Chapter 1

The Nature of Logistics

"Throughout the struggle, it was in his logistic inability to maintain his armies in the field that the enemy's fatal weakness lay. Courage his forces had in full measure, but courage was not enough. Reinforcements failed to arrive, weapons, ammunition and food alike ran short, and the dearth of fuel caused their powers of tactical mobility to dwindle to the vanishing point. In the last stages of the campaign they could do little more than wait for the Allied advance to sweep over them."[1]

—Dwight Eisenhower

"As we select our forces and plan our operations, ... [w]e must understand how logistics can impact on our concepts of operation. . . . Commanders must base all their concepts of operations on what they know they can do logistically."[2]

—A. M. Gray, Jr.

To conduct logistics effectively, we must first understand its fundamental nature—its purpose and its characteristics—as well as its relationship to the conduct of military operations. This understanding will become the basis for developing a theory of logistics and a practical guide to its application.

WHAT IS LOGISTICS?

Logistics is the science of planning and carrying out the movement and maintenance of forces.[3] Logistics provides the resources of combat power, positions those resources on the battlefield, and sustains them throughout the execution of operations. Logistics encompasses a wide range of actions and the relationships among those actions, as well as the resources that make those actions possible. These actions are all given purpose and definition by the larger art of war, of which logistics is a critical and inseparable part.

Actions that fall into the category of logistics are both humble and magnificent, include both the simple and the complex, and range in size from the tiny to the gargantuan. They include the serving of a single meal, the effective distribution of tens of thousands of separate spare parts, and the movement of vast armadas from one corner of the globe to another. The common thread that unites these otherwise disparate activities is their

relationship to the physical needs of a military force. Any action that serves to transport a military force from one place to another, provide it with the physical means of waging war, or preserve its combat power for subsequent employment belongs properly to the realm of logistics.

Logistics can also be described as the bridge which connects a nation's economy to its warfighting forces. *Logistics provides the means which translates national resources into combat power*. Logistics transforms manpower, natural resources, and industrial capacity into units, weapons, equipment, and supplies. It delivers these elements to the theater of operations at the time and place dictated by operational requirements. It sustains the military forces throughout the course of operations. It returns those forces to their home bases when operations are concluded, rearming and reequiping them as needed in preparation for the next action.

The term "logistics" is also used to describe activities in the civilian or commercial world. In this usage, logistics describes the process of procurement, maintenance, distribution, and replacement of resources conducted by corporations, firms, or industries. These activities have many points in common with military logistics and can serve as a source of concepts, techniques, and technologies of great interest to military logisticians. Nonetheless, civilian logistics lacks the warlike purpose that defines military logistics and is thus fundamentally different. In this publication, the term "logistics" therefore describes military logistics.

The terms "logistics" and "combat service support" are often used interchangeably, but there is a distinction. "Logistics" is the larger of the two concepts. Logistics encompasses all actions required to move and maintain forces. This includes the acquisition and positioning of resources as well as the delivery of those resources to the forces. "Combat service support" is the *activity* which actually provides services and supplies to the combat forces. Since most of the delivery of resources occurs at the tactical level of war, combat service support has been considered to be essentially the same as tactical logistics. Indeed, Marine tactical units have logistics officers and logistics sections, but the units that perform logistics functions for these units are referred to as combat service support elements. However, some combat service support is conducted at the operational and strategic levels. For example, health services are provided at the strategic and operational levels through the use of hospital ships, fleet hospitals, and permanent military medical facilities. Conversely, some limited aspects of tactical logistics do not directly correspond to combat service support. (See figure 1, page 6.)

HOW IMPORTANT IS LOGISTICS?

Logistics is part and parcel of any attempt to conduct military operations. It is critical to the creation, maintenance, deployment, and employment of forces as well as to the redeployment,

