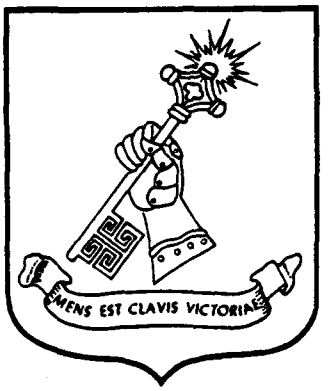
AD-A284 137

Non-Linear Operations: A New Doctrine for a New Era

A Monograph
by

Major Sean B. MacFarland

Armor



DTIC
ELECTE
SEP 07 1994
S G D

94-29039

School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

Second Term AY 93-94

Approved for Public Release; Distribution is Unlimited

DTIC QUALITY INSPECTED 3

94 9 06 138

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	20 APR 94	Monograph

4. TITLE AND SUBTITLE
Non-Linear Operations: A New Doctrine for a New Era (U)

5. FUNDING NUMBERS

6. AUTHOR(S)
Major Sean B. MacFarland, U.S. Army

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Advanced Military Studies
ATTN: ATZL-SWV
Ft. Leavenworth, Kansas 66027-6900
Comm (913) 684-3437 DSN 552-3437

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The latest U. S. Army doctrine calls for quick, decisive victory with minimum casualties. Historically, simultaneity has provided a means of doing this. However, current trends are making it increasingly likely that non-linear operations will be required in order to achieve simultaneity. Our current doctrine provides an excellent framework for conducting mid-to-high intensity linear operations, but it is not well suited to non-linear operations like Operation JUST CAUSE. This monograph provides an alternative, non-linear framework to fill that gap. It concludes that non-linearity will be increasingly necessary to achieve quick and decisive victories, and that the current framework is inadequate for conducting such operations. It also finds that a non-linear framework is universally applicable across the spectrum of conflict, whereas the AirLand Battle framework is not. Lastly, and most importantly, it finds that a non-linear operational framework significantly contributes to achieving the simultaneity necessary for winning quick and decisive victories.

DTIC QUALITY INSPECTED 3

14. SUBJECT TERMS	15. NUMBER OF PAGES
	55
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18 SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclass	Unclass	Unclass	Unlimited

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Sean B. MacFarland

Title of Monograph: Non-Linear Operations: A New Doctrine for a New Era

Approved by:

James J. Schneider, Ph.D. — Monograph Director

COL Gregory Fontenot, MA, MMAS — Director, School of Advanced Military Studies

Philip J. Brookes, Ph.D. — Director, Graduate Degree Program

Accepted this 6th day of May 1994

Accesion For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

ABSTRACT

NON-LINEAR OPERATIONS: A New Doctrine for a New Era
by MAJ Sean B. MacFarland, USA, 45 pages

The latest U. S. Army doctrine calls for quick, decisive victory with minimum casualties. Historically, simultaneity has provided a means of doing this. However, current trends are making it increasingly likely that non-linear operations will be required in order to achieve simultaneity. Our current doctrine provides an excellent framework for conducting mid-to-high intensity linear operations, but it is not well suited to non-linear operations like Operation JUST CAUSE. This monograph provides an alternative, non-linear framework to fill that gap.

First, this monograph will determine the operational implications of the post-Cold War world and the emerging "Information Age." It will then examine how the concepts of simultaneity and non-linearity apply to military operations. The significance of these trends and concepts will be evaluated by analyzing Operations JUST CAUSE and DESERT STORM. The second part of the monograph details a non-linear operational framework. This is then evaluated in terms of its applicability to the spectrum of war. Its effectiveness is analyzed by operational function to determine how it contributes to simultaneity.

This monograph concludes that non-linearity will be increasingly necessary to achieve quick and decisive victories, and that the current framework is inadequate for conducting such operations. It also finds that a non-linear framework is universally applicable across the spectrum of conflict, whereas the AirLand Battle framework is not. Lastly, and most importantly, it finds that a non-linear operational framework significantly contributes to achieving the simultaneity necessary for winning quick and decisive victories.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION: Our new doctrine, as enunciated in the 1993 version of FM 100-5, Operations, states that "the Army must be capable of achieving decisive victory." It must also be able to do so "quickly, and with minimum casualties." [1] In the past, maneuver warfare has been the preferred method of winning such victories. The key to successful maneuver has always been achieving, and then exploiting a moral or physical advantage over the enemy. Of course, this requires adequate command and control, which has also been called the "cybernetic domain of warfare." [2]

The lifeblood of cybernetics is information. This is significant because recently, information technology has begun to undergo a transformation that may be as important to civilization as the agricultural and industrial revolutions. Each of these events has had a fundamental impact on warfare. Although the current "revolution" is far from over, it is becoming evident that it too will change the face of warfare.

The ongoing explosion in cybernetic capability has made operations of unprecedented complexity possible. Consequently, non-linear operations are becoming more widespread and even desirable, as they often allow for greater simultaneity. Simultaneity has long been a "holy grail" of maneuver theory, because it provides for the quickest and most decisive victories. Recent operations like JUST CAUSE and DESERT STORM are clear examples of simultaneity's ability to deliver the sort of results our doctrine demands. Unfortunately, these operations also demonstrated that when simultaneity demands non-linearity, our current doctrine falls short.

The 1993 version of FM 100-5 represents a first attempt to develop a post-Cold War doctrine. Significantly, the new doctrine recognizes that the old AirLand Battle (ALB) framework of deep, close, and rear battle was designed for the European Cold War theater and is essentially linear. Linear theaters, like Cold War

Europe, are characterized by a relatively continuous line of contact separating well defined areas under either friendly and enemy control. This concept will be developed in much greater depth later in the monograph. FM 100-5 perceptively goes on to say that this framework may not apply in all areas of operations. [3] Sadly, this where the manual's discussion of linearity ends. In fact, the entire document directly refers to non-linearity but once, and then only in passing. [4] Although GEN Franks, Commander of the U. S. Army Training and Doctrine Command (TRADOC), recently wrote that "the force projection battlefield framework can and probably will vary from linear to non-linear," the new FM 100-5 fails to describe a non-linear framework. [5] Instead, it goes on to describe the old ALB framework in great detail. This omission has not gone unnoticed in the field. One division commander said of the new doctrine:

> In rejecting the previous battlefield framework, however, the manual fails to either justify its approach or to replace the old idea adequately. It dismisses the past pattern as a relic of the Cold War in the same sentence that it credits that model with some useful flexibility. Then, *without offering other options*, it urges army commanders to go beyond that single alternative in considering the correct battlefield framework for the mission. [6]

This monograph is an attempt to provide commanders with the alternative non-linear framework they currently lack. It explores the trends that make non-linearity both increasingly common and necessary, and it examines the real meaning of non-linearity. Most importantly, it introduces and analyzes a framework suitable for non-linear operations.

TRENDS IN MODERN AND FUTURE WAR: Two concurrent trends, the end of the Cold War and the rapid growth of information technology, are compelling the United States Army toward non-linear operations. The Cold War's conclusion has diminished the likelihood of total war between East and West, particularly in Europe. The end of this stalemate has made the use of force far more

acceptable. As a result, military interventions by major powers, particularly in less developed areas, have become more common. The end of the Cold War has also touched off a search for "peace dividends" in most developed countries, thus reducing the size of the forces available to conduct interventions as well as the depth of popular support for them. These factors must have a significant impact on the character of such operations. The other important delinearizing trend is the burgeoning growth of information technology. Advances in this field are making the weapons of war far more lethal, and at an ever-accelerating pace. This too affects the face of war. The Cold War's end and the birth of the Information Age have made it possible as never before to conduct non-linear, simultaneous operations. The significance of this development was evident in two recent U. S. operations: JUST CAUSE and DESERT STORM.

The U.S. Goal of Quick and Decisive Victory: Our doctrine's quick, decisive, and low cost phraseology seems to imply a more offensive doctrine than that of the Cold War era. The new orientation is well suited to the increasingly likely scenario wherein the United States must intervene to "reverse a *fait accompli*, to prevent a disaster, or excise a menace to international security." [7] Recent experiences in Panama, the Persian Gulf, Haiti, Somalia, and a looming intervention in Bosnia serve to reinforce the impression that we are no longer primarily a defensive force. In the post-Cold War era, defensive scenarios like Korea have become the exception, rather than the rule.

Logically, then, the United States Army must insure that it is properly organized, trained, and equipped to execute quick and decisive operations, both offensive and defensive, while minimizing casualties. Historically, maneuver warfare has provided an answer to this challenge. Maneuver theory regards actual fighting as a last resort; it seeks success in pre-emption or surprise. Maneuver focuses on enemy forces and resources rather than ground, except to the extent that

the ground affects them. It employs risk and it exploits opportunities to defeat the enemy's will to fight by magnifying the effects of mass through "leverage and tempo." [8] Although it has often fallen short of the mark in practice, maneuver theory has also borne abundant fruit when execution matched planners' expectations. Vicksburg, Konniggratz, Sedan, Tannenberg, Kalinin Gol, France in 1940, and Inchon are but a few examples of highly successful, maneuver-dominated operations. High tempo operations, frequently coupled with surprise, provided a decisive edge to the victor in many of these instances. [9] But the most consistent characteristic of quick and decisive operations in the past has been one side's ability to create and exploit an asymmetric advantage over its opponent in one or more of the domains of war. [10] The domains of war, as defined by James Schneider, are the physical, cybernetic, and moral. [11] But how does maneuver warfare create and exploit asymmetric advantages in these domains?

Maneuver theory essentially seeks an advantage in the moral domain by means of "*la manoeuvre sur les derrieres*," as Napoleon put it. [12] Placing forces across the enemy's lines of communications (LOCs), which are also his escape routes, often causes panic or terrorized passivity in his ranks that can lead to his annihilation. [13] Ardant du Picq, in his studies of ancient and 19th century warfare, was among the first to notice that panic often begins in the rear. [14] S. L. A. Marshall reached a similar conclusion, noting that fear of isolation frequently induces flight. [15] Du Picq also observed that in lopsided battles, the defeated force was totally demoralized prior to its physical destruction. [16] Evidently, then, where it is possible to create a moral asymmetry through maneuver, the decisive results with minimum casualties that our doctrine seeks is attainable.

The physical domain of battle is composed of technology, terrain (or geography), and logistics. [17] Maneuver theory can create an asymmetric advantage in terms of terrain and logistics, or it can make it possible to exploit a pre-existing

technology differential. If a scheme of maneuver can lead to a relative advantage in logistics by cutting enemy LOCs, or by improving friendly logistics somehow, then maneuver can yield an important asymmetry. Likewise, a maneuver to gain a decisive positional advantage over the enemy can also give a physical asymmetric advantage. But, where technology is concerned, the asymmetry must already exist. A mobility differential, for example, would endow one side with the ability to rapidly outmaneuver the other. Richard Simpkin has argued that their are four basic levels of mobility. In ascending order of capability, these are provided by the foot, the wheel and track, the rotary wing, and the fixed wing. Mobility differentials exist between forces operating on different mobility levels. [18] The resulting technological asymmetry, if properly exploited by maneuver, could increase the tempo of the operation, and could even be decisive if it led to an overwhelming moral or positional advantage. It should be pointed out that a decisive positional advantage is not always possible. In Vietnam, our asymmetric advantages over the Communist forces in the field were not decisive because the enemy's real source of strength (or center of gravity) was not military. His strategy of *dau tranh* had to be defeated through superior political organization, not in battle. [19] As a result, our military successes did not result in victory. However, maneuver offers the promise of quick and decisive victory whenever our enemy possesses a military center of gravity, by creating or exploiting asymmetries in the physical domain of warfare.

The final domain of war is the cybernetic. This domain is principally concerned with battle command. [20] A battle command system is a bit like a circulatory system. Information is its lifeblood, and the commander is the heart of the system. He is the force that continually draws information in, and pumps it out to other locations. An advantage in this arena allows a force, which may be inferior in all other respects, to triumph because it is able to employ the forces at its disposal effectively. A battalion at the right place, at the right time, is far more useful than a

division elsewhere. A cybernetic advantage is not decisive in and of itself, however. Its value lies in enabling a force to outmaneuver the enemy, thereby gaining a decisive advantage in the moral or physical domains of war. As the foregoing discussion has shown, an advantage in these domains can, in turn, lead to the desired goal of quick and decisive victory.

Quick, decisive, and cheap victories are going to be hard to achieve. Clearly, maneuver theory provides a real means of doing so by achieving an asymmetric advantage over the enemy, morally or physically. But a robust cybernetic capability is an important prerequisite for attaining or exploiting an asymmetry in the other two domains. That is why any attempt to build an army capable of forging quick and decisive victories must begin with an understanding of cybernetics' *raison d'être*: information.

