



**Sustainment of Theater Army Forces: The
Essence and the Art**

**A Monograph
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For operational planners, the findings have six implications. One, planning branches are needed that assume LOCs are not secure or that LOC security is lost during the campaign. Two, planners have responsibilities for securing both intertheater and intra-theater LOCs. Three, securing LOCs may subtract from the forces available to theater planners while permitting the enemy additional time to strengthen his position. Four, careful comparison of the infrastructure's capabilities with the operational scheme is required for sustainment of the latter; this comparison is often difficult. Five, units essential to the supply distribution system should be among the first to deploy to a theater of war or a theater of operations. And six, planners must recognize the infrastructure's current and future limiting factors and devise plans for their minimization.

For a less forward deployed Army, the analytical results firstly imply that Pre-positioned Organizational Material Configured to Unit Sets (POMCUS) stocks will become increasingly important to rapid reinforcement of the unified commands. Secondly, diverting reinforcements to the battle for LOC security, an historically common occurrence will have relatively greater impact on unified commands' operational plans. Thirdly, proportionally fewer combat service support units critical to rapid reinforcement than combat units should be withdrawn from theaters with forward deployed forces.

The requirements for secure LOCs and a theater infrastructure are the essence of sustainment of theater Army forces. The art lies in campaign design and execution that achieves them.

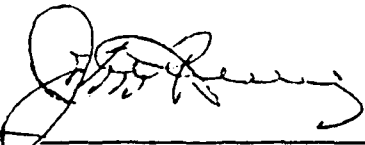
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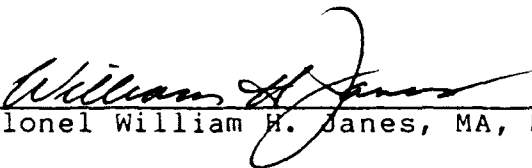
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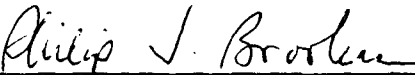
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ABSTRACT

Sustainment of Theater Army Forces: The Essence and the Art, by Major Michael E. Ivy, USA, 47 pages.

This monograph examines two of the assumptions which underlie the Joint Chiefs of Staff support planning model as they relate to sustainment of Army forces in a unified command's wartime campaign. One is that lines of communication (LOCs) are secure. The second assumption is that an intratheater means of distribution exists, which is normally associated with ports, airfields, roads, and railroads, and their operating units.

These two assumptions are analyzed using theoretical, doctrinal, and historical criteria. The analysis shows that secure LOCs and infrastructural capabilities are absolute requirements to sustain Army forces in a unified command's wartime campaign. The analysis also indicates that infrastructural requirements vary greatly between theaters.

For operational planners, the findings have six implications. One, planning branches are needed that assume LOCs are not secure or that LOC security is lost during the campaign. Two, planners have responsibilities for securing both intratheater and intertheater LOCs. Three, securing LOCs may subtract from the forces available to theater planners while permitting the enemy additional time to strengthen his position. Four, careful comparison of the infrastructure's capabilities with the operational scheme is required for sustainment of the latter; this comparison is often difficult. Five, units essential to the supply distribution system should be among the first to deploy to a theater of war or theater of operations. And six, planners must recognize the infrastructure's current and future limiting factors and devise plans for their minimization.

For a less forward deployed Army, the analytical results firstly imply that Pre-positioned Organizational Material Configured to Unit Sets (POMCUS) stocks will become increasingly important to rapid reinforcement of the unified commands. Secondly, diverting reinforcements to the battle for LOC security, an historically common occurrence, will have relatively greater impact on unified commands' operational plans. Thirdly, proportionally fewer combat service support units critical to rapid reinforcement than combat units should be withdrawn from theaters with forward deployed forces.

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I. INTRODUCTION

An army which lacks heavy equipment,
fodder, and stores will be lost.¹

Sun Tzu

That maxim which seems so patently obvious to the student of war has been a recurring historical lesson. Napoleon learned it on the steppes of Russia. Lee realized it on Virginia's hills. Hitler failed to grasp it in North Africa, and like Napoleon, had the vastness of the Russian frontier and the tenacity of her people to tutor him further. So perhaps what is obvious to the student is not as clear to the practitioner. Or perhaps even when the lesson is clear, mustering the material wherewithal necessary for campaigns is simply a difficult task.

Joint Chiefs of Staff (JCS) doctrine recognizes the complexity of providing the unified commands the materiel required to initiate and sustain wartime campaigns. The deliberate planning process includes a support planning model that aims to do just that. This model, like all models, is built on certain assumptions. One is that lines of communication (LOCs) are secure. Another is that an infrastructure exists that will permit intratheater movement of forces and supplies.

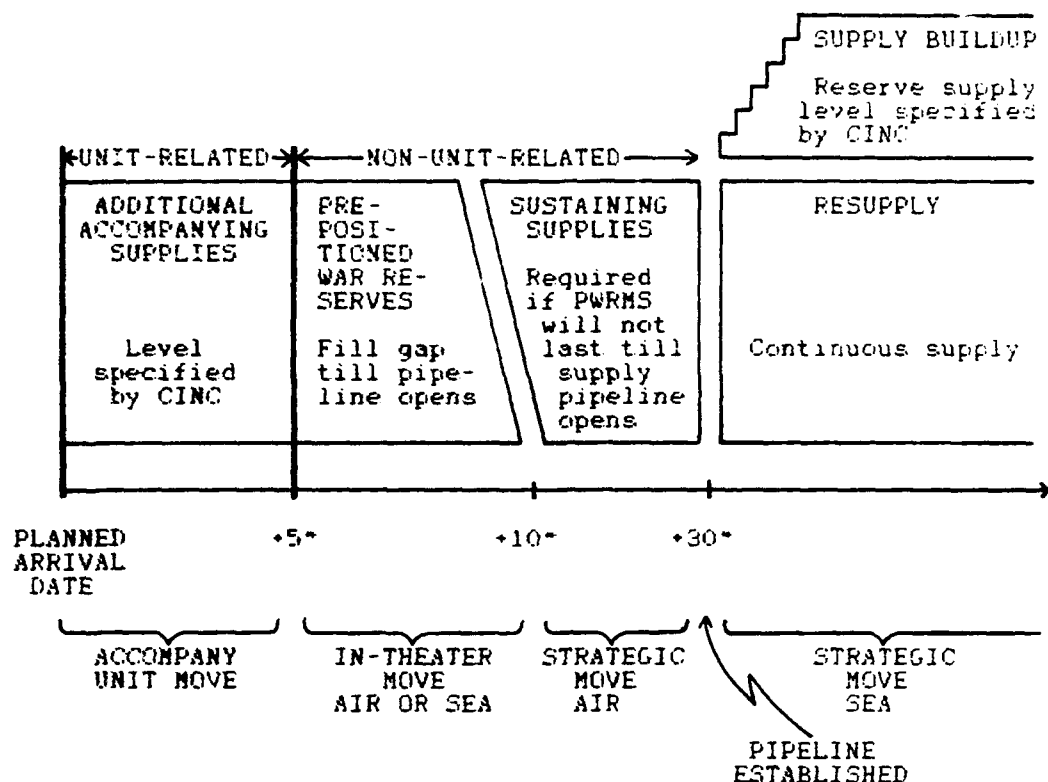
The purpose of this monograph is to determine the extent to which these two conditions are necessary for sustainment of Army forces in a unified command's