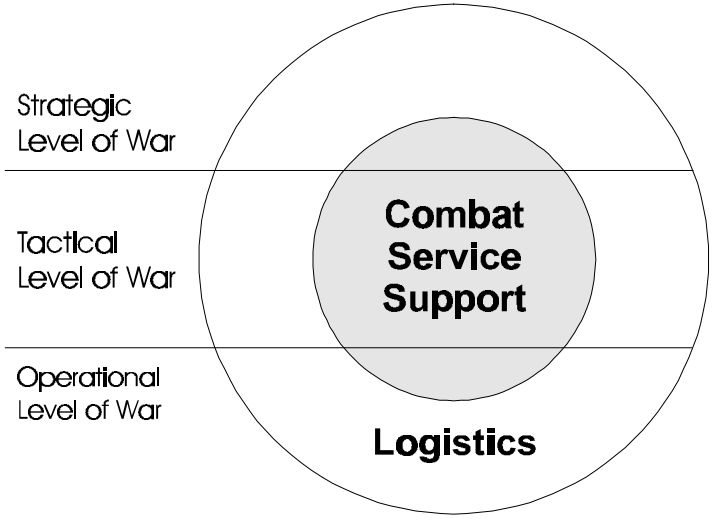

Figure 1. Logistics and combat service support.

reconstitution, and regeneration of those forces after their employment. Without logistics, war as a deliberate, organized activity would be impossible. Without logistics, military units cannot be raised or equipped. Without logistics, forces cannot reach the battlefield. Without logistics, weapons go without ammunition, vehicles go without fuel, equipment breaks and stands idle, the sick and wounded go untreated, troops go without food, shelter, and clothing. Thus, *logistics establishes limits on what is operationally possible*. Nevertheless, while logistics sets the limits, the goal of our logistics effort is to extend those limits as far as possible.

Logistics plays a significant role in any military action, whether the action is part of a war, a military operation other than war, or even a training exercise. Whenever military units are employed, they must be deployed and sustained. In fact, logistic activities are conducted much the same way in peace as they are in war or military operations other than war. Unlike certain functions which are conducted only in war, logistics is always "on."

Logistics is concerned with the provision and allocation of resources. The conduct of war or military operations other than war normally requires extensive resources. However, the resources available to create and sustain combat power are almost always limited. Demand usually exceeds supply. *Logistics helps to ensure the effective use of limited resources.* Logistics assists the commander in making best use of the available resources to accomplish the mission.

Logistics by itself cannot win wars, but it has been the major contributing factor in losing many wars, particularly in the 20th century. At the strategic level, the inability of a nation to generate sufficient forces, move them to the front, and support them once engaged invariably leads to deterioration of the forces' material condition, morale, and tactical capability. This deterioration can be slow, as in the European theater during World War II, or it can occur relatively quickly, as it did in Desert Storm. Both the will and the ability to fight erode, often leading to collapse and defeat.

The impact of logistics inadequacies at the operational and tactical levels is similar. Grand schemes and operational designs never get off the drawing board for want of adequate logistic support. History is filled with examples of forces missing or failing to exploit opportunities because of their inability to logisticly sustain gains resulting from success in individual battles or engagements. On the Western front in World War I, both sides repeatedly demonstrated that it was possible to penetrate the lines of defensive trenches and fortifications; what they could not do was exploit the penetrations once made, primarily due to their inability to support the advancing units.

Logistics is so important that it frequently shapes the designs of campaigns, battles, and engagements. Major operations within a campaign are frequently conducted solely for the purpose of developing the logistics capability required to sustain the campaign as a whole. The island-hopping campaign in the Pacific during World War II was largely dictated by the need to acquire advanced air and naval bases necessary to support forces striking at the Japanese homeland. Conversely, because of their importance to military effectiveness, the logistics capabilities of the adversary are often critical vulnerabilities; supply bases, lines of communications, and combat service support units are always key targets and often become the focal point for engagements and attacks.

CHARACTERISTICS OF LOGISTICS

Logistics is a complex phenomenon that defies easy explanation. Any short definition, particularly one limited to a single sentence or paragraph, will invariably fail to give a complete picture of what logistics is and what good logistics requires. Using the basic description of logistics provided above, we now examine the various characteristics of logistics.

Logistics as Science

Of all the major functions that affect the outcome of war, logistics is the most concrete. In fact, logistics has been one of the few aspects of war that has been consistently described as a science. This means that logistics benefits from a body of facts, relationships, and rules that can be put to use by those who can study and master them. These facts, relationships, and rules can form the basis for calculation, deduction, and, within the limits set by the essentially chaotic nature of war, prediction.

Because of this greater degree of regularity, logistics is an area in which extensive calculation is both possible and necessary. The number and types of ships needed to move a given force from one place to another, the fuel consumed by a unit making a road march, and the spare parts needed to support a certain fleet of vehicles can all be calculated ahead of time. The tools of the civilian engineer—standard planning factors,

formulas, calculations, and rules of thumb—are thus of great use to logisticians.