The Information Age: Alvin Toffler is probably the foremost herald of the dawning information age, proclaiming a revolution in technology that he believes is equal in significance to the agricultural and industrial revolutions. If this "third wave," as he calls it, is as important as he claims, it is bound to affect warfare along with the rest of human civilization. [21] The last such transition, the industrial revolution, resulted in the birth of the operational art. [22] Whether or not the progress of mankind can be reduced to just three epochs is certainly debatable. Nor is it clear that the information age will bring changes as profound as those wrought by the industrial age. But it is becoming obvious that the current transformation will cause the operational level of war to evolve in some real way.

There are a number of reasons to believe that the ongoing information technology explosion will strongly affect warfare. Among these are what Toffler calls "de-massification," the "vanishing front," "systems integration," and "acceleration." The last two factors make complexity manageable, while the first two make it more likely. All four have significant implications for future warfare.

De-massification will lead to a more complicated battlefield. "Smart" and "brilliant" weapons that rely on information, rather than volume, to achieve target destruction are proliferating. They reduce the number of forces required to do the same job, with a corresponding reduction in logistics overhead. [23] As Elliot Cohen observed in his critique of the Defense Department's "bottom-up review:"

> the technological tide of the information revolution will turn in favor of smaller packages of discrete weapons (intelligent mines or cruise missiles, for example) that may require a completely different style of development and acquisition, tactics, and operations. [24]

As these weapons achieve ever greater engagement ranges, lethality, and accuracy, targetable assets must be increasingly dispersed for survivability purposes. This fact, coupled with the weapons' efficiency, will result in lower force densities, which causes the phenomenon Toffler has dubbed the "vanishing front." [25] This has also been called the "empty battlefield" by some historians. Both terms refer to the effects of increased dispersion, cover, and concealment necessitated by more effective weaponry. Although battlefields started to become "empty" as a result of such "second wave" innovations as magazine-fed rifles, machine guns, and breech loading artillery pieces, this process has been greatly accelerated by third wave technology. The result is a lethal zone where little or no activity is discernible. [26] This condition alters operations by expanding the size of battlefields, and by extension, theaters of operations. It makes targeting more difficult, and it vastly complicates all forms of movement and communications.

Fortunately, information technology is not a purely negative influence. It also provides the tools to cope with the increased complexity it helps to cause. The ability to link various systems together to achieve a synergistic effect is called systems integration. [27] The resulting improved performance enhances a force's capability to detect and destroy remote, dispersed targets. Meanwhile, near real-time intelligence and instantaneous communications, both of which are "third wave"

products, have helped to make "fast cycle, time based" strategies possible. [28] This has led to faster military operations because weapon systems can be directly linked to detection and decision making apparatii. The integration of systems, with their increased sensitivity to both internal and external conditions, is the basis of "situational awareness." This quality enables a force to know where all of its elements are with respect to each other, the enemy, and the current plan. Toffler noted that forces possessing "internal feedback, communication, and self-regulatory capability," can *and will* accelerate the operational tempo. [29] This acceleration allows forces to respond to conditions before they change, so that windows of opportunity may be exploited and transient vulnerabilities corrected. Thus, third wave technology provides the key to improved situational awareness. This permits greater operational tempo and flexibility, which are vital attributes in complex operational environments.

The combined effects of dispersion, stemming from de-massification, and accelerated operations, resulting from improved situational awareness, must exert a significant influence on the operational level of war. Resulting, as these effects do, in the compression of time and the expansion of space at that level, it is likely that operational artists will increasingly seek to achieve simultaneity throughout their theaters of operations. Fortunately, simultaneity provides the quick and decisive qualities that the information age has made possible, our new doctrine demands, and maneuver theory has always sought.

Simultaneity: Some "maneuverists" have held since as long ago as the 18th century that the object of maneuver is to achieve the simultaneous destruction of the enemy. This was the end that the actions of turning and holding forces were directed toward. [30] If properly executed, maneuver offered the prospect of quick and decisive victory with minimal (friendly) casualties. Today, advanced information technology has made possible far more complex techniques than the

simple "hammer and anvil" method. Now, truly simultaneous operations throughout the depth and breadth of a theater of operations can be undertaken. Sequential operations are no longer necessary in order to strike at every objective.

Those who criticized the plan for Operation JUST CAUSE as having "too many moving parts" failed to understand the opportunities for simultaneity that third wave cybernetics have brought to warfare. [31] While it is self-evident that simultaneity is essential to quick and decisive victory, not everyone recognizes that operational complexity is often the price to be paid for this goal. The "third wave" influences of de-massification and acceleration have caused that complexity to be increasingly manifested in the form of non-linearity.

Non-Linearity: Mikhael Tukhachevskii, the author of the Russian's "Deep Battle" doctrine, believed that simultaneity is achieved by increasing the contact area between opposing forces. [32] If the enemy's forces are arrayed in depth, then friendly forces must go deep to fight them. Obviously, if they are arrayed in a linear fashion, this becomes unnecessary. But where depth is present, and it almost always is to some degree, maneuverists tend to employ non-linearity to achieve a physical or moral advantage over their opponent. [33] Of course, non-linearity is not an end in itself, but merely a means of achieving simultaneity. Unfortunately, the term non-linearity is more frequently used than understood. The following discussion will examine precisely what non-linearity means.

Abstract Non-Linearity: Linearity is a term borrowed from mathematics. So, it is probably useful to comprehend the meaning of this concept in its original context before proceeding. There are really two types of linearity: systemic and geometric, and both apply to warfare.

Linear systems are those systems that can be mathematically modeled by a linear differential equation. Qualitatively speaking, this means that a system satisfies the conditions of proportionality and additivity. Proportionality requires

that a system's output be proportional to its input. Additivity describes a whole that is equal to the sum of its parts; synergy is absent. These two characteristics combine to make linear systems very predictable, and therefore, tractable. Unfortunately, such systems are rare exceptions in nature. [34] Non-linearity creeps into actual systems through various means like external forces, and feedback such as friction and vibration. Non-linear feedback can quickly cause a system to spin out of control, resulting in the disintegration scientists call entropy. [35] Entropy is the tendency in nature for order to evolve into disorder. [36] When non-linear terms are introduced into a differential equation to reflect this, only approximate solutions can be found. Frequently, even this much is impossible.

A new science, called "Chaos Theory," has recently arisen in response to a growing recognition of non-linearity's messy ubiquity. This theory is an attempt to find patterns in chaotic, non-linear systems like the weather to make them more predictable. [37] Unfortunately, it has a long way to go before even relatively simple non-linear systems, like turbulent fluid flows, can be accurately modeled. The second form of linearity, geometric linearity, simply refers to the presence of clearly defined lines in geometric figures. These two forms of linearity are related, but not directly. Geometric linearity can be the result of a non-linear system, but intuition indicates that other factors would have to intervene to make this so.

Of course, both geometric and systemic non-linearity exist in warfare. But, while systemic non-linearity has always existed, geometric non-linearity has not. Clausewitz was probably the first to grapple with the problem of systemic non-linearity in warfare. He recognized that the opposition of two forces leads to non-linear feedback in the form of fog and friction. His term for the resulting non-linearity was "chance." [38] Despite our awareness of this phenomenon, highly complex systems, like theaters of war, will probably never be reliably modeled because of the strong influence of numerous (and unpredictable) human wills in

them, Chaos Theory notwithstanding. The best option is to make allowances for common non-linearities like fog and friction (F2). In the past, when information technology was primitive or non-existent, command and control (C2) systems were unable to cope with F2. Consequently, operations had to be conducted rigidly in order to minimize the effects of F2. However, today's information technology has made C2 more effective at compensating for F2, thus permitting greater operational flexibility.[39] This, in turn, has led to more geometric non-linearity in warfare.

Historical Non-Linearity: In the 1930's, Russian theorists began to grasp the operational potential of maturing "second wave" technologies like mechanization and radio communications. They saw them as means of expending less energy resisting the natural non-linearity of warfare, thus allowing them to work more efficiently within war's natural framework. This insight enabled them to achieve a high degree of operational simultaneity. As G. Isserson put it, then emerging technologies "made it possible to abandon the 'sticky old tactics' of successive destruction of the enemy piecemeal, and to go over to a new form of simultaneous deep strike."[40] Tukhachevskii also believed that "modern means" of warfare "put within reach the possibility of simultaneous attack,"[41] But there were limits to the simultaneity and non-linearity that could be achieved and sustained with the means he was referring to. Consequently, whenever non-linearity became too great to manage, "second wave" operational artists actively sought to re-establish linearity.

This was seen repeatedly throughout the Second World War. A good example of this occurred after the Normandy breakout, when Patton's Third Army came close to "bagging" the bulk of the German armor in France at Argentan. A recent, unsuccessful counterattack by two German armies had left them in a vulnerable salient between the U. S. Third Army and the Canadian First Army. Although Patton grasped the opportunity this situation presented, he was prevented

from seizing it by his cautious superiors. Fearing fratricide between two converging Allied armies, and unaware of the true magnitude of their opportunity, Bradley and Montgomery intervened to stop Patton's tanks before they could seal the pocket. This enabled 19 German divisions to escape certain annihilation through a narrow gap near Falaise. [42]

In essence, this offensive operation, like many others during the industrial age, ended when the attacker reached a "situational awareness culmination point." Solutions like the British "Phantom" liaison units, the American Signal Information and Monitoring (SIAM) companies, and Patton's "Household Cavalry" provided some relief, but the communications technology of World War II was simply unable to cope with sustained non-linear operations. [43]

Modern Non-Linearity: Despite practical limitations, the Russians did not give up on their vision of non-linear warfare as a means of achieving the simultaneous destruction of enemy forces. As a result, they were quick to see the military implications of the dawning information age. [44] They realized in the mid 1980s that new information technology would permit far greater non-linearity (and thus, simultaneity). Their vision of non-linear future warfare resembles a soccer game, with friendly and enemy forces intermixed and moving fluidly across the entire field, some playing offense and some playing defense on each side. This stands in stark contrast to the traditional linear warfare analogy of American football, with its fixed line of scrimmage separating defenders and attackers. [45] In keeping with their "soccer-mindedness," the Russians have forecasted that future non-linear operations will possess the following characteristics: [46]

- No well defined spatial limits
- Combination of offense and defense
- Proliferation of operational and tactical maneuver (ground and vertical)
- Increased requirement for mobility, maneuverability, and flexibility
- Decentralized conduct of maneuver
- Requirement for centralized command & control to coordinate operations
- Increased lethality

The Soviet General Staff has predicted that "the frontline will disappear and terms such as 'zones of combat' will replace such outdated concepts of FEBA, FLOT, and FLET. No safe havens or 'deep rear' will exist." [47] Some staff theorists have recommended dividing operations areas into "zones of action" and "zones of potential threat" as a means of avoiding older linear terms. [48] One former Soviet Army general said that "war will proceed without boundaries and flanks. The terms front and rear will be replaced by concepts of 'subject to attack' and 'not subject to attack.'" [49] Clearly, Russian theorists have fully embraced non-linearity, seeking to turn it to their advantage. Although they have long sought de-linearization, or as they call it, "fragmentation," cybernetic limitations have severely retarded their efforts. They have also been hindered by the long standing gap between Russian theory and practice that exists in many fields. For a variety of reasons, the Russians have had difficulty implementing their theories in the past, and their recent experience in Afghanistan indicates that they probably still do. [50] Modern Russian writers seem undeterred by these problems, however, and have concluded that modern information technology has eliminated many longstanding obstacles to non-linear operations.

The optimism expressed by the Russian maneuver warfare advocates is possible due to the recent and rapid expansion of military situational awareness capability. Its growth has vastly improved the potential for operational responsiveness to feedback. But situational awareness is really just one component of the broader quality of "dynamism." Dynamism combines situational awareness with mobility and effectiveness. Still, dynamism alone fails to fully describe all of the necessary conditions for non-linearity. The density of the forces within a theater of operations also determines the degree of non-linearity. Thus, geometric operational non-linearity is a function of the dynamism and density of forces within the theater of operations. It is no accident that these two qualities correspond

closely to the effects Toffler called acceleration and de-massification. Figure 1 provides a means of visualizing this relationship.