wartime campaign. The results of the analysis have implications for theater operational and logistical planners. As the conditions which the model assumes tend towards absolute necessity, the practitioner must become increasingly interested in assuring their presence, else the model will not function in reality.

Section II describes the JCS support planning model, its relation to Army forces in a unified command's theater, and the two conditions on which this study focuses. Section III is the analysis, which tests the necessity of the model's assumed conditions against theoretical, doctrinal, and historical criteria. Section IV discusses the implications of the analytical results for operational level planners and a less forward deployed US Army. Section V concludes the monograph with specific recommendations.

II. THE SUPPORT PLANNING MODEL

The support planning model is a straightforward concept that describes how forces are sustained in a theater of war or a theater of operations over time. It relates the definitions of unit-related and non-unit-related supplies and their subcategories to the deployment and employment of contingency, forward deployed, and reinforcing units. The figure on page 3 depicts the model graphically.



*These days are for illustration only. The actual days are theater dependent.

The JCS Support Planning Model*

Unit-related supplies and equipment consist of unit basic loads and additional accompanying supplies. The basic load is "the quantity of supplies required to be on hand" within a unit.* These supplies are to sustain units in combat until resupply is effected." Specific quantities in the basic load are determined by the services based on the owning unit's missions. Army contingency and reinforcing forces deploy with their basic loads.

"Additional accompanying supplies" is a less familiar term. Theater planners may determine that the basic load of a given unit is insufficient to sustain it until resupplied under the concept of operations. If so, the theater commander-in-chief (CINC) will direct that the unit deploy with additional supplies. Simply stated, "Additional accompanying supplies extend the period supported by basic loads."⁵ As directed by the CINC, contingency and reinforcing forces deploy with these supplies also.

Non-unit-related supplies consist of several subcategories. Pre-positioned war reserve materiel stocks (PWRMS) are

to replace total usage, loss, and consumption of all forward-deployed and reinforcing units between D-day and the time when resupply can be established from CONUS [continental US].⁶

The Army has supplies pre-positioned in Europe, Korea, Japan, Hawaii, Alaska, and Panama.⁷ PWRMS also include equipment for initial provisioning of reinforcing units, namely the Pre-positioned Organizational Material Configured to Unit Sets (POMCUS) program in Europe.⁸ In addition to providing the bridge between unit-related supplies and resupply, PWRMS for resupply and POMCUS also reduce the strategic lift requirements during the critical early days of war.⁹

A second subcategory of non-unit-related supplies is sustaining supplies. These are supplies

needed by forces to support them from the

time their accompanying supplies and PWRMS run out and until the continuous resupply pipeline opens. This is especially true if forces have deployed over long distances. The continuous resupply pipeline largely depends on sealift. Sealift could take days or weeks to begin making regular deliveries.... Sustaining supplies, therefore, are normally delivered by airlift.¹⁰

Resupply is the third subcategory of non-unit-related supplies, and is simply all materiel required to sustain the forces, whether contingency, forward deployed, or reinforcing, for the duration of their deployment in the theater.¹¹ As noted above, continuous resupply depends primarily on sealift for movement from CONUS to the theater.

The final subcategory of non-unit-related supplies is supply build-up. The CINC specifies quantities of supplies to stockpile within the theater after commencement of hostilities. This stockpile provides a means to sustain forces if the resupply pipeline is temporarily interrupted.¹² Supply build-up may also support future major operations that will increase demands for supplies within the theater.

Briefly summarizing, the JCS support planning model defines two broad categories of supplies. Unit-related supplies deploy with the owning unit, whether contingency or reinforcing, to sustain it until resupply occurs. Non-unit-related supplies sustain the forces beyond the normally modest unit-related supplies until the units depart the theater. While several assumptions

underlie the model, this analysis will focus on two.

One assumption is that lines of communication (LOCs), both intertheater and intratheater, are secure enough to allow passage of sufficient supplies. Delivery of unit-related supplies for contingency and reinforcing forces is via air lines of communication (ALOCs) or sea lines of communication (SLOCs), depending on the mode of transport of the owning unit. Sustaining supplies, as previously noted, are air transported. Resupply and supply build-up are primarily sea transported. Only one subcategory of non-unit-related supplies, PWRMS, is independent of intertheater LOCs. Forward movement of these supplies still may require secure intratheater ground, air, or sea LOCs, depending on the location of the PWRMS sites relative to the Army force's base of operations within a theater.

A second assumption of the support planning model is that sufficient means exist for distribution of non-unit-related supplies within the theater. As later discussion will show, these means normally translate to an infrastructure that permits forward movement of supplies to combat units. Distribution of materiel from ports of debarkation is required if the model is to accomplish its ultimate purpose of supporting deployed formations. Else, upon exhaustion of unit-related supplies, deployed forces will starve despite a possible abundance of resources at the theater's ports.