This is not to say that logistics is perfectly predictable. On the contrary, anything that touches upon war, and certainly something as central to war as logistics, is greatly affected by the chaos that is at the very heart of warfare. Nonetheless, because the obstacles that must be overcome in order to move and sustain forces—time, distance, and terrain—are generally passive, the relationship between inputs and outcomes is far more regular in logistics than in tactics, operations, strategy, intelligence, or command.

Because logistics is a science, it must be thoroughly understood before it is applied. This means that the logistician must do more than pull planning factors out of a book or apply an existing template to a new situation. The logistician must think each problem through, understanding the major assumptions that underlie the calculations and the implications of any change in those assumptions. In other words, the science of logistics requires that its practitioners understand not only the various elements of logistics but the relationships between them.

Despite the strong scientific character of logistics, no single theory underlies the many activities that come under the heading of logistics. The reason is twofold. The first is the great variety of things that must be done in order to move and sustain a

fighting organization. The second is that *logistics is defined less by a set of activities than by its results*. To use a simple example, the purpose of logistics is not to use a particular technique to move so many gallons of fuel or tons of ammunition, but to ensure that the fuel and ammunition are in the right place at the right time.

In contrast to the pure sciences, in which knowledge may be accumulated for its own sake, logistics exists solely for the purpose of supporting military operations. Thus, logistics is an applied science, an endeavor in which the difference between success and failure is a function not only of knowledge but of the techniques, tools, skills, and will to put that knowledge to use. Indeed, the use of logistics is so important that it makes sense to describe logistics as an art as well as a science, a critical and inseparable part of the larger art of war.

Logistics as Art

While some aspects of war fall principally in the realm of science, an even greater part of the conduct of war falls in the realm of art. Art includes the creative application of scientific knowledge through judgment, experience, and intuition to devise practical solutions. In logistics, as in all other aspects of war, it is crucial to develop a vision of what needs to be done and how to do it. In addition to technical skill, development of this vision requires creativity, insight, and the ability to recognize and assess risk. Mechanical and inflexible application of procedures and formulas can lead to paralysis and failure.

Logistics must supplement analysis and calculation with foresight and intuition in order to anticipate future requirements. When circumstances change, logisticians must be flexible and ingenious in adapting to the new situation. Creativity, boldness, daring, and a willingness to innovate or even improvise when necessary are required to exercise the art of logistics. When balanced with sound judgment and decisionmaking skills, application of these characteristics provides the basis for successful logistics.

Logistics as Relationships

In logistics, as with any other aspect of the art of war, "the essential thing is action."[4] However refined, extensive, or accurate the science of logistics may be, it can be translated into the fact of effective logistics only if a large number of people do the right thing at the right time. Some of the actions that make up effective logistics are routine and are thus governed by preexisting rules and procedures. Other actions are ad hoc, taken in response to particular situations. The common denominator that unites these actions is their relationship to the definitive tasks of logistics, the movement and maintenance of forces. Thus, if an action helps to move or maintain a force, it is part of logistics.

The actions that comprise logistics are rarely isolated. Rather, they are but small steps in long, interrelated, and highly complex chains of activity. Originating in the civilian economy, resources pass through the levels of war and many echelons of command, connected by a network of logistics systems and

processes. The intricacy of these relationships quickly becomes evident to anyone who tries fully to describe, by narrative or flowchart, all the logistic activities of even the most rudimentary military force. Nonetheless, any understanding of the logistics of a particular force depends heavily upon a good sense of the nature of these relationships.

The classic technique for making sense of these relationships is to reduce them into abstractions such as lines of communications, kinds of logistics at each level of war, and echelons of various sorts. These abstractions are simultaneously useful and dangerous. They are useful because they provide a shorthand that often captures one or more important features of a relationship—for example, its scale or geographic location. These abstractions are dangerous because they mask the inherent complexity of logistic relationships and often make them seem more straightforward than they really are.

Logistics as Organization

Because of its inherent complexity, logistics requires the sustained, creative, and systematic cooperation of large numbers of people. Such cooperation can be achieved only by means of deliberate, well-considered, and custom-tailored organization. Because of this, it is as impossible to speak of logistics without discussing logistics organizations as it is to explain modern medicine without mentioning hospitals.