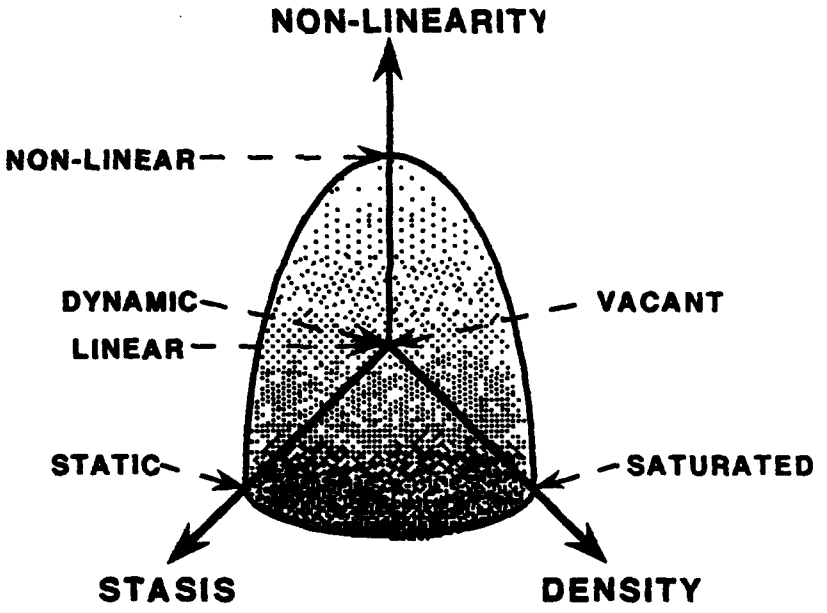


Figure 1
Non-Linearity as a Function of Density and Stasis

The preceding figure is a three dimensional Cartesian coordinate system consisting of three mutually orthogonal axes. They are labeled "non-linearity," "density," and "stasis." Stasis, which is essentially the inverse of dynamism, was chosen because, like density, it is inversely proportional to non-linearity. This makes a graphical representation of the relationships between the three qualities much simpler. Plotting the relationships between density, stasis, and non-linearity results in a curved surface. As the graph indicates, non-linearity increases as density and stasis decrease. Moving across the shaded surface, the highest and most lightly shaded area represents the least linear conditions.

The origin of the axes and where the surface intersects them represent the extreme conditions of each of the three qualities. These extrema are theoretical absolutes, and would probably not exist in reality. However, they serve to define

the end points of the spectra in question. Absolute non-linearity consists of small numbers of highly dynamic forces operating in a large space, with a thorough intermingling of friendly and enemy forces throughout the theater. Absolute linearity consists of 100% of all forces within a theater occupying continuous and static positions within range of enemy weapons systems. In this state, enemy and friendly forces would be completely segregated; there would be no intermingling, gaps, or flanks.

Operational non-linearity is most likely when the force density is lowest. Fewer forces spread over a larger space inevitably leaves open areas. By convention, a "vacant" theater is defined as devoid of forces. In this case, a force of any size could go anywhere unopposed, thus leading to totally non-linear operations. "Saturation" is the other extreme of density. This condition describes a theater that is completely covered by mutually supporting weapon systems. Under these circumstances, no force could move anywhere without opposition. Such a "complex of interconnecting fire positions and carefully sited long-range weapons would weave a stultifying, trapping web over a vast area," resulting in stasis. [51] Any movement would require a systematic clearing of the opposing weapon systems, thus requiring a linear operational approach to protect flanks, support systems, etc. It is important to note that in discussing the impact of force density on operational linearity, density's relationship with dynamism was critical. These qualities are all closely interrelated.

The dynamism of the forces in a theater is the other determinant of operational non-linearity. Conditions are most "dynamic" when all elements of combat power (firepower, maneuver, leadership, and protection) in a theater are completely mobile and moving, to include all combat support and combat service support elements. [52] Dynamism is also dependent on responsiveness and effectiveness. The former quality implies a command and control system capable of

timely responses to feedback, while the latter refers to a force's ability to apply sufficient elements of combat power against a given point. This makes non-linear operations more possible and more probable, since it allows commanders to make optimal use of their organization, training, and equipment. Such dynamic forces require fewer numbers to dominate a theater, thus permitting greater economies of force. Furthermore, the enhanced capability of highly dynamic forces not only requires lower force densities, but leads to higher costs in raising and maintaining them. As a result, these forces *must* trade quantity for quality. Consequently, highly dynamic forces are committed in lower densities than more static forces within the same size space. Even the militaristic Soviets admitted that they were forced to "continuously review and revise their design for battle. That design must in the future rely upon fewer forces in fewer places to accomplish any mission." [53]

At the opposite extreme of stasis is the "static" condition, where no mobility potential exists. Trench or fortress-bound forces fit this description best. Because static combat power makes economies of force impossible, greater densities must be committed to dominate the same size theater. Again, the strong linkage between mobility (or stasis) and density is evident.

The correlation between low density, highly dynamic forces and non-linearity is clear, and Toffler said that the trend toward less dense and more dynamic forces is equally clear. The Russians have chosen to see these trends as opportunities, rather than problems, while post-Cold War realities have made such opportunities more likely. But all of this is only theory. The validity of these notions can only be confirmed in practice, in the crucible of war.

The Lessons of JUST CAUSE and DESERT STORM: Two recent American operations demonstrate how non-linearity occurs in actual "third wave" theaters of operation. Many have called the Persian Gulf War the first war of the "Information Age," [54] but this discounts other valuable lessons from the

invasion of Panama the previous year. To its credit, FM 100-5 specifically cites Operation JUST CAUSE as an example of how information age technology has made simultaneous operations possible. [55] Each operation used non-linearity to varying degrees to achieve simultaneity. In each case, the level of non-linearity was directly related to the density and dynamism of the forces involved.

Operation JUST CAUSE: Two salient lessons emerged from Operation JUST CAUSE in December 1989. The first is that, just as the Russians had predicted, non-linearity provides the best means of achieving simultaneity. The second lesson learned is that U. S. doctrine lacks any sort of framework for conducting such operations.

It is not surprising that non-linearity provided the best vehicle for the planners to attain the required simultaneity. This is because the Panamanian Defense Force (PDF) was dispersed and had the ability to either strike at our own vulnerable points, or to evade our forces. The Panamanians could have easily damaged the Panama canal or attacked American non-combatants. They were also capable of rapidly escaping into the jungle, where they could have become an elusive guerrilla force. [56] This mobility, coupled with the PDF's existing command and control (C2) network gave the PDF a dynamic potential, at least in the opening stages of conflict. Had they been disposed more linearly, or had they been less able to escape destruction, then the tremendous complications inherent in simultaneous, non-linear operations would have been neither required nor worth the added effort. But in the event, non-linearity was forced upon U. S. forces. The low density and initial dynamism of both forces clearly placed this operation in the non-linear region of the graph in Figure 1. External factors, such as a desire for a quick victory at the policy level further reinforced the tendency toward simultaneity, and hence, non-linearity. [57]

The planners at USSOUTHCOM and XVIII Airborne Corps had to devise a non-linear, simultaneous operation. This was the only way to achieve the quick, decisive victory required while also minimizing casualties on both sides. Unfortunately, the AirLand Battle (ALB) doctrinal framework of deep, close, and rear was the only framework they had. By attacking 27 dispersed targets simultaneously, the distinctions between the close, deep, and rear battles became essentially irrelevant. Friendly and enemy forces were both thoroughly intermingled throughout the theater of operations. Although U. S. forces were usually on the offensive, in some cases they occupied blocking and defensive positions. The simultaneity of the operation precluded the emergence of any "lines of operation" that would have clarified the relative locations of deep and rear. That is why JUST CAUSE represents a new type of warfare. Unlike past simultaneous attacks in depth, such as Operation MARKET GARDEN and Operation OVERLORD in the Second World War, no lines of operation emerged. In those operations, ground or amphibious forces moved on axes perpendicular to their respective lines of contact to link up with the airborne forces dropped in front of them. Consequently, those operations were "longitudinally linear." This does not mean that link-up operations automatically preclude non-linearity. Link-ups must occur during non-linear operations as well. But, when attacks in depth are conducted primarily as a means of advancing the line of contact along a particular axis, then those deep attacks are still linear. No such operations occurred in Panama, making Operation JUST CAUSE the first completely non-linear, simultaneous operation in history. The ability to cope so effectively with such a serious doctrinal deficiency is a tribute to the innovativeness of the JUST CAUSE planners. The following figure gives an indication of how poorly suited the ALB framework was for the planning of this operation.

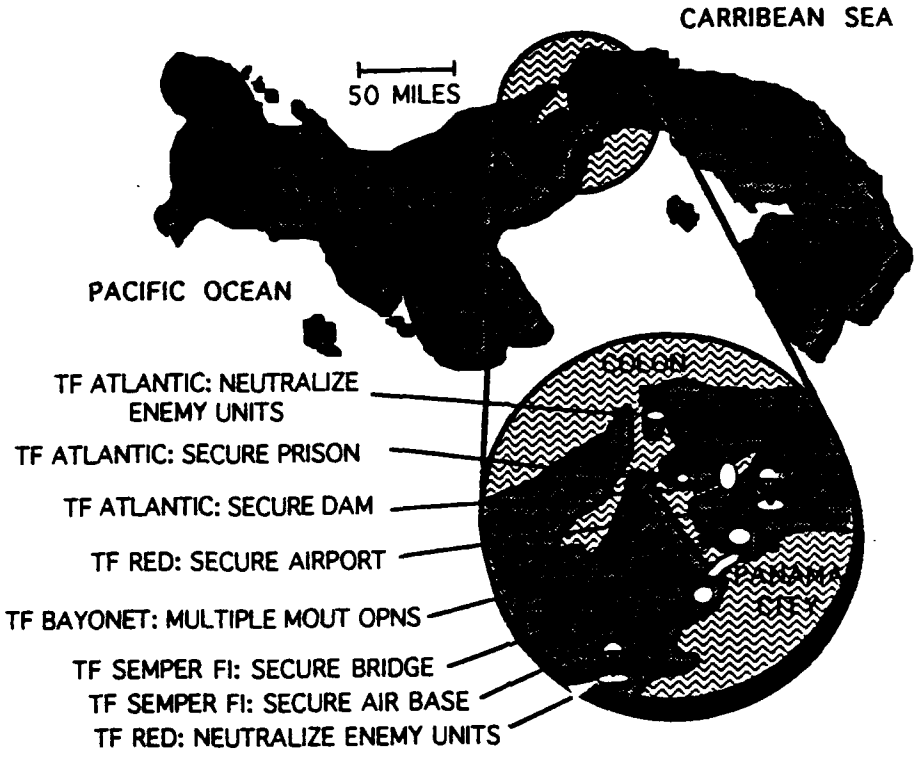


Figure 2
Operation JUST CAUSE [58]

This figure depicts only the major objectives of Operation JUST CAUSE. Any attempt to show the many minor tactical objectives seized by land, sea, airborne, and airmobile forces would only further confuse the outline of the operation. It is impossible to identify where the deep, close, or rear battles were by looking at this, or any other map of this operation. That is because they were really all one in the same. Nor does a study of Figure 2 reveal that the main effort was directed against the PDF's C2 system, which was centered in Panama City. Yet, this was the clearly stated main effort enunciated by the theater commander in chief (CINC), GEN Maxwell Thurman. [59] Because non-linear operations require decentralized execution to succeed, subordinate commanders need to fully understand the commander's intent and the concept of the operation. One of the challenges of simultaneous, non-linear operations is to clearly convey these

instructions, so that decentralized execution does not result in non-synchronous operations. The ALB framework was not able to satisfy this requirement. As one participant described it,

> Panama was not a neat linear battlefield. Although, at the operational level, boundaries were assigned during the initial operations, they were of little value. The battlefield more resembled a lethal mosaic of separate attacks conducted by land, sea, and air from the four points of the compass. [60]

The planners of JUST CAUSE had to improvise in order to achieve simultaneity. We were fortunate that they had the time and the talent to successfully do so. Obviously, we can not be content with this. Our doctrine should provide planners with a more useful starting point for non-linear operations.

Operation DESERT STORM: One lesson that should not be learned from Operation JUST CAUSE is that non-linear operations are always required to win quick and decisive victories with minimum casualties. They certainly were not in Operation Desert Storm. There, a significant percentage of the enemy was disposed in static, linear positions that did not necessitate non-linearity to achieve simultaneity against them. As a result, DESERT STORM provides an interesting case wherein linearity and non-linearity were mixed in order to accomplish the enemy's simultaneous destruction. The degree of non-linearity in the Kuwaiti Theater of Operations (KTO) varied according to the level of dynamism and density of the local forces. The theater was characterized by three distinct degrees of linearity that roughly corresponded to the Marine Forces (MARFOR) zone in the East, the VII (US) Corps zone in the Center, and the XVIII (US) Airborne Corps zone in the West. The type and quantity of forces in deployed by both sides in these areas, as well as the size of each areas, set the conditions for non-linearity across the KTO. This, in turn, strongly influenced the character of the operations that occurred in each zone. Figure 3 lays down the relative density and dynamism of the forces arrayed against each other just prior to the commencement of the

Coalition ground offensive. Attack helicopter units are not depicted, but both VII and XVIII Corps had considerably more of this capability than the Marines, who relied more heavily on close air support than Army units.