That the model assumes these conditions is not necessarily "bad" or unreasonable. The assumptions will adversely impact the sustainment of Army forces in a unified command's wartime campaign only when the conditions they describe are necessary to the sustainment effort but are unattainable within the time requirements of the concept of operations. The next section will test the necessity of the conditions which the support planning model assumes.

III. ANALYSIS

Theory, doctrine, and history will serve as the analytical framework. Three criteria will indicate the extent to which secure LOCs and a theater infrastructure are necessary to sustain Army forces in a theater of war or operations. First, what does classical military theory and current doctrine suggest regarding the essentiality of the condition for successful wartime campaigning? Second, was the condition present during successful wartime campaigns? Third, did the absence of the condition contribute to the failure of unsuccessful campaigns?

Secure Lines of Communication

Classical military theorists agree that secure LOCs are a prerequisite to military operations. Writing during an era when armies frequently lived off the land,

Clausewitz notes that some things, such as replacements and munitions, could come only from the army's home. Hence, "communications with the homeland are essential."¹³ Jomini rates secure LOCs among "the laws of good logistique," and says that they "serve as a bond between the army and ... [its] base."¹⁴

Both these theorists further assert that LOCs are so important that proper objects of strategy are protection of one's own and attack of the enemy's. Clausewitz writes 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.¹⁵

Jomini is equally emphatic:

The great art of directing properly one's lines of operations consists ... in combining his marches in such a manner as to seize the hostile communication, without losing his own....¹⁶

B.H. Liddell Hart 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.¹⁷

The essence of Hart's indirect approach is gaining the enemy's rear, for both the physical and psychological impact. Indeed, one would be hard pressed to find a theorist of any era who disputes the necessity of secure LOCs to campaign execution.

United States joint doctrine reflects theory with respect to LOC security. JCS Publication 4-0, Doctrine

for Logistic Support of Joint Operations, says, "The availability and vulnerability of LOCs affects where combat forces can be projected and supported, and in what density."¹⁰ Other joint publications assign specific responsibilities for LOC security and for assessing the viability of both intertheater and intra-theater LOCs.¹¹

Army doctrine likewise echoes theory. Field Manual 100-5, Operations, maintains that LOCs linking the theater base with the forward tactical formations provide the continuity necessary for phased operations or campaigns. It suggests specific ways of maximizing LOC security to include conducting major operations expressly for that purpose.¹² Field Manual 100-16, Support Operations: Echelons Above Corps, cautions that absence of a SLOC for short-warning contingencies "creates severe logistics support problems."¹³ Based on the body of theory and doctrine, this is true of all operations; the convergence of thought is unmistakable.

Doctrine and theory are supported well by historical evidence. Almost without exception, secure LOCs are a component of successful campaigns. During World War II, the 1942 German submarine campaign profoundly impacted American strategic and operational planning for the European Theater of Operations (ETO). Losses of dry cargo rose from 1.7 percent in January to 2.5 percent in May. The average monthly tonnage of tankers sunk over the same period was 3.5 percent. While the percentages

do not appear large, the losses were not replaced until well into 1943.²² The result was "a real crisis in shipping until the spring of 1943, and the British economy as well as Allied military operations were in jeopardy...."²³

Two results emanated from the crisis. One, planners accepted that secure SLOCs were a precondition for ground operations in the ETO.²⁴ Two, since the Navy was ill-equipped for anti-submarine warfare,²⁵ the convoy system was adopted to protect shipping. 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."²⁶ 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 a perceived Japanese threat.²⁷ 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 emphasis was on air. Aerial resupply was

critical to both the Imphal-Kohima operation in 1944 and the Irrawady campaign in 1944-45. During the latter operation, Field Marshall Slim made airfields the highest priority, constructing them every fifty miles during the advance.²⁸ Support to the Chinese was even more dependent on air, via the renowned Hump. Air LOC security was naturally a vital concern, and the Air Transport Command accepted longer legs with increased flying times to avoid Japanese held areas in northwest Burma.²⁹

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,"³⁰ they still relied on communications 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."³¹

Five decades later the Ho Chi Minh Trail served the same purpose for the North Vietnamese to sustain their army (the NVA) 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.³² The importance that they attached to the trail was evident by their violent reactions to attempts to interdict it, once in 1970 by an unfriendly Cambodian

government and again in 1971 by US ground operations into Laos.³³ Indeed, some consider that the US inability to sever permanently the Ho Chi Minh Trail was a major operational failure of the war.³⁴

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.³⁵ Still they worried about the threat of Argentine submarine attacks and Russian spy ships and overflights in the vicinity of Ascension.³⁶ And well that the British did fret over LOC security; by the war's end they had lost six ships and ten more badly damaged.³⁷

The US was not without concerns for LOC security during Operation URGENT FURY in 1983. 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.³⁸

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 to the Georgia coast. James 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.³⁹ To these can be added another reason - Sherman's army moved toward a secure base. Can these same conditions be replicated to permit a modern army to campaign successfully without secure LOCs? While anything is possible,^{*} three examples from different wars suggest probably not.

Excellent modern cases of insecure LOCs, both intertheater and intratheater, directly contributing to campaign failure and the ultimate capture of an army are Axis operations in North Africa in World War II. The British grip on the Mediterranean put the Axis inter-theater 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."⁴⁰ Malta-based British air rendered the Axis capture of additional ports, such as Tobruk, almost meaningless because shipping was simply too vulnerable.⁴¹

Axis intratheater ground LOCs frequently suffered the same problems as the SLOCs. After failure at 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.⁴²

^{*}The Berlin Wall came down in 1989.

In fact, operations in North Africa confirm the theory of Clausewitz, Jomini, and Hart. Campaigns on both sides aimed principally at severing the enemy's communications while protecting one's own. Rommel summarized,

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.⁴³

Though he ultimately fell short, Rommel had the theory right.