The concept and details of organization for logistics can vary greatly. Factors such as geography, the national economies involved, enemy action, the organization and warfighting philosophy of the forces being moved and maintained, and the dynamics of the war being fought all play a role in determining the best logistics organization for a given force. It is even quite possible that the various activities of logistics will be carried out by a number of different organizations.[5]

The common denominator in all healthy logistics organizations is the combination of a shared vision and initiative. The shared vision, promulgated by means of a common organizational culture and the expressed views of leaders, allows the various parts of a logistics organization to set objectives, establish standards, and measure the usefulness of their work. Initiative makes it possible for all parts to solve the problems that they face and overcome the obstacles that stand in their way in a timely and effective manner.

Logistics as a Complex System

Military organizations and military evolutions are complex systems. A complex system is any system composed of multiple parts, each one of which must act individually according to its own circumstances and which, by so acting, changes the circumstances affecting all other parts. Military forces are constantly evolving, changing their size, composition, organization, and capabilities in response to the environment in

which they operate. Because of this, the logistics organizations that move and maintain these forces must evolve as well. In responding to change, a healthy logistics organization functions as a complex system, operating within the complex system of the military force it supports.[6]

The most important implication of this is that a logistics organization will rarely, if ever, achieve a state where "everything goes like clockwork." Indeed, such extreme regularity is a sign that stagnation has set in and the system is probably not adapting to changing circumstances. A healthy logistics organization will thus be a work in progress with some elements in a relatively stable condition and many others in a state of flux. In times of crisis, when circumstances are changing rapidly and swift adaptation is required, logistics organizations are likely to function in nonstandard ways. Periods in which the system operates in a regular and orderly fashion will alternate with periods in which it is in considerable turmoil.

LOGISTICS AND WAR

The character of any war is shaped to a significant degree by the logistics concepts and capabilities employed to move and sustain the forces of each belligerent. At the same time, what we ask of logistics and what logistics is able to provide are profoundly influenced by the particular circumstances of a war, campaign, or battle. These circumstances include, but are

not limited to, geography, climate and weather, resources, technology, population, culture, politics, style of warfare employed by forces, scale, skill of commanders, and goals pursued by the various combatants. Moreover, because all of these factors may interact with each other to produce unpredictable or undesirable results, logistics is often affected further by the dynamics of a particular battle or campaign as it evolves.

What a military force is physically able to do is limited by the way it is moved and supplied. An army supplied from bases along a single line of communications cannot execute movements, however promising they might be, if those maneuvers take it very far away from that line. The style of war employed by a military force is intimately linked to its logistics capabilities. The grand maneuvers that made Bonaparte the master of central Europe were dependent upon the Napoleonic system of drawing the bulk of needed supplies from towns, fields, and granaries in the theater of operations. When, in places like Spain and Russia, these proved inadequate, the rapid movement of large masses of men and horses so necessary to Bonaparte's success was no longer possible. The matériel-intensive style of warfare employed by armed forces of the Republic of Vietnam proved successful in the early 1970s, when the requisite mountains of supplies were provided by the United States. When these supplies were no longer available, the same style of warfare was unable to prevent a catastrophic defeat.[7]

Great feats of arms have often been made possible by the skillful exploitation of special capabilities in logistics. For his conquest of the Persian empire, Alexander the Great conditioned his troops to march with a minimum of baggage, and he developed an intelligence system that made him aware of the location of sources of food and fodder along his route of march. For the British fighting in Spain during the Napoleonic wars and the Marines who fought in the mobile phase of the Korean war, the advantage was control of the sea, which allowed operational movement and the provision of logistic support that was largely independent of traditional lines of communications. The dynamic two-division assault into Kuwait conducted by the First Marine Expeditionary Force (I MEF) during Desert Storm was made possible by the MEF's ability to create a massive forward logistic support base in the middle of the desert immediately before the beginning of the ground offensive.[8] The expeditionary logistics capabilities inherent in modern amphibious forces enabled the 24th Marine Expeditionary Unit to establish forward support bases hundreds of miles inland in Turkey and northern Iraq in support of humanitarian assistance operations during 1991.[9]

Just as logistics does much to shape the operations of war, the changing fortunes of war often have a profound effect on logistics. The winning or losing of a battle, the gain or loss of an ally, the movement of forces from one geographical area to another, and even significant changes in popular opinion and sympathies can often force radical changes in the way that a force is moved and supplied. For the first part of the American