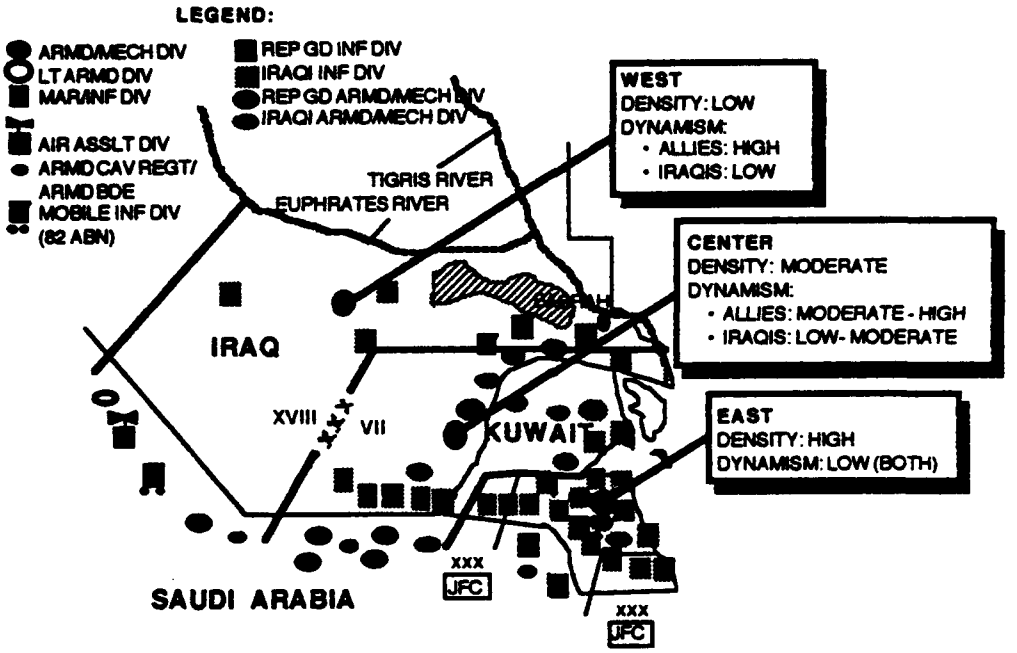


Figure 3

Non-Linearity Conditions in the KTO [61]

In Kuwait, the Iraqis were densely deployed in static, linear positions mostly along the Saudi border. The overwhelming preponderance of the Iraqi forces were ordinary infantry divisions defending from prepared positions. The principal Coalition forces available to oppose the Iraqis in this area were also largely foot-mobile. Two U. S. marine divisions bolstered by a single armored brigade constituted the primary offensive combat power in this area. Joint Force Command (Arab) forces on each flank were mechanized, but lacked the offensive inclination, the modern weapons, the training, and the level of situational awareness that American, British, and French units possessed. As a result, their dynamism was severely limited. The low degree of dynamism on both sides in the East, coupled with the high density of forces, particularly Iraqi, militated strongly against non-

linear operations there. Even if more mobile forces had been available to employ against the Iraqis in Kuwait, non-linearity would not have been desirable from a coalition perspective. Since the bulk of Iraqi forces were disposed in forward, static positions along the line of contact, there was little or no need to send large forces into the enemy's rear. The Iraqis made it possible to simultaneously destroy their forces in the East with linear tactics. Because complexity was not required, the theater commander in chief (CINC), GEN Schwartzkopf quite correctly eschewed it.

The situation was different in the center portion of the KTO, however. Iraqi forces along the Saudi border thinned dramatically west of Kuwait Some forces, particularly the Republican Guard, which Schwartzkopf judged to be the Iraqi operational center of gravity, were deployed in depth. [62] A large percentage of the enemy forces in this part of the KTO were mechanized and the terrain was highly favorable to maneuver. Deployed against the Iraqis, in the center of the Coalition forces, was the VII (US) Corps, a fully mechanized formation. It was given the mission to penetrate Iraqi defenses west of the Wadi Hafir al Batin that runs along the Iraqi-Kuwaiti western border, and plunge deep into Iraq to destroy the Republican Guard (RG) divisions. [63] This zone was far more dynamic and far less dense than the eastern zone. Force densities were moderate; a fully mechanized corps faced the bulk of two Iraqi corps, who were about 50% mechanized. Consequently, more non-linearity was possible than in the East. Conditions were not ideal, however. Force densities were still relatively high, and both sides suffered from limited dynamism. Foot-mobile infantry divisions limited Iraqi mobility and their situational awareness was heavily degraded by Coalition air strikes. The VII (US) Corps lacked an airmoble capability and had inadequate logistics to support sustained high tempo, non-linear operations.

GEN (then LTG) Franks, the corps commander, came under some criticism during DESERT STORM for his deliberate maneuvering. GEN Schwartzkopf and Chairman of the Joint Chiefs of Staff, GEN Powell, both felt at the time that Franks was not aggressive enough, given the force densities and his relative advantage in dynamism. [64] Although this perception is understandable, it is also questionable. It stemmed from a misunderstanding of the relative non-linearity conditions across the KTO. Powell and Schwartzkopf believed that the successful non-linear operations in the XVIII Corps zone in the first 48 hours of the attack should have been matched by VII Corps. But the ideal time for non-linear operations had passed by then. Franks probably could have still committed some of his force to non-linear operations, although it is not clear what this would have achieved. Franks' enjoyed good situational awareness; he had a firm handle on both the enemy and friendly situation. [65] But he was facing a locally heavy enemy force density that he lacked the mobility to overcome by non-linear means. Had the VII (US) Corps possessed more dynamism in the form of an air assault brigade, perhaps Franks could have employed it in conjunction with some forward detachments to immobilize the RG. His logistics were too heavily strained after two days to do any thing more. [66] Furthermore, the Iraqi forces facing Franks' corps near Kuwait were much denser than those confronting the XVIII Airborne Corps, and he knew it. His maneuver space was limited by narrow boundaries. Given these moderately favorable conditions for non-linear operations, the benefits would probably have been modest, at best.

The XVIII (US) Airborne corps was in the West. This was a hybrid organization that included airborne, air assault, light armored, and heavy mechanized forces. Its mission was to cut communications through the Euphrates River valley and to protect the VII (US) Corps' left flank as it swung around the Iraqi defenses in Kuwait and struck toward the RG near Basrah. [67] The low force

densities and high mobility of the Coalition forces allowed the greatest non-linearity in the theater to occur in the XVIII (US) Airborne Corps zone. The 101st Airborne Division (Air Assault) was sent far into Iraq to establish forward operating bases. These were used to launch attack helicopter operations and air assaults against the Euphrates LOCs until fast moving mechanized forces moved into the river valley to seal it for good. Once this was accomplished, the heavy elements of the corps turned 90° and attacked East toward Basrah, while other widely dispersed portions of the corps faced North and West to guard the Coalition's flanks. Midway through this short operation, the corps main effort shifted hundreds of kilometers and changed from cutting the Iraqi's LOCs to attacking the RG. [68] Close, deep, and rear operations frequently overlapped one another, particularly during the 101st's air assaults. Although the ALB framework sufficed, it was certainly not optimized for the operation.

Lessons Learned: Both operations proved the value of simultaneity in accomplishing quick and decisive victories while holding casualties down. But they also show that each operation must be evaluated against the conditions of dynamism and density prior to drawing conclusions about the relevance of non-linearity. Sometimes the conditions for non-linearity vary within a single theater of operations, as in DESERT STORM. These conditions can and do change over time as well as space. Fortunately, the United States possesses a clear superiority in the ability to conduct non-linear operations, primarily because of its advantage in information technology.

The end of the Cold War has released many assets for use in contingency theaters that were formerly dedicated to countering the Warsaw Pact threat. [69] No other nation in the world can match the capabilities that these assets provide us. We should fully exploit this cybernetic asymmetry to allow us to achieve the necessary simultaneity for winning quick, decisive victories while sustaining (or inflicting)

minimum casualties. United States joint doctrine recognizes this and exhorts commanders to "exploit the information differential" toward that very end. [70] Unfortunately, the Army's FM 100-5 does not heed this advice. It fails to provide a sufficiently flexible framework for operations like JUST CAUSE and the western portion of DESERT STORM.

A NON-LINEAR OPERATIONS DOCTRINE: As this monograph's discussion of trends in modern warfare has shown, the lack of a non-linear operational framework is a doctrinal deficiency that the Army can not long afford to ignore. Panama and the Persian Gulf proved that the AirLand Battle framework, as good as it is, is not suited to the type of non-linear operations that are becoming more common. The terms, deep, close, and rear, all refer to operations according to their position relative to the *line* of contact. Since lines are linear by definition, ALB is also linear, though not in a simple, one dimensional sense. Because it considers depth as well as breadth, ALB avoids linearity along the close battle's line of contact. However, by synchronizing all other operations (i.e., the deep and rear battles) with the close battle, the framework becomes "longitudinally linear." [71]

The recurring use of the word "linear" to describe ALB is in not meant in a pejorative sense. As FM 100-5 correctly points out, AirLand Battle was the best possible doctrine for fighting the Warsaw Pact in Central Europe and it proved its worth against the Iraqis, particularly in and around Kuwait, during Operation DESERT STORM. [72] Unfortunately, the U. S. Army has not taken a bold step forward with its new doctrine to address the trends discussed earlier in this monograph. A less linear doctrine called "AirLand Operations" was developed after the Gulf War. It featured a framework that discarded the deep and rear battle concepts in favor of less longitudinally linear terms like "shaping area" and "logistics area." [73] But, the 1993 version of FM 100-5 did not incorporate this

doctrine. Instead, it retained much of the AirLand Battle terminology that was first introduced in 1982.

Nevertheless, it is probably safe to say that whenever large, relatively mobile forces confront each other, ALB will be relevant to some degree, depending on local density and dynamism. The problem with the AirLand Battle framework is that it is applicable only to a relatively small subset of all potential military operations. Moreover, that subset exists very near the linear end of the spectrum, and in nature, linearity is the exception, not the rule. [74] However, the probability that a totally non-linear framework would be the ideal framework for an actual operation is at least as low as that of a totally linear framework. In practice, the vast majority of operations will probably contain some elements of both linear and non-linear operations, as did DESERT STORM. Pieces of both types of frameworks will often be applicable to the same operation. The problem is that right now, we only have one framework. The remainder of this monograph is dedicated to providing a workable non-linear alternative.

Since a non-linear operation makes the identification of close, deep, and rear areas difficult, these terms must be abandoned in a non-linear framework. Such spatial references serve more to confuse, than to clarify what is occurring. A more function-based reference system provides greater universality across the spectrum of linearity. Consequently, *main effort*, *economy of force*, and *support* provide the primary elements of the non-linear operations (NLO) framework depicted below. Some elements of the support network and certain types of economy of force operations are not shown in this figure in order to enhance the clarity of the basic structure. In addition, the framework retains some current doctrinal constructs in modified forms, like "battlespace" and "areas of operation", because they are still useful in non-linear operations. The shapes and relative locations of the three

primary framework elements are purely arbitrary and can be modified, multiplied, or dispersed as necessary to suit local conditions.