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.⁴⁴ Arguably, the NKPA verged on exhaustion at the time, but the strike against its primary LOC resulted in a withdrawal that "quickly degenerated into a rout and a flight for survival."⁴⁵

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.⁴⁶ French failure from that time forward was a foregone conclusion. "Dien Bien Phu, like almost all other besieged fortresses, eventually died from its own supply deficiencies."⁴⁷

History clearly shows that secure LOCs are an absolutely 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 confirms current US doctrine as well. Projection of combat forces is at extreme risk in the absence of secure LOCs; continuity of operations demands assured communications; and major operations to insure safe passage of supplies may sometimes be required. While secure LOCs are no guarantee of victory, if left unsecured they promise defeat.

But more than secure LOCs is required to sustain Army forces in a unified command's wartime campaign. Supplies must also be distributed within a theater. The extent to which an infrastructure is necessary to accomplish the task of distribution is the next subject of analysis.

The Infrastructure

The JCS support planning model assumes that an intratheater means of distribution exists. This means is normally associated with an infrastructure that permits the transload and forward movement of supplies.^{4a} Again employing theory, doctrine, and history, the analysis tests the association between supply distribution and a theater infrastructure.

Nineteenth century European armies depended largely on the locale for subsistence, which was by far their biggest supply challenge. Consequently, Clausewitz and Jomini measured the infrastructure mostly in terms of its agricultural productivity.⁴⁹ Nonetheless, both offer advice applicable to modern theaters. Clausewitz gives importance to roads, rivers, and "busy coastal areas." He also concludes that the larger the army, the greater the requirement for a well-developed infrastructure.⁵⁰ Jomini offers similar advice:

It does not suffice to assemble immense provisions, there is yet necessary [sic] the means of causing them to follow the army....⁵¹

The means, he says, are "portable provisions," light but solid carriages in large numbers, roads, and rivers. Thus, the classical theorists give credence to the necessity of the facilities which enable movement of supplies and soldiers.

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 notes, "All logistical functional areas, and hence, all sustained combat power, rely on the transportation and distribution system."⁵² Field Manual 100-5 directly associates the availability of ports, airfields, depots, and transportation facilities, and the forces needed for their operation with the ability

of Army units to initiate and sustain campaigns.⁵³ Field Manual 100-16 echoes this requirement, stating, "Care must be taken to frontload adequate terminal and motor transport equipment in order to offload and move supplies."⁵⁴ That the CINC's strategic estimate must include the theater's infrastructure in assessing the theater's sustainment capability attests to the importance that US doctrine places on the facilities and units for supply distribution.

History demonstrates the requirement for an infrastructure, as doctrine defines it, to sustain large, mechanized army formations operating over extended land distances. The Allied build-up and execution of Operation OVERLORD and the operations which 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 was stressed maximally to 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.⁵⁵ During the final stages of the build-up, port congestion caused the British to reduce their import program to free berths.⁵⁶ 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. Of primary concern 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.⁵⁷ Planners scrutinized the French rail system as well, recognizing that ports lacking sufficient rail outlets would be of little use.⁵⁸

Another planning concern for OVERLORD was support for the units ashore until ports were opened. Provisional units were formed to organize and operate an over-the-shore supply distribution system. 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...."⁵⁹ Their success at Omaha Beach was obvious after two weeks when activities "resembled the operations of a major port."⁶⁰

Despite the intense planning, the infrastructure stymied the pursuit across France. The bottleneck was the transportation of supplies, particularly fuel, from the ports to the front.⁶¹ 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.⁶² This herculean 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."⁶³

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. Also demonstrated is that at each phase of the operation the infrastructure presented some limiting factor. Nonetheless, the attention given the facilities and units for supply distribution undoubtedly contributed to the overall success of 1944 Allied operations in the ETO.

How the lack of an infrastructure can promote campaign failure is shown by the Axis experience in North Africa and the German invasion of Russia. The North African theater, with its paucity 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...."⁶⁴ Furthermore, with no adequate railroad running east from Tripoli, the Afrika Korps was heavily dependent on motor transport.⁶⁵ As the ground LOCs extended during the 1942 offensive, the Germans' lack of motorization was telling. Rommel lamented, "Supply difficulties, particularly getting the stuff up

overland, are ... a great headache."⁶⁶ 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, hundreds of miles from the front, unable to be moved for want of motor or rail transport.⁶⁷ The infrastructure, both the North African fixed facilities and the German services of supply, simply 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.⁶⁸ The absence of roads across the Russian frontier exacerbated the problem, rapidly and drastically reducing the Grosstransportraum's motor transport capability.⁶⁹ The rail system was equally broken. The Eisenbahntuppe could not convert Russian rail to German gauge fast enough to keep up with the offensive. Establishment of transload points to move cargo from German to Russian trains was a disaster; huge bottlenecks developed.⁷⁰ In November 1942, Army Group Center received barely half of its daily requirement of supply trains.⁷¹ As in North Africa, German ignorance of the infrastructure's capabilities contributed significantly to operational failure.

These historical examples lead to the unsurprising conclusion that campaigns involving large, mechanized formations require an infrastructure in the classical sense. Airfields, ports, and railroads, with the units

to operate them, and motor transport over a decent road network are the bedrock of the supply distribution system in such a theater. 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 infrastructure in continental and maritime theaters. The ETO relied on trans-Atlantic deliveries to a fairly limited number of ports. Trans-load 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 1944.⁷² 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.⁷³ Ships backed up at ports, aggravating an already severe shipping shortage.⁷⁴

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. But this solution was expensive; the increase in turn-around times further intensified the shipping shortage. Interservice coordination improved to synchronize ship arrivals with port availability and discharge capa-

city.⁷⁵ Introduction of the DUKW, an amphibian two-and-a-half ton truck, provided a means of ship-to-shore cargo discharge "at ports having inadequate facilities, or over coral beaches."⁷⁶ 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.⁷⁷ 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 encountered 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.⁷⁸ 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.⁷⁹ The best the local infrastructure could offer during the approach to Port Stanley was one tractor and trailer, which the British used to haul heavy equipment.⁸⁰ As in the Pacific theaters of World War II, a

largely undeveloped island required means of supply distribution and transportation which 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 Marshall Slim's emphasis on airfield construction.* He gave equal attention to building railroads and roads. Slim notes that large numbers of

labour, 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.^{a1}

Even with this recognition, the Fourteenth Army frequently depended on cart paths and airdrops, and more often than not, lived on a shoestring.^{a2}

Summarizing, theory, doctrine, and history agree on the necessity for an infrastructure to support ground 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 large, mechanized formations in World War II. Less developed infrastructures, historically more reliant on special units and raw manpower than fixed facilities to distribute supplies, permit less mechanized combat forces. History

*See page 11.

also confirms that infrastructural deficiencies, whether in facilities or service and transportation units, can impede operations. Successful armies overcame the impediments through resources or willpower; unsuccessful armies were hostage to their inadequate means of supply distribution.