War of Independence, the size, staying power, and operational mobility of George Washington's Continental Army was hampered by a logistics system based on an insufficient number of wagons moving on poorly maintained roads. The alliance with France brought with it the capability to supply the Continental Army by sea and thus made possible the massing and maintenance of the force that won the decisive victory at Yorktown. The capture of Seoul by United Nations' forces in the immediate aftermath of the Inchon landing in 1950 deprived the North Korean army of its logistics infrastructure and its lines of communications.[10] The deployment of the 22d Marine Expeditionary Unit to conduct noncombatant evacuation operations in Liberia during 1990 was initially envisioned as a short-duration mission. As events unfolded, the unstable security situation in Liberia required an extended commitment of amphibious forces, in turn necessitating the establishment of an extensive logistics pipeline to support the U.S. Embassy as well as the military units participating in the operation.

The Human Dimension

Though logistics deals primarily with the physical world, it has a considerable effect on the moral aspect of war. (The term moral as used here is not restricted to ethics, but pertains to those forces of a psychological rather than a tangible nature.) The moral aspect is significant because war is above all a human endeavor. War is a contest between hostile, opposing wills, a struggle in which moral factors—resolve, fear, courage, morale, leadership, will, esprit—are often more important than mental or physical ones.[11]

Logistics plays an important role in the cohesion of a fighting force. By providing the necessities of life, effective logistics frees members of that force from preoccupation with their own needs. This allows them to focus their physical and mental energies on their military duties. By providing the means of waging war, effective logistics not only gives fighters the means of dealing with the physical challenges they face but also gives them the sense of being part of a large and powerful team. By displaying economy, adaptability, fairness, flexibility, and innovation, a logistics system can foster the sense that those in charge know what they are doing. In other words, *good logistics reinforces the moral authority of leaders.*

The link between logistics and the human dimension of war can be seen during World War I in the German spring offensive of 1918. Because of the repeated failure of the German logistics system to provide adequate food and clothing to frontline troops, once German soldiers penetrated the Allied lines, many spent their time looting captured Allied supply depots. Indeed, so great was the sense of privation of many of these soldiers that they looted items that were of no immediate use to them—such as writing paper and shoe polish—simply because they had been in short supply. The immediate, physical effect of the looting was to slow down the tempo of the German attack and thus give the Allies time to bring up reinforcements and establish new defenses. More importantly, the psychological effect of the sharp contrast between Allied plenty and German shortages contributed to the widespread belief

within the German forces that eventual Allied victory was inevitable.

While logistics can have a profound effect on morale and combat effectiveness, the performance of the logistics function is greatly affected by the human aspects of warfare as well. Like other military units, logistics units are composed of human beings whose capacity for action depends heavily on moral factors. Leadership, the maintenance of unit cohesion, and the provision of a clear sense of purpose are as important to the motivation and capabilities of logistics units as they are to the performance of military units of other kinds. High morale among logisticians can, by itself, no more transport supplies across an ocean than the high morale of infantrymen can, by itself, overcome the firepower of a machine gun. Nonetheless, in logistics as in other aspects of the art of war, moral limits are usually reached before absolute physical ones.

Many of the great feats of arms of military history were preceded by feats of logistics that required an extraordinary degree of courage and self-sacrifice. The 1775 siege of Boston that did so much to convert a local rebellion into the American War of Independence would not have been possible without the incredible efforts involved in transporting the artillery and supplies captured at Fort Ticonderoga during the depths of a New England winter. Two centuries later, the Vietnamese operation

of 1954 to capture the French fortress of Dien Bien Phu in what was then French Indochina depended on the transport of tons of supplies by porters carrying packs and pushing bicycles along hundreds of miles of jungle-covered mountain trails.

Violence and Danger

The means of war is force, applied in the form of organized violence. Since war is a violent enterprise, danger is a fundamental characteristic of war. The actions that fall into the category of logistics are rarely, if ever, inherently violent. However, because what they do cannot be separated from war as a whole, those who practice logistics must often deal with both violence and danger. In some cases, this is the direct result of enemy action. Attacks on logistics installations and lines of communications are commonplace in modern warfare. In other cases, the danger faced by those involved in logistics is derivative, resulting from risks taken to provide needed support under conditions of bad weather, fatigue, shortages, and the sense of urgency created during combat. The famous "Red Ball Express," the logistic operation designed to supply the Allied pursuit following the breakout from the Normandy beachhead, was largely free from significant enemy interference. Nonetheless, the urgency of the operation put enormous strain on the truck drivers, mechanics, military policemen, and supply specialists who tried to make the system work. Stress, the poor quality of roads, and the tendency to push vehicles to their mechanical limits resulted in a great number of accidents and many fatalities.[12]

