrastructure's limiting factors should be identified in the intelligence preparation of the theater and the plan should minimize these factors' effects on the campaign.

These considerations describe the art of support. The conditions they create -- secure LOCs and infrastructure capabilities -- are essential elements of operational art; the art lies in the operational planning and execution to achieve them.

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