Analysis shows that secure LOCs and sufficient infrastructure are two absolute requirements to sustain Army forces in a unified command's wartime campaign. It also shows that "sufficient" infrastructure varies considerably between theaters. One importance of these findings is what they imply for operational planners. This is the subject of the next section.

IV. IMPLICATIONS

The foregoing analysis has implications for planners at the strategic level and service functional areas as well as the operational level. With respect to the necessity for secure LOCs and a theater infrastructure, the linkages are so close that operational implications cannot be considered in isolation from the strategic and service-related concerns. Therefore, while the discussion that follows focuses on the operational level, strategic level implications are also noted. Implications for the US Army as it assumes a less forward deployed posture in the coming years are discussed separately.

Implications for Operational Planners

An assumption that frequently appears in operation plans (OPLANS) is, "LOCs will be secure."⁸³ To have utility, this assumption must be both necessary and valid.⁸⁴ The analysis has confirmed the necessity of secure LOCs to a unified command's operations. However, it also clearly demonstrates that the condition is often difficult to achieve. Such an assumption would have been quite invalid in the early days of the Atlantic and Pacific theaters of World War II. 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 [emphasis added]."⁸⁵ For the Axis' North African theater, assuming secure LOCs, either intertheater or intratheater, would have been ludicrous. What would have been a good assumption at the start of the NKPA's 1950 campaign was invalidated in a stroke by the Inchon invasion, suggesting the need for an OPLAN branch.

Whether "LOCs are secure" is a valid assumption depends primarily on the ability of one's forces to make them so. For intertheater LOC security, the US depends mostly on the Navy.⁸⁶ Intratheater LOC security is more for the CINCs to accomplish through campaign design, including allocation of forces for that purpose if necessary.

But the business of LOC security is more complicated than simply defining the theater boundary and labelling one side "intertheater" and the other "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.⁸⁷ Today, security of the long SLOC to the US Central Command would require similar coordination and cooperation with the US Atlantic Command or the US Pacific Command, or both. Certainly theater planners have a role in insuring those relationships.

Also complicating LOC security is the overlap which 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.⁸⁸ At some point, the intertheater LOC becomes a theater concern to secure. Surely Operation JUST CAUSE theater of operations planning included protection of inbound strategic airlift from any Panamanian Defense Force threat. Again, close coordination between 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 Army campaigns may be affected by the battle to secure the LOCs. First, securing the inter-theater LOCs may draw away resources otherwise available to ground operations. Accelerated troop movements to New Caledonia and the Fiji Islands in 1942 meant a reduction in combat power for the campaigns that followed. Second, the time required to secure the inter-theater 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.

Just 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.

To briefly recap, the essentiality of LOC security has at least three implications for operational planners. First, if the theater OPLAN assumes intertheater LOC security, then two branches are probably needed. One would assume that LOCs are not secure from commencement of hostilities. The other would assume that LOC security is lost during the ground campaign. The second implication is that operational planners play a part in intertheater LOC security and have major responsibilities for securing intratheater LOCs. The more the OPLAN relies on throughput distribution using strategic

transportation, the more concerned must the operational planner be with intertheater LOC security. A third implication is that securing LOCs may take resources away from the operational planner while concurrently allowing the enemy time to strengthen his position.

The analysis also holds implications concerning the theater infrastructure. Most obvious is that operational planners must fully appreciate the peculiarities of their respective theaters to make supply distribution happen. The methods employed in Europe in World War II would not have worked in the Pacific theaters. Operations in North Africa and Russia required proportionally greater motor transportation resources than Europe because of differences in rail networks. The British had to rethink their methods of supply distribution in the Falkland Islands war. The diversity of theaters in which today's US Army forces may fight makes careful analysis of the infrastructure's capabilities an imperative.

The US must be prepared to defend allies across the highly developed transportation networks of Central Europe, but also in Central America, the Middle East and the Pacific. Each operation demands separate equipment - long and short haul aircraft, troop and supply helicopters, land-based trucks of all sizes and amphibious vehicles.²²

Two extremes exist as to how infrastructural analysis proceeds. At one end of the spectrum is the planner who, after asking what the existing facilities and service and transport units will support, tailors the

forces within those restraints. This is essentially the method the Allies employed in the ETO, with ultimate success. At the opposite pole is the planner who starts by determining the forces required or available to accomplish the mission, then creates 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 Marshall Slim's margin of error logistically was often infinitesimally small. The "right" answer for most situations probably lies somewhere between the two extremes.

There are indicators to suggest towards which pole the operational planner should lean. A well-developed infrastructure with fixed facilities is required to support large, mechanized formations; a high density of troops distributed throughout a geographically large, contiguous land theater; and sustained high-intensity combat. The emphasis shifts from developed facilities to units (including host nation organizations) with special capabilities or simple labor when the theater is maritime or poorly developed. But neither extreme is absolute. The Provisional Engineer Brigades of the ETO were units with special capabilities working in the most infrastructurally mature theater of World War II. Conversely, the Fourteenth Army used tanks in Burma despite the lack of roads and railroads. If ever the operational level logistician is an artist, it must lay in marry-

ing infrastructural capabilities with operational concepts.