Because logistics is a function of war, the logistics system and the units and personnel that operate that system will be subjected to violence and danger. Commanders have an obligation to protect their logistic elements if these elements are to carry out their essential functions in support of operations. At the same time, logistic organizations must prepare for the stresses of combat. The characteristics that enable us to function in the environment of violence and danger—physical fitness, excellence in basic military skills, technical proficiency, leadership, and unit cohesion—are as important to logistic units as they are to any other type of military organization.

Friction

War is a complex enterprise subject to a multitude of factors. The interaction of these factors, the most important of which is the basic clash of opposing human wills, results in friction. In war, deliberate action of all sorts, to include logistic action, is made difficult by friction, "the force that resists all action." Activities that are a routine part of both civilian and military life in time of peace—the transportation of people and cargo, the distribution of goods, and the provision of services—become harder to carry out in war. Friction can take a number of forms. Physical friction can be caused by such things as weather, accidents, or the incompatibility of systems, equipment, or units that were not prepared to work together. Psychological friction is the distress or disorientation that results from fear or fatigue. Both physical and psychological friction are greatly increased by enemy action.

Because it has so many causes and so takes many forms—indeed, because it is an inherent part of war—friction cannot be eliminated. It can only be reduced and overcome. A means of reducing friction is simplicity, the achievement of which requires continual efforts to eliminate needless complexity. We can overcome friction through the exercise of initiative, creativity, and will power throughout the force. Initiative greatly multiplies the number of minds and wills that take an active part in overcoming friction. Creativity increases the number of possible solutions to any given problem. Will power brings possible solutions far closer to their absolute physical limits than would otherwise be the case.

Logistics is subject to friction to the same degree as other functions in war. Logistics deals in large quantities of matériel, vast distances, and short response times; logistics employs formulas, calculations, and prediction to a greater extent than other functions. All of these actions are readily impacted upon and disrupted by unforeseen events, our own errors, or enemy action. It is important to note that logistics units, installations, facilities, and resources are not merely subject to attack but, in many cases, are the *preferred* targets of military action. We must cope with friction in logistics in the same manner as we do in other aspects of warfighting. Despite the complexity of tasks and functions in logistics, we must strive for simplicity both in the planning and execution of logistics. Designing flexibility into the logistics system provides the means for adaptation to the changes resulting from friction and for the exercise of initiative and creativity.

Uncertainty

All actions in war take place in an atmosphere of uncertainty. Uncertainty pervades battle in the form of unknowns about the enemy, about the environment, and even about the friendly situation. Because logistics deals chiefly with the physical aspect of war, we are tempted to believe that logistics is largely immune from the uncertainties of war. Logistics makes extensive use of precise calculation. Items are counted. Distances are measured. Formulas are used to predict outcomes that range from the amount of fuel a unit needs to make a road march of a given distance to the number and type of ships needed to move a given force from one point to another. Nonetheless, the uncertainty that is part and parcel of war ensures that these calculations, however necessary, will rarely be more than approximations. At times, moreover, the fortunes of war are such that the results of many calculations will bear little resemblance to reality.

We know how much a Marine needs to eat to maintain physical strength and morale, but we do not know whether a particular shipment of rations will be destroyed by enemy action or lost in an accident. We can use our knowledge to calculate the amount of food a force will need to sustain itself for a given number of days, the capacity of various transportation systems needed to move that food, and the human effort needed to turn that food into palatable meals. We cannot, however, predict with any certainty the events, such as casualties or the

surrender of large numbers of enemy troops, that can greatly change the numbers of people who must be fed.

As with friction, uncertainty on the battlefield can only be reduced, not eliminated. The logistics system must be able to function effectively in an environment of uncertainty. It must not come to rely on standard formulas and calculations performed too far in advance of actual operations. The basic nature of logistics requires it to anticipate requirements based on assumptions and predictions in order to position resources where and when they may be required. Nevertheless, it is crucial that the logistics system also be able to adapt to changing circumstances, respond to new requirements, and rapidly implement alternative courses of action when initial assumptions and calculations are found to be in error.