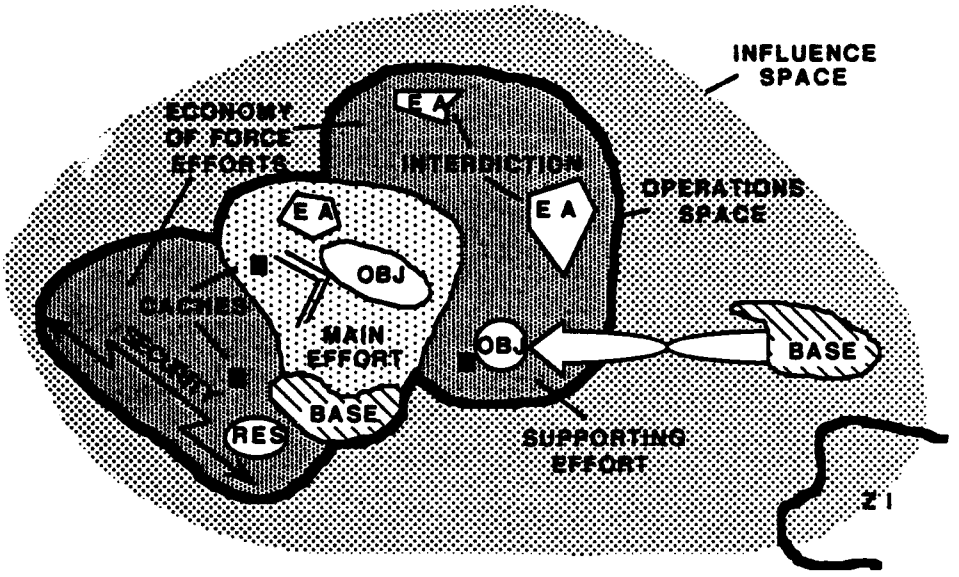


Figure 4
Non-Linear Operational Framework

Influence Space: Starting at the outside of the diagram and working inward, the first shaded region encountered is the *influence space*. This is based on the term "battlespace," which is found in the 1993 version of FM 100-5. Battlespace is somewhat of a misnomer, as it has a highly tactical flavor. It encompasses all areas relevant to a campaign, which may be composed of several operations, each of which may include multiple battles. However, it is still a useful concept. It is intended to show the relationships between the tactical and operational levels of war, and it links operations within an area of operations to relevant events and places far beyond its boundaries, on air, sea, land, and in space. [75] Battlespace has other complex properties which make it a useful addition to the ALB framework. It is three-dimensional, portable, and applicable at all levels of command. By blending it with an old (1982) doctrinal term, "area of influence," any potential confusion can be eliminated. The relabeled term, influence space,

retains the multi-dimensional flavor of the 1993 doctrine by referring to a space, rather than an area. It also more precise because battles are not fought throughout the operational "battlespace," but influence is exerted throughout it. Lastly, and on a more practical level, the abbreviation of influence space (IS) is not nearly as unfortunate as that of battlespace (BS).

In NLO, influence space incorporates all of the battlespace properties except one. Unlike battlespace, it does not apply to all levels. As a result, the term battlespace is retained to serve the same purpose for tactical commanders as influence spaces does for operational commanders. Returning to the above figure, since the IS is not assigned by a higher headquarters, no boundary is shown. It also extends over a portion of the zone of the interior (ZI), because it may be necessary to include the ports of embarkation or the home stations of forces that are deploying into the operations space.

Operations Space: Continuing to move toward the center of the figure, the next demarcation represents the assigned *operations space* (OS). In contrast to the influence space, this area (or volume) is marked by a clearly defined border. The OS corresponds directly to the current concept of the "area of operations" (AO), as defined in the current FM 100-5. The definition of AO serves the purposes of both linear and non-linear operations equally well. It should be of sufficient size for a commander to accomplish his mission and protect his force, while allowing him the ability to employ all available systems to the "full extent of their capabilities."[76] The substitution of "space" for "area" only serves to maintain a consistency of reference to multiple operational dimensions within NLO terminology. Although the OS concept is useful, it is the last part of the current framework that pertains to non-linear operations. Once the OS boundary is crossed, the current manual ceases to provide a usable framework for non-linear operations. So the rest of the framework must be developed "from scratch."

Main Effort: To develop a new framework, it is best to begin with the fundamentals. As the the baron de Jomini discovered, the fundamental principle of war is to concentrate and apply maximum combat power at the decisive point. [77] This immediately establishes a useful frame of reference. The *main effort* is at the decisive point, and is therefore a logical choice for the first completely new element of a framework.

The main effort consists of whichever elements of combat power are concentrated at the decisive point. Currently, we understand these elements to be leadership, firepower, maneuverability, and protection. [78] Mass alone may not determine how this effort is weighted, as any element of combat power may predominate within a concentration. Furthermore, the decisive point against which combat power is concentrated may not be a single place, but a dispersed function, like command and control or artillery. [79] Because the decisive point provides a focus for all efforts, regardless of their relative locations, the linear concept of "lines of operation" has been de-emphasized in this framework. FM 100-5 defines them as "the directional orientation of the force," which connects "the force with its base of operations and its objectives." [80] Since non-linear operations often require changes to, or even the severance of, links between forces and their bases, "lines of operation" becomes an overly restrictive term. This does not cause a problem in NLO, however. As the Russian theorist, G. Isserson, explained in the 1930s, the theoretical reason for conducting non-linear operations in the first place is to maximize simultaneity. [81] It is self-evident that simultaneous operations minimize sequentialness. Thus, they do not necessarily require a line of subsequent operations. This characteristic of NLO renders the lines of operation concept irrelevant under conditions of maximum simultaneity, as they were in Operation JUST CAUSE.

Economy of Force: The explanation of the nine principles of war in FM 100-5 states that because the main effort is at the decisive point, only the minimum essential combat power should be allocated to secondary efforts. [82] By definition, then, any effort that is not part of the main effort is an economy of force effort. So, it is logical to conclude that the second portion of the framework should be *economy of force.* Of course, there may be more than one economy of force effort within an OS. Economy of force zones include all forces and efforts directed at establishing a favorable correlation of forces at the decisive point. That means that security, interdiction by fires and/or maneuver, deception, supporting efforts, and reserve forces would all fall into this category.

Security: Security operations "enhance freedom of action by reducing vulnerability to hostile acts, influence, or surprise." [83] They are typically conducted by relatively small, mobile, and dispersed forces against larger enemy concentrations to deny them knowledge of friendly operations and to prevent surprise. They also consist of precautions taken by all units to preserve operational security. Because these steps are taken to avoid the necessity of expending time and resources on reactions to unforeseen enemy operations, they perform an economizing function.

Interdiction: Whether it is done by fires or maneuver forces, interdiction is done to "divert enemy forces from the main effort." [84] Since it requires far fewer resources to interdict an enemy force than to defeat or destroy it, and because it improves the correlation of forces at the decisive point, this should certainly be considered an economy of force measure.

Deception: Deception is an attempt to portray a situation that doesn't exist in order to gain an advantage over the enemy. [85] Obviously, the single most important advantage attainable is that of a superior concentration of combat power at the decisive point. All deception efforts are directed toward this goal by causing the

enemy to array his forces in a posture that will contribute to such an advantage. When enemy forces have been rendered unable to react to the friendly main effort, they need not be defeated or destroyed. This happy circumstance results in an economy of friendly forces.

Supporting Efforts: The conduct of fixing attacks and defensive operations in the offense, or any operation designed to shape the battlefield in the defense, are all economy of force operations.[86] By drawing enemy combat power away from the decisive point or by causing the enemy to be in a weakened position at the decisive point, they enhance the correlation of forces for the main effort there. Even if the bulk of friendly combat forces are involved in various supporting efforts, they are still performing economy of force missions by allowing a sufficient amount of combat power to concentrate within the main effort at the decisive point.

Reserves: Lastly, reserves must also be considered as force economizers. Their function is to react to the unexpected, for better or for worse. They exploit success or defeat enemy attacks.[87] It is impossible to deploy sufficient forces to react to every possible contingency wherever it might occur. Designating a single force, with adequate flexibility and mobility, to await events at a convenient location only makes good sense. These reserves may or may not be located inside the OS, but they must have the means to arrive where they are needed in a timely fashion. They may consist of an offshore Marine Expeditionary element, an aviation unit (attack or airmobile) at a makeshift airfield anywhere within the OS, or it may be an armored force at a nexus of the ground transportation network. In any case, this single force fulfills the functions of many, simply by being where and what it is.

Admittedly, reserves are theoretically unnecessary under truly simultaneous, non-linear conditions. They are included because such conditions will not always prevail. Linearity can occur locally during non-linear operations and unexpected enemy reactions may occur despite every attempt to achieve simultaneity. It is only

realistic to assume that operations will usually be less than totally simultaneous and non-linear.

Support: In physics, Sir Isaac Newton's third law of motion tells us that every action creates an equal and opposite reaction. Put another way, to create a useful force, the reaction force must have a supporting surface for it to push against. [88] Similarly, the actions of the main effort and actions within the economy of force zones must also be supported. When acting against the enemy, combat forces put pressure on their supporting resources. That is why the third element of the non-linear framework must be *support*. This element consists of a network of manned bases, unmanned supply caches, organic support, and support packages in transit. Bases and caches are static nodes between which supported forces and support packages move. These packages travel over irregular paths as determined by the factors of mission, enemy, troops, terrain, and time available (METT-T). This support network of nodes and discrete, path independent pulses moving between them, represents a break from the linear concept of continuous lines of communications between bases and supported forces. There is a strong correlation between this support network concept and the idea of "sea control" that was championed in 1911 by the British naval theorist, Julian Corbett. He argued that in a non-linear environment like the open sea, it is not necessary to control all points along a fixed line of communications to assure an uninterrupted flow of supplies. It is only important to secure "local and temporary control" of the area surrounding convoys of merchant ships. [89] Similarly, lines of communications can and must be abandoned on land during non-linear operations. Discrete support packages that are adequately protected by defensive measures, such as escorts or stealth, can travel over multiple, constantly changing routes to their destinations.

Bases: Resources are stockpiled in bases where they are marshaled for transfer to the forces deployed within an OS. This arrangement provides security

for the resources, and it increases efficiency by centralizing many support functions. Of course, more than one base may be necessary to support a widely dispersed non-linear operation. These bases do not have to be inside the OS, but they must be positioned where they can provide adequate and responsive support to the combat forces. Local conditions, means of delivery available, security, the quantity and nature of the support required all combine to determine the proper location of bases.

Caches: Small, unmanned stockpiles within the OS, called caches, can be used to provide intermediate supply sources to forces operating far from the nearest base. Their security resides in remaining small, numerous, and covert. As George Washington explained in 1778 to Nathanael Greene, who was about to embark on an independent campaign in the Southern colonies:

> The more numberous *(sic)* they are, the better; as their multiplicity, decreasing the importance of each, would leave no one a sufficient object of enterprise; enhance the trouble of destroying them, and lessen the labour and expence *(sic)* of forming them in the first instance. [90]

Caches allow mobile supported forces to replenish themselves as needed when regular contact with bases is not possible. They also allow support packages to remain in more secure areas while avoiding the difficulties inherent in locating and linking up with a moving combat force. Obviously, the process of emplacing, stocking, and using caches presents challenges of its own, but improved information technology will mitigate these potential problems. The best way to circumvent all cache-related difficulties is to maximize operational simultaneity. Shorter operations require less resupply, and hence, fewer caches. The primary benefit of caches, then, is that they permit non-linearity where simultaneity is impossible or necessarily limited.

Support Packages: These can move by air, land, water, or the electromagnetic spectrum (as data is at least as important as the more tangible forms

of supply). Support packages may be radio signals, airdrops, truck columns, or ship convoys. Regardless of the transmission medium, they consist of discrete amounts of support moving in accordance with local conditions. This represents a dramatic difference from linear support concepts because it does not rely on fixed lines of communication. Ulysses S. Grant used this concept during his Vicksburg campaign in 1863. He established a fortified base at Grand Gulf, Mississippi to support his operations on the enemy held East bank of the Mississippi River. Each day, large wagon convoys rolled from this base to his forces operating deep in the enemy interior. These trains were heavily guarded to prevent Confederate interference as Grant made no effort to occupy the territory these "support packages" traversed. [91] By adopting this radical system, Grant successfully anticipated Corbett's "local and temporary control" doctrine by almost 50 years.

Modern technology provides a means of improving on Grant's support method. By enabling supporters to know where, when, and just how much support is required, it makes the process more efficient, which reduces the quantity of support required. This "de-massification" of support is only possible through Toffler's "third wave" information technology. [92] This technology can also reduce or eliminate the strong guard forces that Grant had to dedicate to protecting his convoys. Improved situational awareness allows support packages to avoid threats and interference. By relieving many combat forces from guarding convoys or, even worse, long and vulnerable LOCs, it is possible to muster greater concentrations of combat power against the enemy, thus making decisive victory that much more probable.

Organic Support: The degree to which a supported force can support itself determines its organic support capacity and its consequent independence from the support network. This allows it to operate farther from caches and bases, or with less frequent support infusions from support packages. Napoleon found that

being "freed from the encumbrance of slow-moving supply convoys and a strategy based on the existence of prestocked arsenals and depots" made the *Grande Armée* capable of "running rings around their slower opponents both strategically and tactically."[93] Of course, modern, high-technology armies can no longer live off the land to the degree that Napoleon's army did, but the underlying principle remains valid. A robust organic support capability still confers a significant advantage on a force. This support consists of any supplies or any service capabilities that are co-located with a supported force, whether moving or stationary. Obviously, a high degree of non-linearity within the OS, or an inadequate support network would make such support even more valuable.

NLO DOCTRINE ANALYSIS: Two aspects of the non-linear operations doctrine are critical to determining its utility. Its framework must be applicable to a broad range of operations beyond capability of ALB and it must operate effectively where applied.