The requirement for an infrastructure also implies that port operation, transportation, and engineer units should be among the first introduced to a theater. All are required to establish the supply distribution system and facilitate the movement of combat forces regardless of the theater's characteristics. US operational planners face a particular challenge in this respect. Field Manual 100-5 accurately notes:

Since a large proportion of the Army's CSS [combat service support] units are in the reserve components the preparedness of those units and the time necessary to mobilize and deploy them will be a significant factor in planning the establishment of an overseas theater of war. If reserve component forces are not readily available, the scope and nature of theater sustainment will be seriously affected.²⁰

The result of allowing time for reserve component units to mobilize and deploy is the same for the operational planner as "waiting" for secure LOCs. The time provides the enemy additional opportunity to strengthen his position. This is particularly critical if forced entry is required, as in the ETO and many Pacific islands.

The operational planner also must recognize that any infrastructure has a limiting factor, and that factor may change over time. The Allied build-up in England was first limited by port discharge capacity. When that was fixed, port offload capacity impeded the

accumulation of supplies. During the initial days of OVERLORD over-the-shore discharge capacity fell behind the requirements. Shortage 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 in the Falkland Islands. The tasks of the operational planner are to anticipate the next limitation and plan for its reduction and to understand the effects of limiting factors on operational planning to make necessary adjustments.

Summing up what the requirement for an infrastructure implies for the operational planner, first is that careful comparison of the infrastructure's capabilities with the operational scheme is required. This is a most obvious and perhaps most difficult imperative. A second implication is that the units essential to the supply distribution system should be among the first to deploy. And thirdly, the analysis shows the importance of recognizing the infrastructure's current and future limiting factors, working towards their reduction, and adjusting operational plans as necessary.

A theme common to the implications of LOC security and sufficient infrastructure is that they can impose operational limitations. The analysis demonstrates that the absence of either contributes significantly to

failure. Even short of failure, that LOCs must first be secured and an infrastructure established has frequently delayed initiation of campaigns, with all that delay means to relative combat power. One reason US Army 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 less forward deployed Army.

Implications for a Less Forward Deployed Army

Foremost among the implications is that pre-positioned organizational materiel configured to unit sets (POMCUS), as a subset of pre-positioned war reserve materiel stocks (PWRMS), will take on added importance. Time is a critical element, and POMCUS stocks substantially reduce the time required to equip reinforcing forces. Without POMCUS, reinforcing forces must deploy with their equipment, and all except light infantry and airborne units would rely primarily on sealift. This sets SLOC security as a precondition, and the analysis demonstrated that securing SLOCs is a time-consuming task during major conflict. As the Army reduces its forward deployed posture but retains its commitment to reinforce overseas theaters, pre-positioned equipment becomes even more essential for timely action.

Delivery of reinforcing units will still require secure ALOCs, but the air war need not have been won.

The Navy and Air Force can open corridors for airlift transit that will permit timely introduction of reinforcing units if hostilities have commenced. Certainly this is not without risk, but it may involve less risk than allowing the enemy the additional time which SLOC security implies.

Even light forces could profit from pre-positioned equipment. The 82d Airborne Division deployed a platoon of Sheridan tanks from Fort Bragg to Panama prior to the initiation of Operation JUST CAUSE.²¹ Though the tanks apparently were hidden successfully, operational security would have been at less risk had a few tanks been pre-positioned in Panama.

The increased significance of POMCUS stocks carries further implications. The security of POMCUS will become even more important, and this is not an easy task.²² Reinforcing units' access to POMCUS - roads and transportation from points of debarkation to POMCUS sites - also assumes greater consequence. Theater operational planners may need to add resources to these seemingly mundane chores if the equipment is to be available to reinforcing units upon their arrival in the theater. It may also require relocation of some POMCUS sites to improve upon their security and accessibility.

The battle for LOC security will impact more on an Army in a less forward deployed posture. In the World War II Pacific theaters Army forces were diverted to islands critical to the SLOCs. Diversion of forward

deployed forces for such contingencies is unlikely, but it is conceivable that a theater could lose planned reinforcements for such missions. As theater planning becomes more reliant on reinforcements in lieu of forward deployed units, such diversions would upset significantly operational plans. In an environment of insecure LOCs, planning flexibility will be at a premium.

The infrastructural requirement implies that the combat-to-combat service support ratios may need adjustment in theaters with forward deployed forces. Rapidly reinforcing these theaters requires in-place transportation and quartermaster capabilities based on the planned reinforcements. These requirements will change very little. Thus, as the total number of forward deployed forces decreases, those units which are critical to introducing reinforcing units will see no corresponding decrease 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.

Summarizing, the requirements for secure LOCs and "sufficient" theater infrastructure have three implications for the Army as it withdraws forward deployed forces. One, POMCUS stocks will become increasingly important as operational planning relies more on reinforcing units. The war will not wait on the SLOC security that is required to deploy reinforcements with their equipment. Two, diverting reinforcements to the

battle for LOC security will have relatively greater impact on operational plans. And three, since withdrawal of forward deployed combat units will not change substantially the wartime requirements to support the return of reinforcing units, proportionally fewer of the critical CSS units should be withdrawn. Otherwise, ground operations during the war's initial phases are at risk.

V. RECOMMENDATIONS AND CONCLUSION

I don't know what the hell this logistics is... but I want some of it.⁹³

Admiral Ernest J. King

From the implications for a less forward deployed Army come two recommendations, both related to Conventional Forces in Europe (CFE) reductions. As the Army reduces Europe's forward deployed forces, every effort should be made to retain POMCUS stocks at least at current levels. POMCUS provides the only means of timely introduction of large, mechanized formations that heretofore were required for a conventional fight in Central Europe. POMCUS stocks ought not be a bargaining chip for CFE negotiators until potential adversaries during a war in Europe are unable to threaten our Atlantic SLOCs or the requirement to rapidly reinforce the theater no longer exists.

The second recommendation is that NATO and US Army Europe force developers objectively determine what the right combat-to-CSS ratio is given fewer forward deployed forces. As discussed previously, the CSS requirements to support rapid reinforcement argue against reducing in-theater CSS capabilities in proportion to reductions in combat forces. This is admittedly a political football; does the presence of CSS units represent the same commitment to the defense of NATO as like numbers of combat units? If the answer is no, and US Army CSS capabilities are significantly reduced, then the risks to rapid reinforcement increase while forward deployed combat and sustainment resources concurrently decrease. Objective analysis will at least describe the problem in a way that permits exploration of viable alternatives.