Fluidity

For all that friction does to inhibit deliberate action, war itself is remarkably fluid. Each episode in war is the temporary result of a unique combination of circumstances, presenting a unique set of problems which require an original solution. No episode can be viewed in isolation, nonetheless. Rather, each merges with those that precede and follow it, creating a continuous, fluctuating flow of activity filled with unexpected events and fleeting opportunities.

Great advantages accrue to the military force whose logistics can adapt to changing circumstances and new situations. For this reason, logisticians must always be looking ahead, attempting to identify potential future actions and positioning logistics to support the next battle or even the battle after the next. To do this, they must have a *thorough understanding of the commander's intent* as well as an awareness not just of their own situation but the situation at the operational and sometimes even strategic levels.

The effect of fluidity and the ability of logistics to adapt can be seen in an example from the Korean war. In December of 1950, the entry of Chinese divisions into the war converted a highly successful pursuit by United Nations forces into a headlong retreat. A major factor in preventing this defeat from turning into a catastrophe was the rapidity with which the United Nations logistics system adapted to the new situation and the simultaneous inability of Chinese logistics to do the same. More precisely, logisticians of the United Nations forces were able to quickly change the means by which any given part of the force was moved and resupplied. This ensured that rear guards had sufficient ammunition, that vehicles had fuel, and that necessary improvements to routes of march—which included an entire bridge airdropped to the 1st Marine Division—could be made. The Chinese, on the other hand, remained bound to their traditional, guerrilla-style, logistics system, which assumed that combat units could draw food supplies from a compliant civilian population and that ammunition consumption would be very low. In a situation where the

civilian population was either nonexistent or actively hostile and where units might be required to make several attacks in a week, this failure of the Chinese logistics system to adapt to new conditions translated directly into the failure of the Chinese forces in Korea to properly exploit significant tactical and operational opportunities.[13]

Disorder

In war, friction, uncertainty, and fluidity combine to create a great deal of disorder. Even under the most favorable cir- cumstances, plans will go awry, orders will be misunderstood, important messages will be lost, and units will be mixed. Disorder presents particular problems for logistics, which necessarily depends on what may be called the "orderly virtues"— economy, accountability, standardization, and regularity.

Because of the great benefits that derive from a well-ordered logistics system, logisticians have sometimes made the mistake of trying to combat disorder by stubbornly enforcing procedures, even when the consequence of such enforcement is disaster. A classic example of this is the response of the British quartermasters who, at the critical moment of the battle of Ishandhlwana during the Anglo-Zulu War of 1879, insisted on issuing ammunition "by the book." Men who lacked the proper requisition forms, as well as men who requested ammunition from quartermasters serving units other than their own, were turned away. As a result, the final Zulu charge caught many

British riflemen with empty cartridge boxes and thus succeeded in overrunning the entire British position.

Not so disastrous in the short run, but nonetheless dangerous, is the belief that the disorder inherent in war is so irresistible that all considerations of economy, accountability, standardization, and regularity should be dispensed with. This belief, which was endemic to U.S. forces during the last years of World War II, resulted in such waste, confusion, and destruction that the tempo of operations was considerably slowed. Failure to properly account for supplies resulted in avoidable shortages of such things as artillery ammunition. Widespread refusal to recycle gasoline containers exacerbated already severe gasoline shortages on the front lines with consequent reductions in the ability of frontline units to exploit opportunities. Even something as simple as the littering of roads with tin cans and other garbage led to a shortage of truck tires which greatly hampered the ability of many units to make long road marches.[14]

To deal with disorder, the logistics system must strive for balance. On the one hand, it must estimate requirements and distribute resources based on plans and projections; otherwise the needed support will never be available where and when it is required. On the other, a system that blindly follows schedules and procedures rapidly loses touch with operational realities and inhibits rather than enables effective action. Logistics must

balance the need for economy with the requirement for redundancy and reserve capacity. It must balance the need to anticipate with the requirement to adapt and respond. Finally, above all, it must balance the need for efficiency with the need for effective support on a battlefield characterized by friction, uncertainty, fluidity, and disorder.

LOGISTICS AND OPERATIONS

Effective logistics is absolutely necessary to the conduct of war but does not, in and of itself, guarantee victory. Rather, logistics makes an essential contribution to victory by generating and sustaining the forces that conduct military operations. In doing this, logistics enters into a tense and dynamic partnership with military operations, a relationship in which both logistics and operations exert a powerful influence on each other.