Applicability: The applicability of this operational framework is nearly universal. This is because it is easy for a flexible framework, as a non-linear framework must be, to adapt to less flexible conditions. Although it is not optimally suited to relatively rigid situations, this framework still suffices. To demonstrate this, it is necessary to examine hypothetical conditions at opposite extremes of the linearity spectrum.

At the non-linear end of the spectrum, fluidity is maximized. The main effort might be directed against a dispersed function, while friendly and enemy forces would be heavily intermingled throughout the depth and breadth of the OS. This would lead to multiple economy of force operations, also throughout the OS. Such conditions would demand a highly dispersed support network. It would rely heavily on external bases and perhaps large numbers of small caches if any

subsequent operations were required. Small and numerous support packages would move along constantly changing paths between supporting nodes and supported units. Since the non-linear framework was specifically designed to cope with these conditions, it would have no trouble in doing so.

When operating in a more linear situation, the non-linear framework can be adapted into a more linear form. When an area of operations becomes clearly segregated between enemy and friendly held territory, the support network would move *in toto* behind the front line of troops (FLOT), forming what is currently called the rear. Given the relative security provided by a rear area, support packages could consistently move along the most efficient routes between static bases within the OS to relatively static combat forces, thus creating *de facto* lines of communication. The main effort, whether conducted by close or deep forces could coalesce against a single geographic decisive point in a linear operation. If sequential operations are conducted against the decisive point, lines of operation would emerge. Meanwhile, all supporting efforts, both close and deep, could form a single the economy of force zone if necessary. Thus, the NLO framework could easily become a rough approximation of the AirLand Battle framework of close, deep, and rear. The only difference would be that close supporting efforts would not belong to the same part of the framework as the main effort, as they do in ALB, but would remain part of the economy of force effort along with all of the deep battle efforts.

Since non-linear operations often occur in low intensity conflicts (LICs), this framework is ideally suited for both LIC and operations other than war (OOTW). It is also applicable in the relatively less frequent, mid-to-high intensity conflicts where the conditions for non-linearity are present. As second and third wave technologies continue to roll across the face of the planet, these conditions will become increasingly common, making this an important aspect of NLO's

applicability. The only sub-optimal case, highly linear, mid-to-high intensity conflict, will be encountered less and less often in the future. However, the non-linear framework is easily adapted to meet the unique requirements of this scenario in an adequate, if not ideal, manner. It also allows a single framework to be used across an entire OS despite varying levels of density and dynamism that may occur within it, as in Operation DESERT STORM. Thus, the non-linear operational framework is universally applicable.

During this monograph's discussion of trends in modern warfare, several operations were examined to illustrate the operational significance of non-linearity. The following figure graphically reflects the applicability of the NLO and ALB frameworks to those operations' differing degrees of non-linearity.

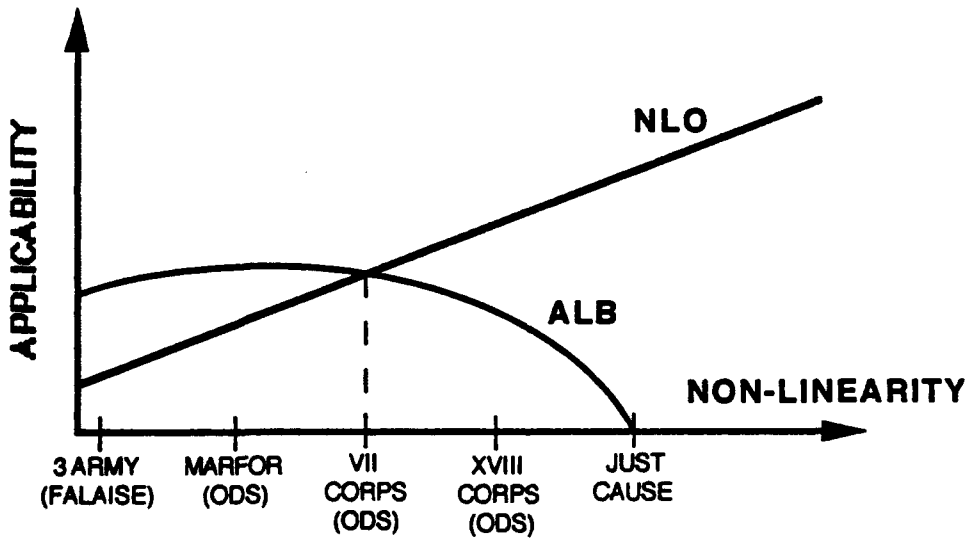


Figure 5
Applicability of Frameworks

As was discussed earlier, Patton's Third Army at Argentan was not allowed to go on to Falaise because of poor situational awareness during a temporary period of non-linearity. Given the efforts of his superiors to restore linearity due to the limitations of "second wave" information technology, the ALB concepts of deep, close, and rear were probably superior to elements of NLO in organizing the

theater, although these could also be made to apply. The linear, though simultaneous, operations of the Marine Forces in Kuwait during Operation DESERT STORM (ODS) did not require a non-linear framework to succeed. Had the embarked marines in the Persian Gulf made an amphibious landing instead of merely demonstrating off the Kuwaiti coast, however, this would have made the NLO framework far more useful than the ALB framework. The operations of VII (US) Corps represented a cross-over point between the two frameworks, as evidenced by the tension between the Corps and Theater commanders over the tempo of the advance. While the ALB framework sufficed in the XVIII Airborne Corps zone, the NLO framework would have avoided confusion over poorly suited terms like deep, close, and rear, where they were heavily intermixed. Finally, Operation JUST CAUSE represents the point at which the ALB framework loses all relevance, and beyond which, only a non-linear framework is valid.

The relative applicability graph makes a strong case for the NLO framework. Occaisionally the limited presence of non-linear conditions makes the new framework less than ideal, though it still applies. Perhaps this is a good argument for retaining the old ALB framework as a hedge. But what is most striking is that there are conditions under which only a non-linear framework will do, thus making an NLO framework indispensible.

Effectiveness: The primary purpose of non-linearity is to enhance simultaneity. It does this by striking as many objectives as possible at once. It also prevents the enemy from recovering his cybernetic coherence once an operation begins. [94] This helps to minimize enemy interference, thus hastening his defeat and our success. Because simultaneity makes quick, and decisive victories with minimal casualties possible, it is the most logical criterion to measure the NLO framework against. The "operational functions" provide a systematic means of

evaluating the simultaneous properties of the framework. These are maneuver and movement, fires, command and control, intelligence, logistics, and protection. [95]

Maneuver and Movement: The United States Army has become trapped into thinking in terms of sequential operations because we are primarily a force projection army. The phases of contingency operations listed in FM 100-5 reflect this. They progress through pre-deployment, deployment, entry/lodgment establishment, force build-up, decisive operations, post-conflict, and redeployment phases. [96] This is a perfectly logical, though highly linear sequence of events. In fairness, the manual makes mention of probable overlap between phases, and *coups de main* are cited as an exception to this rule. [97] But rather than just suggesting that less linear operations are possible, our doctrine should recognize that they are both increasingly likely and often desirable.

The NLO framework is specifically designed to accommodate all degrees of simultaneity. As a result, a commander's or planner's vision of a future operation need not be restricted by a linear, sequential paradigm. He can survey the entire spectrum of linearity and select the appropriate balance, based upon the factors of METT-T. Paradigms tend to operate like blinkers, preventing us from seeing anything lying beyond their parameters. [98] Consequently, anyone who approaches an operation while possessing only a linear framework is bound to have difficulty in seeing non-linear possibilities. This could potentially preclude maximum simultaneity. The NLO framework enables us to avoid this trap.

Fires: One of the biggest stumbling blocks to simultaneity is the coordination of operational fires. The ongoing, and seemingly endless debate over the proper placement and meaning of the fire support coordination line (FSCL) is a prominent case in point. The division of labor between air and land forces is a difficult question, particularly in non-linear operations. Clearing and coordinating fires takes time, especially between services. The inability of the FSCL to conform

to the needs of a non-linear battlefield was vividly demonstrated during Operation DESERT STORM. There the line was placed far enough out to allow ground commanders essentially to ignore air support, so they would not have to worry about synchronizing it with their maneuvers. [99] Obviously, this solution is unacceptable. We can not allow a significant part of our combat power to be marginalized simply because it is too hard to handle. Air power is critical to achieving simultaneity, and must, therefore, be fully integrated into all operations.

In the NLO framework, the FSCL is eliminated. In a highly non-linear environment, it is likely that no clear delineation between close, deep, operational, and tactical fires will be discernible. Maneuver forces and fires will be spread throughout the OS. Obviously, the FSCL, along with the Joint Targeting Board (JTB), and the ponderous Air Tasking Order (ATO) process are inconsistent with highly dynamic, non-linear operations. This presents commanders with a tremendous problem. Eventually, the third wave phenomena of precision weaponry and improved situational awareness will make it possible to cope with it. In the meantime, however, some compromises will have to be made. Perhaps an early removal of the FSCL from doctrine would force ground and air commanders to exhibit greater trust in each other. The important contribution of the NLO framework to this situation is that it can grow with technological improvements far better than the present system can, permitting maximum flexibility in fires. By allowing the distribution of tactical and operational fires throughout an OS, the NLO framework fosters greater simultaneity.

Command and Control: One of the greatest advantages that the United States enjoys over any potential adversary is in the field of information technology. That technology is most severely tested during the conduct of non-linear operations. By deliberately creating non-linear conditions, we can force the enemy to operate at a relative cybernetic disadvantage to us. Martin Van Creveld says that a force with

inferior information, and/or the ability to process it, will "automatically" perform at a lower level than its opponent. [100]

This proclamation must be caveated, however. It does not consider the moral domain. If an enemy force is willing to absorb heavy casualties and continue to fight despite being isolated, then the relative difference in performance levels means much less. Somalia, Vietnam, and Afghanistan are all examples of conflicts in which the enemy would not succumb despite being at a severe cybernetic disadvantage. In all of these cases, the enemy center of gravity lay in the civilian population, and no success in battle can ensure victory in such situations. Consequently, NLO must be complemented by non-military and special operations, which are the most important operations in these circumstances.

During the conduct of actual military operations, however, we can exploit this relationship between information and performance to our advantage. The ability to produce faster and better informed decisions than the enemy can makes an increased operational tempo desirable for us. Obviously, a quickened tempo translates into greater simultaneity. Thus, the command and control aspect of non-linear operations, though challenging, also contributes to simultaneity.

Intelligence: Sun Tzu recognized the importance of situational awareness. He said, "Know the enemy and know yourself; in a hundred battles you will never be defeated." [101] This is a pretty safe prediction, given the difficulty in attaining such knowledge, particularly of the enemy. Even if all warfare were not based on deception, as Sun Tzu also said, the enemy would probably not cooperate with your attempts to learn about his situation. [102] The usual problems in gathering timely intelligence are only compounded in the dynamic environment of non-linear operations. The intelligence challenge is difficult enough under traditional, linear conditions. Clausewitz recognized that the human will that animates enemy reactions to friendly actions and counteractions, combined with

"the fog of war," resulted in limited situational awareness even in his day. [103] It takes very little imagination to see how a modern non-linear environment could magnify these adverse effects. Technology can mitigate some of the impact of "fog" on the intelligence function, but it will probably never adequately model the complex human interactions of non-linear warfare. Simultaneity provides the surest means of avoiding the problem of predicting possible enemy reactions, as it deprives him of the time required to react. So, while the intelligence function of non-linear operations does not contribute to simultaneity, it argues in its favor.

Logistics: Non-linear logistics are the key to simultaneity. By reducing their dependence on static lines of communication, our forces can achieve unprecedented operational flexibility. B. H. Liddell Hart said that forces concerned with protecting their critical lines of communications do not march on their stomachs; they merely wiggle on them. [104] This is because LOCs tend to work like elastic tethers. As they lengthen, they exert increased restraint on combat operations, *until operations must cease due to logistics culmination.*

Historically, few armies have abandoned their LOCs, even temporarily. For all its faults, there was no better method of suppling a large force under normal circumstances than the old base and LOC system. During the Civil War, Grant and Sherman exhibited great daring by freeing themselves from their LOCs to gain flexibility. Other great captains, like Hannibal in Italy, achieved success in a similar way. Yet each sought to establish new supply lines as soon as possible because they could not sustain themselves indefinitely without them. Today, that is no longer the case thanks to improved situational awareness and the de-massification of warfare. Small support packages can now move along the paths of least resistance between remote bases and dispersed, mobile combat forces. The increased flexibility in logistics gained by non-linear support makes non-linear, simultaneous operations throughout a theater much more attainable.

