

THE RELATIONSHIP OF INFORMATION TO THE RELATIVE COMBAT POWER MODEL IN FORCE XXI ENGAGEMENTS

A Monograph
by
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Infantry



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ABSTRACT

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by MAJ David V. Boslego, USA, 65 pages

Two future-oriented publications of the U.S. Army Training and Doctrine Command, Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century*, and a draft FM 100-6, *Information Operations*, have alluded to adding information as a fifth element to Huba Wass de Czege's Relative Combat Model. Wass de Czege developed his model, comprising the elements of firepower, maneuver, survivability, and leadership as a means of analyzing the factors essential for tactical success. This monograph evaluates the propriety of adding information to Wass de Czege's model.

Organized into six sections, this monograph first introduces the problem and identifies the significance of the issue. The second section traces the historical antecedents of combat power and information through the twentieth century. The third section analyzes the Wass de Czege's model and determines that information has been an integral component since the model's inception in 1976. The fourth section evaluates the role of information in battle in 2010 and determines that while the U.S. Army may place greater reliance on information than in the past, the anticipated uses of information are neither new nor revolutionary. The fifth section evaluates the relationship of information to the concept of combat power in 2010 and determines that the publications do not share the same perspective. This divergence is likely related to the disparate understanding of the term information. The last section synthesizes the findings from the previous sections and concludes the current combat power model adequately addresses information and should not be changed.

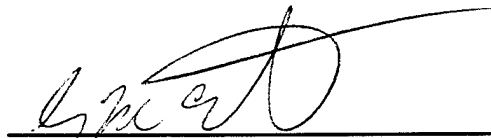
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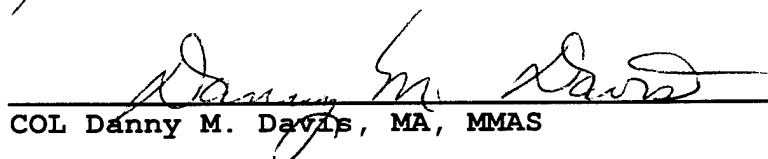
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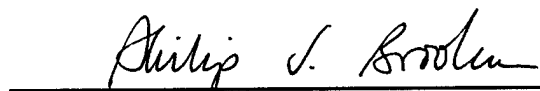
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I. INTRODUCTION

Recognizing the importance of mental flexibility in shaping tomorrow's armed forces, a recent Joint Staff working paper entitled "Joint Vision 2010" stated "how leaders think about the nature and conduct of military operations in the information age will be more important than the technology on which the precision force is based."¹ Doctrine, the collective embodiment of our thoughts about the nature of war, will perform a critical role in guiding our Army through change in the information age. Futurist David Langford described the relationship in information-age terms. "Weapons technology is only the hardware of warfare; of equal importance is the software which governs its use and which takes many forms."²

The preeminent importance of doctrine in the information age challenges today's leaders to develop coherent concepts for the employment of forces using technology often not yet developed, possibly not even conceived. In a 1984 paper which addressed managing change, Huba Wass de Czege³ wrote:

Sound doctrinal change has often been the least expensive and most effective way to increase an army's fighting effectiveness. However, to increase effectiveness, a successful army's doctrine must do several things. First, it must not depart radically from principles of combat which have stood the test of time from ancient history to the present. Next, it must exploit the potentialities of the existing materiel and human components of the army. It should not demand things of soldiers which are difficult to execute in training and impossible to do in war. Finally, it must provide direction for change. That is, doctrine must at least keep pace with the changing technology of war; ideally, it should anticipate technological change.⁴

When looking to solve the future's problems, we must look to the past for a foundation on

which to build new doctrine. At the tactical level, one of the timeless principles is the application of combat power against the enemy at the decisive point on the battlefield. In 1976, Wass de Czege designed a model to conceptualize the factors affecting the outcome of engagements. The Relative Combat Power Model became part of Army doctrine in 1982 and has remained a core concept of our tactical thinking. The model incorporates the factors of firepower, maneuver, protection, and leadership to describe, in abstract terms, the elements vital to success. While Wass de Czege stated a number of uses that could be made of his model, the central application of the model in this monograph will be in the analysis of tactical engagements. Special Text (ST) 71-3, *Tactics, Techniques, and Procedures for the Digitized Brigade*, states "commanders must use the dynamics of combat power and combat functions to create their vision of how to think about the battle."⁵ It is the *how* which is so important to doctrine. The concepts developed to assist soldiers in thinking about battle inevitably color their perceptions of war. These concepts create mental frameworks which simplify the real world. The disadvantage to any framework is an inherent perceptual bias it creates. The inclusion or exclusion of elements from the combat power model will affect how soldiers view the components both singly and as interactive elements. This monograph examines the relationship of information to the combat power model.

In future battle, the management of information is viewed to be one of a commander's most important functions. As ST 71-3 noted,

In future conflicts the volume of information available to the battle commander and his staff will be significantly greater than in the past and potentially overwhelming. The assimilation of this information and

subsequent translation into military action will be key, and is a critical function of command.⁶

Due to this anticipated criticality of information, the U.S. Army Training and Doctrine Command's (TRADOC) concept document, Pamphlet 525-5, *Force XXI Operations*, alludes to adding information as a fifth element of the Relative Combat Power Model.⁷

Special Text 71-3 refers to information as an element of a revised combat power model.