A military operation is an inherently chaotic enterprise shaped by the interplay of two or more hostile wills. It is thus necessarily dynamic. The outcomes and byproducts of battles and engagements are unpredictable. Success or failure in battle does not always bring one side or another closer to its original goal. The situation changes continuously and creates new possibilities for one or more belligerents to exploit. Because of these dynamics, the results of military operations defy

calculation. The result is tension between the desire to design and implement an infinite number of creative and adaptable operational schemes and the need to operate within the realistic boundaries imposed by logistical supportability.

The relationship between logistics and military operations can therefore be stated as: *logistics sets the outward limit on what is operationally possible.* A useful analogy is that of a paddle ball, a toy consisting of a wooden paddle, a ball, and a piece of string. Logistics is like the string; it doesn't determine where the ball will go but sets a limit on how far it can go before being pulled back. Logistics provides and sustains combat power. By determining *how* it provides and sustains combat power, logistics exerts a significant influence over the design and execution of military strategy, campaigns, and tactics. By determining for *how long* it can continue to provide and sustain combat power, logistics establishes constraints for the application of this combat power.

The relationship between operations and logistics applies at all levels of war and across the range of military operations. At the strategic level, the ability of a nation to employ forces to achieve national objectives, to concentrate them in a theater of operations, to keep them there, and to have them engage in operations is directly influenced by the logistics capabilities of that nation. Russia in World War I and China during the Korean war had little difficulty raising large land armies. Concentrating them in a theater of operations and keeping them supplied once there proved far more difficult. As a result, the

forces which could be employed were significantly limited; the actual combat power brought to bear was only a fraction of the country's whole capacity.

A classic example of the limitations imposed by logistics at the operational level can be seen in the series of campaigns for control of Libya during World War II. Distances were so great, the transportation infrastructure so poor, and the difficulties of moving supplies into the theater so overwhelming that otherwise successful offensives were frequently halted for lack of supplies. On the other hand, an example of logistics opening an operational window also comes from the struggle for North Africa during World War II. In the summer of 1942, Axis forces unexpectedly captured the British fortress of Tobruk. Tobruk was a major British logistics base, well-supplied with trucks, fuel, food, and ammunition. The capture of these supplies turned what had been a local offensive with limited objectives into a major threat to Allied control of the Middle East.[15]

Operations during the initial phase of Operation Restore Hope in Somalia in 1992-93 demonstrate that the limitations imposed by logistics apply to military operations other than war as well. Efforts to deliver aid to the most critically affected portions of the country were delayed by the lack of logistics infrastructure required to receive and process supplies as well as to support the military forces who would ensure the safe delivery of those supplies. Marines could not bring the relief supplies inland until the necessary support facilities were established in and around the coastal city of Mogadishu.

If logistics sets the limits, it follows that one of our key objectives must be to ensure that limits imposed by logistics do not inhibit effective operations. We do this in several ways. First, we must ensure that plans and operations always take into account logistic realities. That is, operations must not ask for the impossible or intentionally overstep boundaries set forth by logistics. Second, logistic plans must be developed in concert with operational plans. This helps ensure that logistic plans can support operational designs to the greatest extent possible. Third, logisticians must constantly strive to expand the limits of the possible by employing initiative, creativity, and adaptability in the design and conduct of logistic activities. Finally, it will often be necessary to take specific operational actions to expand logistics capabilities. Whether that means seizing a critical support facility prior to moving against an operational objective, delaying an attack in order to build up the resources necessary to exploit the results, or reducing the size of a force to help reduce the volume of support required, *commanders must consider logistics in the development of plans and the allocation of resources*.

CONCLUSION

Logistics is an integral part of warfighting. Logistic action is an essential part of military action. Logistic relationships and organization are inseparable from the web of relationships and organizations that make modern war possible. Logistics provides the resources of combat power, positions those resources in the battlespace, and sustains them throughout the execution of operations. Because it is an integral part of warfighting, logistics is subject to characteristics of war. Since war is fundamentally a human activity, it is the human dimension that is paramount in logistics. Violence and danger, moral and physical forces, friction, uncertainty, fluidity, and disorder play roles in logistics that are similar to those that they play in other aspects of warfighting. Logistics is a key component of any and every operation of war. While it does not determine the shape that operations take, it sets limits that restrict the options available to commanders. Thus, the more flexible and far-reaching the logistics, the greater the possibility for bold, decisive, and imaginative action.