The findings of this monograph are not surprising. Sustainment of Army forces in a unified command's wartime campaign requires secure intertheater and intratheater lines of communication, and a theater infrastructure is necessary for supply distribution. Certainly other conditions must exist for the JCS support planning model to perform as envisioned, such as sufficient air and sea lift.²⁴ But the prerequisites for campaigning with distinct operational planning implications are secure LOCs and facilities and units to distribute supplies tailored to a theater of war or a

theater of operations. These are the essence of support of theater Army forces.

The implications of the analysis offer useful questions for theater planners to consider. What is the operational planner's role with respect to intertheater LOC security? How does the operational planner attack his enemy's LOCs, be they intertheater or intratheater, while protecting his own? How should the operational planner adjust if a campaign to secure intertheater LOCs must precede the theater campaign? How does the operational planner tailor the infrastructure to suit the theater's particular geographic and military characteristics? How does the operational planner time phase forces into the theater while insuring throughout the proper combat-to-CSS ratio? What are the infrastructure's limiting factors, how can they be identified a priori, and how does the operational planner minimize their effects?

These questions describe the art of support of theater Army forces. The conditions - secure LOCs and infrastructural capabilities - are essential; the art lies in operational planning and execution that achieves them. Hopefully, raising the questions in light of theoretical, doctrinal, and historical analysis has provided a framework useful to the operational design of lines of communication and theater infrastructure.

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¹Sun Tzu, The Art of War, trans. Samuel B. Griffith (New York: Oxford University Press, 1971), p. 104.

²U.S. Armed Forces Staff College, The Joint Staff Officer's Guide 1988, AFSC Pub 1 (Washington, D.C.: U.S. Government Printing Office, 1 July 1988), p. 174.

³U.S. Joint Chiefs of Staff, Dictionary of Military and Associated Terms, JCS Pub 1 (Washington, D.C.: U.S. Government Printing Office, 1 June 1987), p. 48.

⁴U.S. Department of the Army, Operational Terms and Symbols, Field Manual 101-5-1 (Washington, D.C.: U.S. Government Printing Office, October 1985), p. 1-10.

⁵AFSC Pub 1, p. 173.

⁶Lena Laures, "War Reserves - Key to Sustainability," Army Logistician, 17 (July-August 1985), p. 4.

⁷Laures, p. 4.

⁸AFSC Pub 1, p. 173.

⁹U.S. Department of the Army, Support Operations: Echelons Above Corps, Field Manual 100-16 (Washington, D.C.: U.S. Government Printing Office, April 1985), pp. 6-71 - 6-72.

¹⁰AFSC Pub 1, p. 174.

¹¹AFSC Pub 1, p. 174.

¹²AFSC Pub 1, pp. 174-175.

¹³Carl Von Clausewitz, On War, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1984), p. 341.

¹⁴Antoine Henri Jomini, The Art of War, trans. O.F. Winship and E.E. McLean (New York: G.P. Putnam, 1854), p. 269.

¹⁵Clausewitz, pp. 345-346.

¹⁶Jomini, p. 91.

¹⁷B.H. Liddell Hart, Strategy (New York: Signet, 1974), p. 326.

^{1a}U.S. Joint Chiefs of Staff, Doctrine for Logistic Support of Joint Operations (Initial Draft), JCS Pub 4-0 (Washington, D.C.: U.S. Government Printing Office, June 1989), p. V-2.

^{1b}U.S. Joint Chiefs of Staff, Unified Action Armed Forces (UNAAF), JCS Pub 2 (Washington, D.C.: U.S. Government Printing Office, December 1986), p. 2-7. The Navy is to "protect vital sea lines of communication." U.S. Joint Chiefs of Staff, Doctrine for Joint Operations (Final Draft), JCS Pub 3-0 (Washington, D.C.: U.S. Government Printing Office, April 1989), p. I-7. The CINC's strategic estimate includes an assessment of both intertheater and intratheater LOC security.

^{2a}U.S. Department of the Army, Operations, Field Manual 100-5 (Washington, D.C.: U.S. Government Printing Office, May 1986), pp. 65-68.

^{2b}Field Manual 100-16, p. 6-89.

^{2c}Richard M. Leighton and Robert W. Coakley, Global Logistics and Strategy: 1940-1943 (Washington, D.C.: Office of the Chief of Military History, U.S. Department of the Army, 1955), pp. 206-208.

^{2d}James A. Huston, The Sinews of War: Army Logistics, 1775-1953 (Washington, D.C.: Office of the Chief of Military History, U.S. Department of the Army, 1966), p. 511.

^{2e}Leighton and Coakley, p. 15.

^{2f}Leighton and Coakley, pp. 206-208.

^{2g}Huston, p. 519.

^{2h}Leighton and Coakley, pp. 151-155.

²ⁱDon T. Riley, "The Evolution of Operational Art - The Reconquest of Burma, 1943-1945" (unpublished School of Advanced Military Studies monograph, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 29 May 1987), p. 31.

^{2j}Roger D. Launius, "Flying the 'Hump'," Airman, XXIX (December 1985), p. 19.

^{2k}T.E. Lawrence, Seven Pillars of Wisdom (New York: Penguin Books, 1986), p. 346.

^{2l}T.E. Lawrence, "The Evolution of a Revolt," Army Quarterly, I (October 1920), p. 64.

³²Stanley Karnow, Vietnam: A History (New York: Penguin Books, 1984), p. 334.

³³Bruce Palmer, Jr., The 25-Year War: America's Military Role in Vietnam (New York: Simon and Schuster, 1985), p. 99 and pp. 108-109.

³⁴Harry G. Summers, Jr., On Strategy (Carlisle Barracks, Pennsylvania: U.S. Army War College Strategic Studies Institute, 1982), p. 76.