Protection: Non-linear operations entail a higher degree of risk than linear operations because more elements of the force are exposed to enemy action. Intermingling of forces can result in the temporary juxtaposition of friendly support elements and enemy combat forces. In such situations, speed, stealth, surprise, and dispersion are the primary means of protection. Combat forces assigned to reserve and security roles can provide a secondary means of responding to sudden enemy threats. But non-linear operations demand a reduced emphasis on force-intensive protective measures, lest they become a sort of "self-licking ice cream cone," absorbing a disproportionate share of the available combat power for protection purposes.

The apparent weakness of protection in non-linear operations is actually critical to achieving simultaneity. By releasing forces from security duties, more combat power is made available for use against the enemy, particularly at the decisive point. This gives an operational commander greater flexibility, and therefore permits greater simultaneity. If all forces, especially support forces, placed protection as a high priority, simultaneous operations would be practically impossible in non-linear theaters. Consequently, the force extensive (as opposed to intensive) protection methods of NLO are essential to simultaneity.

Summary: Of the six operational functions of non-linear operations, maneuver and movement, fires, command and control, logistics, and protection all contribute to simultaneity. The intelligence function does not, but it does provide an incentive to conducting simultaneous operations. Thus, NLO does provide a valid means of achieving simultaneity. This, in turn, makes quick and decisive victories with minimum casualties possible.

CONCLUSION: Any attempt to suggest new doctrinal concepts must be tempered with a certain degree of humility. As Michael Howard's oft-quoted dictum about doctrinal development says, no matter what we are working on, we

"have got it wrong ... still it is the task of military science in an age of peace to prevent the doctrines from being too badly wrong." [105] Even this modest standard is difficult to attain. No less a respected authority on warfare than Martin Van Creveld predicted in 1990 that high technology weapons would be useless, and that the "normal concepts of Clausewitzian strategy will not apply" ever again. [106] These words were still being printed at the very same time that preparations for Operation DESERT STORM were in full swing. This operation was, of course, a text-book example of high-tech, Clausewitzian warfare. The lesson in this for us is not to crawl too far out on any doctrinal limb, even if that limb happens to be as sturdy as the battle-proven AirLand Battle doctrine.

As this monograph has shown, the requirement to win quick and decisive victories with minimum casualties has made operational simultaneity vital to our success in the future. Fortunately, the United States currently enjoys a tremendous advantage over the rest of the world in critical "Information Age" technology. This makes it possible for our forces to operate in a highly non-linear manner. Recent trends indicate that non-linearity will become increasingly necessary to achieve the operational simultaneity we seek. As a result, we must be prepared to conduct non-linear operations, both technically and doctrinally. Unfortunately, our preparedness in the latter lags the former by a significant margin. Our recently published, AirLand Battle-based doctrine has a finite applicabililty across the spectrum of conflict linearity. Furthermore, trends in force dynamism and battlefield densities indicate that this usefulness is likely to shrink.

A non-linear operational framework based on functional, rather than spatial orientations seems to provide a more flexible system. The NLO framework moves away from the terminology of deep, close, and rear and adopts the less restrictive language of main effort, economy of force, and support. Five of the six operational

functions of the NLO doctrine enhance simultaneity, while the sixth, intelligence, makes it more desirable, if not achievable.

If we are to insure that we have not gotten our doctrine "too badly wrong," it would seem prudent to take heed of the current trend toward non-linear warfare. The 1993 version of FM 100-5 has taken the first step by acknowledging its linearity and finite applicability. [107] This monograph has attempted to take the next step. It offers a possible solution to the complex problem of winning the kind of victory we want in the mostly uncharted territory of non-linear operations, beyond the horizons of AirLand Battle.

ENDNOTES

1. U. S. Department of the Army, Operations, Field Manual 100-5, (Washington, D.C.: U. S. Government Printing Office, 1993), p. 1-5.

2. James J. Schneider, "Theoretical Paper No. 3: The Theory of the Operational Art," (School of Advanced Military Studies Paper, March 1988), p. 6.

3. Field Manual 100-5, p. 6-12.

4. Ibid., p. 7-11. Specifically, the manual says that the forms of maneuver, envelopment, turning movement, infiltration, penetration, and frontal attack, "may apply to either linear or nonlinear battlefields." Or, they may not. For example, it is difficult to see how a non-linear enemy free of his LOCs could be "turned." The text refers to linearity only three other times. The introduction mentions how the Army's ideas about warfighting are evolving, among other ways, from "linearity to greater fluidity." This trend is not very clear, however, as this version deleted the paragraphs its predecessor devoted to nonlinearity. The word "linear" also appears twice on page 6-12 to say that yes, the AirLand Battle framework is linear: "Options available range from a linear framework with clearly defined geometry and lines with contiguous units and deep, close and rear boundaries, to a less precisely structured framework where units might not be adjacent to one another and have no linear relationship."

5. Frederick M. Franks, "Full Dimensional Operations: A Doctrine for and Era of Change," Military Review, 12 (December 1993), 8.

6. L. D. Holder, "Offensive Tactical Operations," Military Review, 12 (December 1993), 50.

7. Elliot A. Cohen, "Down the Hatch: Dump the Bottom Up Review," New Republic, (7 March 1994), 15.

8. Simpkin, Race to the Swift: Thoughts on 21st Century Warfare, (New York: Brassey's, 1985), p. 22.

9. Marc I. Alderman, "Quick, Decisive Victory: The Search for the Holy Grail," (School of Advanced Military Studies Monograph, 1993), p. 42.

10. John M. Peppers, "Quick, Decisive Victory - Wisdom or Mirage?" (School of Advanced Military Studies Monograph, 1993), p. 42.

11. Schneider, p. 7.

12. David G. Chandler, The Campaigns of Napoleon, (New York: Macmillan, 1966), p. 162.

13. Anthony Kellet, Combat Motivation: The Behavior of Soldiers in Combat, (Boston: Kluwer, 1984), p. 304.

14. Ardant Du Picq, "Battle Studies," in Roots of Strategy: Book 2, trans. John N. Greely and Robert S. Cotton, (Harrisburg, PA: Stackpole, 1987) p. 171.

15. S. L. A. Marshall, Men Against Fire: The Problem of Battle Command in Future War, (Gloucester, MA: Peter Smith, 1978), p. 42.

16. Du Picq, p. 150.

17. Schneider, p. 6.

18. Richard Simpkin, Race to the Swift, pp. 145-51.

19. Douglas Pike, PAVN: People's Army of Vietnam, (Novato, CA: Presidio, 1986), pp. 220-1.

20. Schneider, p. 6.

21. Alvin and Heidi Toffler, War and Anti-War: Survival at the Dawn of the 21st Century, (New York: Little, Brown, and Co., 1993), p. 9. This book was written in the aftermath of DESERT STORM. It applies Toffler's theories about information age technology to modern warfare. It also recounts how Toffler's earlier book, The Third Wave, influenced GEN Donn Starry and the development of the AirLand Battle doctrine. However, Toffler is a futurist, not a historian. As a result, his vision of the future merits far more consideration than his interpretation of the past.

22. Schneider, "Theoretical Paper No. 4: Vulcan's Anvil: The American Civil War and the Emergence of Operational Art," (School of Advanced Military Studies Paper, June 1991), p. 35.

23. Toffler, p. 73.

24. Cohen, p. 17.

25. Toffler, p. 68.

26. Schneider, "The Theory of the Empty Battlefield," Journal of the Royal United Services Institute for Defense Studies (JRUSI), (September 1987), 37. This paper explains the causes and effects of the increasing dispersion of forces on modern battlefields.

27. Toffler, p. 78.

28. Ibid., p. 80

29. Ibid., p. 80.

30. Simpkin, Deep Battle: The Brainchild of Marshal Tukhachevskii, (London: Brassey's, 1987), pp. 33-4.

31. Thomas Donnelly, Margaret Roth, and Caleb Baker, Operation Just Cause: The Storming of Panama, (New York: Lexington Books, 1991), p. 79.

32. Simpkin, Race to the Swift, p. 37.

33. A. Dwight Raymond, "Firepower, Maneuver, and the Operational Level of War," (School of Advanced Military Studies Monograph, 1992),p. 25.

34. Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," International Security, 3 (Winter 1992-3), 62. This is an excellent article that discusses systemic non-linearity in clear, qualitative language without oversimplifying the subject. It also casts a new light on Clausewitz's thought process and its relevance. The author explains that Clausewitz was aware of the two principle sources of non-linearity in warfare: external feedback from the enemy ("*zweikampf*") and internal feedback ("friction"). These two factors combine to create the unpredictability of war ("chance") that modern scholars have labeled "non-linearity" or "chaos."

35. Ibid., pp. 75-6.

36. Gordon J. Van Wylen and Richard E. Sonntag, Fundamentals of Classical Thermodynamics, (New York: John Wiley and Sons, 1978), pp. 242-3. Entropy is also known as the second law of thermodynamics. That law says that order can be imposed on a disorderly system, but this requires the expenditure of energy. The expenditure of energy results in an equal and balancing disorder elsewhere.

37. James Gleick, Chaos: Making a New Science, (New York: Penguin Books, 1987), p. 31. This book has popularized the concept of understanding non-linear or chaotic systems. It has left many readers (some within the military) with the prematurely optimistic notion that science is on the verge of eliminating uncertainty.

38. Beyerchen, pp. 67-9.

39. Clayton R. Newell, The Framework of Operational Warfare, (New York: Routledge, 1991), pp. 127-8.

40. Simpkin, Deep Battle, p. 38.

41. Ibid., p. 39.

42. Russell F. Weigley, Eisenhower's Lieutenants: The Campaign of France and Germany 1944-1945, (Bloomington, IN: Indiana Universtity Press, 1981), pp. 205-9.

43. Jonathan M. House, Toward Combined Arms Warfare: A Survey of 20th-Century Tactics, Doctrine, and Organization, (Ft. Leavenworth, KS: Combat Studies Institute, August 1984), p. 121; H. Essame, Patton: A Study in Command, (New York: Charles Scribner's Sons, 1974), pp. 134-5. House refers to the British GHQ Phantom liaison system and the American SIAM companies, which served Montgomery and Bradley, respectively, as electronic "directed telescopes." Essame explains how Patton used the 6th Cavalry Reconnaissance Group (Mechanized) in a similar role. His "household cavalry" was dedicated to maintaining contact between Patton and his major subordinate commands, thus permitting him to achieve higher degree of "situational awareness" during the high tempo operations he favored.

44. U. S. Army Combined Arms Command, "The Non-Linear Nature of Future War: A Soviet/Commonwealth View," (Foreign Military Studies Office Study, 4 March 1992), p. 1.

45. Lester W. Grau, "Soviet Non-Linear Combat: The Challenge of the 90s," (Foreign Military Studies Office Study, September 1990), p. 2.

46. U. S. Army Combined Arms Command, p. 2.

47. Grau, pp. 1-2.

48. Ibid., p. 12.

49. David M. Glantz, "Soviet and Commonwealth Military Doctrine in Revolutionary Times," (Foreign Military Studies Office Study, March 1992), p. 20. MG V. I. Slipchenko, a General Staff Academy faculty member, made these comments based on his analysis of the Gulf War. He also believes that in a non-linear conflict, "the difference between operational and strategic art in such a war will disappear."

50. Grau, p. 1. The Russians word, *ochagovvy*, means "fragmented." They have always used it to describe non-linear operations. Unfortunately for the Russians, they are better at writing doctrine than executing it. This seems to stem from a longstanding cultural problem. The Russians are famous for producing great mathemeticians and scientists but lousy engineers and technicians. Their poor showings at the beginning of WW II and in Afghanistan are further evidence of this deficiency. Prior to WW II, brilliant military theoreticians like Tukhachevskii, Triandafillov, and Svechin wrote excellent doctrines for the Soviet Army. Unfortunately, the German invasion forced the Soviets to execute Svechin's doctrine with Tukhachevskii's force structure. It took them two years to recover. More recently, the Russians came to grief in Afghanistan. Perhaps because the Russians were so fixated by a possible war in Europe, they failed to see the applicability of their non-linear doctrine to that war. Perhaps, like the United States Army in Vietnam, the Russians could not identify a military center of gravity to maneuver against.

51. Christopher Bellamy, The Future of Land Warfare, (New York: St. Martin's Press, 1987), p. 275.

52. Field Manual 100-5, pp. 2-10-12.

53. Robert Hall, Soviet Military Art in a Time of Change: Command and Control on the Future Battlefield, (New York: Brassey's, 1991), p. 5.

54. Frederick J. Brown, The U. S. Army in Transition, (New York: Brassey's, 1993), p. 7. See also: Toffler, p. 69. Toffler refers to a collection of papers about the Gulf War that was authored and edited by Alan D. Campen. It is called, The First Information War.

55. Donnelly, Roth, and Baker, p. 59.

56. Field Manual 100-5, p. 6-5.

57. Donnelly, Roth, and Baker, p. 65.

58. Ibid., p. 100.

59. Ibid., p. 59.

60. William C. Bennett, "JUST CAUSE and the Principles of War," Military Review, 3 (March 1991), 11-12.

61. Robert H. Scales, Certain Victory: The U. S. Army in the Gulf War, (Ft. Leavenworth, KS: CGSC Press, 1994), pp. 161 and 390.

62. Rick Atkinson, Crusade: The Untold Story of the Persian Gulf War, (New York: Houghton Mifflin, 1993), p. 107.

63. Atkinson, p. 112.

64. Ibid., p. 406. Indeed, VII (US) Corps had a less favorable correlation of combat power in its zone just prior to the ground attack than did the Marines for their supporting attack in the East.

65. Atkinson, p. 440-1. Franks had a good handle on both his own and the enemy's situations when Schwartzkopf grew displeased with the VII Corps's rate of advance. Franks wanted to divert some forces to clean out a pocket that contained a bypassed Iraqi brigade when the CINC urged him eastward. Franks told him that "We know where the enemy is." His plan was to mass and synchronize the attacks of three heavy divisions against the Iraqi Tawalkana Division, which Schwartzkopf told him was in some disarray to his front. The CINC reminded the corps commander of his desire to "press the fight" during the night rather than to wait for morning. The enemy was growing more dense at this point and had sufficient dynamism to form a new defensive line to Franks' front. This caused the VII Corps to temporarily slow down and become more linear. The information advantage that the CINC gave the corps in the form of intelligence on the enemy's command and control problems improved Franks situational awareness. This translated into increased dynamism, and therefore less linearity, in the VII Corps' advance that night.

66. Ibid., p. 422.

67. Atkinson, p. 246.

68. Scales, p. 148.

69. Ibid., p. 162.

70. U. S. Joint Staff, Joint Publication 5-00.1, Joint Tactics, Techniques, and Procedures for Campaign Planning, (Washington, DC: U. S. Government Printing Office, August 1993), p. IV-14.

71. Raymond, p. 25.

72. Field Manual 100-5, p. 6-12.

73. National Defense University, Armed Forces Staff College Publication 2, Service Warfighting and Synchronization of Joint Forces, (Norfolk, VA: U. S.Government Printing Office, August 1992), p. I-3-17.

74. Beyerchen, p. 62.

75. Field Manual 100-5, p. 6-12.

76. Ibid., p. 6-12.

77. Antoine-Henri de Jomini, "Summary of the Art of War," in Roots of Strategy: Book 2, ed. J. D. Hittle, (Harrisburg, PA: Stackpole, 1987), p. 461.

78. Field Manual 100-5, p. 2-10.

79. Ibid., p. 6-8.

80. Ibid., p. 6-7.

81. Simpkin, Deep Battle, p. 34.

82. Field Manual 100-5, p. 2-5.

83. Ibid., p. 2-5.

84. Ibid., p. 2-18.

85. Ibid., p. 6-9.

86. Ibid. p. 2-5.

87. Ibid., p. 6-16.

88. Frederick J. Bueche, Introduction to Physics for Engineers and Scientists, (New York: McGraw Hill Inc., 1975), p. 54.

89. Julian Corbett, Some Principles of Maritime Strategy, (Annapolis, MD: Naval Institute Press, 1988), p. 321.

90. John Morgan Dederer, Making Bricks Without Straw: Nathanail Greene's Campaign and Mao Tse-Tung's Mobile War, (Manhattan, KS: Sunflower University Press, 1983), p. 44.

91. Edwin C. Bearss, The Campaign for Vicksburg: Grant Strikes a Fatal Blow, (Dayton, OH: Morningside House, Inc., 1986), p. 481.

92. Toffler, p. 59.

93. Chandler, p. 45

94. Schneider, "Theory of the Operational Art," p. 36.

95. Armed Forces Staff College Publication 2, p. II-5-2

96. Field Manual 100-5, pp. 3-9-11.

97. Ibid., p. 3-10.

98. Thomas S. Kuhn, The Structure of Scientific Revolutions, (Chicago: University of Chicago Press, 1970), p. 64. This book was the seminal work on

paradigms and paradigm shifts. It reveals how innovation is often ignored as being too radical when it does not fit the preconceptions of a prevailing paradigm.

99. Lester C. Jauron, "The Fire Support Coordination Line: Should it Delineate Responsibilities Between Air and Ground Commanders?" (School of Advanced Military Studies Monograph, 1993), p. 20.

100. Martin Van Creveld, Command in War, (Cambridge, MA: Harvard University Press, 1985), pp. 264-5.

101. Sun Tzu, The Art of War, (New York: Oxford University Press), p. 84.

102. Ibid., p. 66.

103. Beyerchen, p.80.

104. Van Creveld, Supplying War: Logistics from Wallenstein to Patton, (Cambridge, MA: Cambridge University Press, 1984), p. 26.

105. Michael Howard, "Military Science in an Age of Peace," Chesney Memorial Gold Medal Lecture given 3 Oct 1973.

106. Van Creveld, The Transformation of War, (New York: Free Press, 1991), p. 212. The author believes that professional, high-technology forces are "dinosaurs." He argues that because of the threat of nuclear weapons, future wars will be protracted and fought by massive, low-tech armies. In his opinion, the Iran-Iraq War of the 1980s would be the last conventional war ever fought. But Van Creveld is not alone in his misapprehension. As Robert Kaplan, the renowned author of Balkan Ghosts, related in his article, "The Coming Anarchy" on page 72 of the February 1994 The Atlantic Monthly: "when I asked Pentagon officials about the nature of war in the twenty-first century, the answer I frequently got was 'Read Van Creveld." If this school of thought were correct, then quick and decisive victories with minimal casualties would be impossible. This way of thinking ignores the trends discussed in this monograph, however.

107. Field Manual 100-5, p. 6-12.

BIBLIOGRAPHY

Books:

Atkinson, Rick. Crusade: The Untold Story of the Persian Gulf War. New York: Houghton Mifflin, 1993.

Bearss, Edwin C. The Campaign for Vicksburg: Grant Strikes a Fatal Blow. Dayton, OH: Morningside House, Inc., 1986.

Bellamy, Christopher. The Future of Land Warfare. New York: St. Martin's Press, 1987.

Brown, Frederick J. The U. S. Army in Transition. New York: Brassey's, 1993.

Bueche, Frederick J. Introduction to Physics for Engineers and Scientists. New York: McGraw Hill Inc., 1975.

Chandler, David G. The Campaigns of Napoleon. New York: Macmillan, 1966.

Corbett, Julian. Some Principles of Maritime Strategy. Annapolis, MD: Naval Institute Press, 1988.

Dederer, John Morgan. Making Bricks Without Straw: Nathanail Greene's Campaign and Mao Tse-Tung's Mobile War. Manhattan, KS: Sunflower University Press, 1983.

Donnelly, Thomas, Margaret Roth, and Caleb Baker. Operation Just Cause: The Storming of Panama. New York: Lexington Books, 1991.

Du Picq, Ardant. "Battle Studies." In Roots of Strategy: Book 2. Trans. John N. Greely and Robert S. Cotton. Harrisburg, PA: Stackpole, 1987.

Essame, H. Patton: A Study in Command. New York: Charles Scribner's Sons, 1974.

Gleick, James. Chaos: Making a New Science. New York: Penguin Books, 1987.

Hall, Robert. Soviet Military Art in a Time of Change: Command and Control on the Future Battlefield. New York: Brassey's, 1991.

House, Jonathan M. Toward Combined Arms Warfare: A Survey of 20th-Century Tactics, Doctrine, and Organization. Ft. Leavenworth, KS: Combat Studies Institute, August 1984.

Jomini, Antoine-Henri de. "Summary of the Art of War." In Roots of Strategy: Book 2. Ed. J. D. Hittle. Harrisburg, PA: Stackpole, 1987.

Kellett, Anthony. Combat Motivation: The Behavior of Soldiers in Combat. Boston: Kluwer, 1984.

Kuhn, Thomas S. The Structure of Scientific Revolutions. Chicago: University of Chicago Press, 1970.

Marshall, S. L. A. Men Against Fire: The Problem of Battle Command in Future War,. Gloucester, MA: Peter Smith, 1978.

Newell, Clayton R. The Framework of Operational Warfare. New York: Routledge, 1991.

Pike, Douglas. PAVN: People's Army of Vietnam. Novato, CA: Presidio, 1986.

Scales, Robert H. Certain Victory: The U. S. Army in the Gulf War. Ft. Leavenworth, KS: CGSC Press, 1994.

Simpkin, Richard, E. Deep Battle: The Brainchild of Marshal Tukhachevskii. New York: Brassey's, 1987.

---------. Race to the Swift: Thoughts on 21st Century Warfare. New York: Brassey's, 1985.

Sun Tzu. The Art of War. New York: Oxford University Press, 1981.

Toffler, Alvin and Heidi. War and Anti-War: Survival at the Dawn of the 21st Century. New York: Little, Brown, and Co., 1993.

Van Creveld, Martin. Command in War. Cambridge, MA: Harvard University Press, 1985.

---------. Supplying War: Logistics from Wallenstein to Patton. Cambridge, MA: Cambridge University Press, 1984.

---------. The Transformation of War. New York: Free Press, 1991.

Van Wylen, Gordon J. and Richard E. Sonntag. Fundamentals of Classical Thermodynamics. New York: John Wiley and Sons, 1978.

Weigley, Russell F. Eisenhower's Lieutenants: The Campaign of France and Germany 1944-1945. Bloomington, IN: Indiana Universtity Press, 1981.

U. S. Government Publications:

National Defense University. Armed Forces Staff College Publication 2. Service Warfighting and Synchronization of Joint Forces. Norfolk, VA: U. S. Government Printing Office, August 1992.

U.S. Army. Field Manual 100-5. Operations. Washington, DC: U. S. Government Printing Office, June 1993.

U. S. Joint Staff. Joint Publication 5-00.1. Joint Tactics, Techniques, and Procedures for Campaign Planning. Washington, DC: U. S. Government Printing Office, August 1993.

Articles and Publications:

Bennett, William C. "JUST CAUSE and the Principles of War." Military Review, 3 (March 1991), 2-13.

Beyerchen, Alan. "Clausewitz, Nonlinearity, and the Unpredictability of War." International Security, 3 (Winter, 1992-3), 59-90.

Cohen, Elliot A. "Down the Hatch: Dump the Bottom Up Review." New Republic, (7 March 1994), 14-17.

Franks, Frederick M. "Full Dimensional Operations: A Doctrine for and Era of Change." Military Review, 12 (December, 1993), 5-10.

Holder, L. D. "Offensive Tactical Operations." Military Review, 12 (December, 1993), 48-56.

Schneider, James J. "The Theory of the Empty Battlefield." Journal of the Royal United Services Institute for Defense Studies (JRUSI), (September 1987), 37-44.

Unpublished Papers:

Alderman, Marc I. "Quick, Decisive Victory: The Search for the Holy Grail." School of Advanced Military Studies Monograph, 1993.

Glantz, David M. "Soviet and Commonwealth Military Doctrine in Revolutionary Times." Foreign Military Studies Office Study, March 1992.

Grau, Lester W. "Soviet Non-Linear Combat: The Challenge of the 90s." Foreign Military Studies Office Study, September 1990.

Jauron, Lester C. "The Fire Support Coordination Line: Should it Delineate Responsibilities Between Air and Ground Commanders?" School of Advanced Military Studies Monograph, 1993.

Peppers, John M. "Quick, Decisive Victory - Wisdom or Mirage?" School of Advanced Military Studies Monograph, 1993.

Raymond, A. Dwight. "Firepower, Maneuver, and the Operational Level of War." School of Advanced Military Studies Monograph, 1992.

Schneider, James J. "Theoretical Paper No. 3: The Theory of the Operational Art." School of Advanced Military Studies Paper, March 1988.

---------. "Theoretical Paper No. 4: Vulcan's Anvil: The American Civil War and the Emergence of Operational Art." School of Advanced Military Studies Paper, June 1991.

U.S. Army Combined Arms Command. "The Non-Linear Nature of Future War: A Soviet/Commonwealth View." Foreign Military Studies Office Report, March 1992.

Speeches:

Howard, Michael. "Military Science in an Age of Peace." Chesney Memorial Gold Medal Lecture, 3 October 1973.