³⁵Kenneth L. Privratsky, "British Combat Service Support During the Falkland Islands War: Considerations for Providing Operational Sustainment to Remote Areas" (unpublished School of Advanced Military Studies monograph, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 1 April 1986), pp. 18-19.

³⁶Max Hastings and Simon Jenkins, The Battle for the Falklands (New York: W.W. Norton and Company, 1983), p. 131.

³⁷Hastings and Jenkins, p. 316.

³⁸Mark Adkin, Urgent Fury: The Battle for Grenada (Lexington, Massachusetts: D.C. Heath and Company, 1989), p. 143.

³⁹Huston, pp. 236-237.

⁴⁰The West Point Atlas of American Wars, Volume II, 1900-1953, ed. Vincent J. Esposito (New York: Praeger Publishers, 1972), World War II Map 77.

⁴¹Matthew Cooper, The German Army, 1933-1945: Its Political and Military Failure (New York: Stein and Day, 1978), p. 362.

⁴²Erwin Rommel, The Rommel Papers, ed. B.H. Liddell Hart, trans. Paul Findlay (New York: Harcourt, Brace and Company, 1953), p. 265.

⁴³Rommel, pp. 199-200.

⁴⁴Clay Blair, The Forgotten War: America in Korea, 1950-1953 (New York: Anchor Books, 1989), p. 318.

⁴⁵The West Point Atlas of American Wars, Volume II, 1900-1953, Korean War Map 6.

⁴⁶Bernard B. Fall, Hell in a Very Small Place (New York: Random House, 1968), p. 44 and p. 180.

⁴⁷Fall, p. 455.

^{4a}JCS Pub 4-0, pp. V-1 - V-5. This publication employs the term "power grid" to describe the transportation and distribution system within a theater. The power grid includes the LOCs (both intertheater and intratheater), ports, bases, and airfields as well as the service units which operate them. This analysis considers LOCs as a separate entity, and includes railroad and motor transport as components of the infrastructure.

^{4b}Clausewitz, p. 325, p. 332, and p. 338; Jomini, pp. 158-159.

^{5a}Clausewitz, p. 338 and pp. 342-343.

^{5b}Jomini, p. 159.

^{5c}JCS Pub 4-0, pp. V-1 - V-2.

^{5d}Field Manual 100-5, pp. 63-64.

^{5e}Field Manual 100-16, p. 6-99.

^{5f}Roland G. Ruppenthal, The European Theater of Operations: Logistical Support of the Armies, Volume I, May 1941 - September 1944 (Washington, D.C.: Office of the Chief of Military History, U.S. Department of the Army, 1985), pp. 60-75.

^{5g}Ruppenthal, p. 239.

^{5h}Ruppenthal, pp. 285-286.

⁵ⁱHarold Mack, "The Critical Error of World War II" (unpublished National Defense University Paper 81-1, February 1981), pp. 3-4. Mack, who was the Chief of Movements for U.S. Army Forces in the ETO, asserts that this examination caused planners to focus on Quiberon Bay, located on the south side of the Brittany Peninsula. Operation CHASTITY was developed to secure the bay after the breakout from the Normandy beachhead. He faults Patton, among others, that CHASTITY was never executed, and further claims that if Quiberon Bay had been captured and developed as planned, the Allied advance would not have ground to a halt in the fall of 1944. Whether this is true, and the reasons that CHASTITY was not executed, merit further historical analysis.

^{5j}Ruppenthal, p. 283.

^{5k}Ruppenthal, p. 397.

⁶¹Ronald Andidora, "The Autumn of 1944: Boldness Is Not Enough," Parameters, XVII (December 1987), p. 74. See also Ruppenthal, p. 491.

⁶²Ruppenthal, pp. 557-559.

⁶³Ruppenthal, p. 572.

⁶⁴Martin van Creveld, Supplying War: Logistics from Wallenstein to Patton (New York: Cambridge University Press, 1982), p. 199.

⁶⁵van Creveld, pp. 184-185.

⁶⁶Rommel, p. 186.

⁶⁷van Creveld, p. 200.

⁶⁸van Creveld, p. 159.

⁶⁹van Creveld, p. 155.

⁷⁰van Creveld, p. 178.

⁷¹Cooper, p. 331.

⁷²Huston, p. 542.

⁷³Huston, p. 538.

⁷⁴Leighton and Coakley, p. 398.

⁷⁵Leighton and Coakley, pp. 399-403.

⁷⁶Leighton and Coakley, p. 410.

⁷⁷Huston, pp. 554-555.

⁷⁸Hastings and Jenkins, p. 219.

⁷⁹Privratsky, p. 14.

⁸⁰Hastings and Jenkins, p. 264.

⁸¹Viscount Slim, Defeat Into Victory (London: Macmillan Publishers Limited, 1987), pp. 172-173.

⁸²Riley, p. 9.

⁸³See, for example, the School of Advanced Military Studies Allied Forces Central Europe (AFCENT) exercise of Academic Year 1989-90, Enclosure C (Logistics Estimate) to Tab D (NATO Ministerial Directive), p. 3-21-7.

^{a4}U.S. Department of the Army, Staff Organization and Operations, Field Manual 101-5 (Washington, D.C.: U.S. Government Printing Office, May 1984), p. 5-1.

^{a5}Huston, p. 511.

^{a6}See endnote number 19.

^{a7}Leighton and Cookley, p. 175.

^{a8}Field Manual 100-16, p. 6-36.

^{a9}Rick Marshall, "Logistics: Does the Tail Wag the Tiger?" Defense and Foreign Affairs, XIV (August-September 1986), p. 31.

^{a10}Field Manual 100-5, p. 64.

^{a11}Dennis Steele, "Operation Just Cause," Army, 40 (February 1990), p. 41.

^{a12}Marshall, p. 31.

^{a13}Military Logistics Forum, 1 (September/October 1984), p. 3.

^{a14}See John P. Dunigan, "Strategic Mobility - Does the United States Have the Strategic Lift to Get to Our Next War and Remain for the Duration?" (unpublished School of Advanced Military Studies monograph, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, May 1989.)

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