The dynamics of combat power take on a new dimension for application as a practical tool or mental model for leaders to employ combat power. The acronym FLIPM (representing the component parts, or dynamics, of firepower, leadership, information, protection and maneuver) serves as a mental model for leaders at all levels to conceptualize, plan and employ their combat power.⁸

This passage identifies information as a distinct component of combat power; an integral part of all combat operations. At first look, this proposed addition seems innocuous by serving only to highlight the term in the commander's mind. Whether a model contains four elements or five is by itself insignificant. Further analysis will suggest the implications are much more important. A modification to the combat power model will ultimately impact upon commanders' perception of the role of information on the battlefield. Prior to the inception of subordinate doctrine, the Army leadership must determine how we will think about information. Specifically, they must decide if information will be a co-equal element of combat power along with firepower, maneuver, protection, and leadership in future warfare or remain an enabling function, akin to the role of logistics. At the heart of the issue is how the Army will conceptualize information. An important aspect of information which the Army must resolve is how to model information and integrate it with other elements of combat power. This monograph seeks

to facilitate that discussion by analyzing the Relative Combat Power Model and the role of information on the battlefield in 2010.

This monograph argues that information should not be made a co-equal element of combat power. The proof for this assertion follows in the next five sections. Section Two examines the evolution of information and the concept of combat power. This section answers the question: How have these concepts of information and combat power evolved this century? Analysis of doctrine shows that information has been accorded importance and integrated into combat power throughout this century. The greatest emphasis has been on using information as a means to attain surprise. Combat power evolved from the theoretical writings of J.F.C. Fuller as a means of expressing the physical components of warfare. Following the analysis of the doctrinal development of combat power and information, Section Three analyzes Wass de Czege's Relative Combat Power Model. Section Three addresses the question: Does Wass de Czege's Relative Combat Model incorporate information? Analysis reveals that this model provides a coherent means of conceptualizing how the components of combat power interact with one another and that information has been an integral part of the Relative Combat Power Model since its inception. While the magnitude of information in future operations may be a change from our previous experience, the concept is neither new nor revolutionary. Section Four addresses information warfare in 2010 and answers the question: Does the U.S. Army's vision of battle in 2010 so radically change that it deserves another place in the relative combat power model? Research indicates that the future use of information may affect how we apply the elements of combat power, but not how the components

interrelate. Section Five answers the question: What are the differing relationships of information to the combat power model in several pieces of emergent doctrine? Analysis indicates current ideas conflict in their view of information's relationship to the combat power model. Section Six synthesizes the findings from the previous sections to support the conclusion that the current combat power model adequately addresses information and should not be changed.

Relying exclusively on unclassified sources, this monograph addresses combat power as it applies to tactical engagements in mid- to high-intensity warfare. It focuses on the capabilities and challenges the U.S. Army expects to face in 2010. Unlike Wass de Czege's essay "Understanding and Applying Combat Power," this monograph does not analyze each component in depth, but instead analyzes the relationship of information to the aggregate combat power model.

The Army's current understanding of combat power is embodied in the 1986 edition of FM 100-5. "Combat power is the ability to fight. It measures the effect created by combining maneuver, firepower, protection, and leadership in combat actions against an enemy in war."⁹ Unfortunately, the 1993 version does not provide a precise definition. Instead it addresses how combat power was created and describes its effects. While nuances exist in the use of the term between the 1986 and the 1993 versions of FM 100-5, the concept is used in both editions in essentially the same manner. For purposes of simplicity and clarity, this paper adopts the 1986 definition.

Two aspects of the definition deserve mention. The first is that combat power is defined as an ability. In many ways, this distinction is analogous to the differentiation of

energy into two components in physics: potential and kinetic. Combat power is like potential energy, it is the ability to fight. If one were able to measure combat power, the result would only give an indication of which opponent was favored, not which would win. The definition of combat power inherently recognizes the interactive nature of battle by abstaining from predicting success. This is a marked departure from the predictive operations research methodologies prevalent in the 1960s and 1970s.¹⁰

The second aspect is the definition's unquantifiability. The 1982 edition of FM 100-5 acknowledged the significance of force ratios in deciding battle then noted that "a number of intangible factors often predominate. Among these intangible factors are the state of training, troop motivation, leader skill, firmness of purpose, and boldness."¹¹ While often expressed as an equation, the real value of combat power is in its ability to help understand the relationship between the physical properties of warfare.

Another term that is linked to the discussion of combat power and information is *model*. Robert Shannon, in his textbook *Systems Simulation: the Art and Science*, defined a model as "a representation of an object, system, or idea in some form other than that of the entity itself. Its purpose is usually to aid us in explaining, understanding, or improving a system."¹² This monograph examines Wass de Czege's Relative Combat Power Model in light of the increasing requirements of information. Wass de Czege's model fits Shannon's definition. The Relative Combat Power Model is an aid to explaining and understanding the relationship of combat power elements to one another and to the outcome of engagements. The following discussion will trace the evolution of *how* we have thought about combat power and information and the degree to which

information has been incorporated into the concept of combat power.

II. DOCTRINAL DEVELOPMENT OF COMBAT POWER AND INFORMATION

The concept of combat power is an important element of American military doctrine. The antecedents of the Wass de Czege's Combat Power Model have pervaded tactical thought throughout this century. Rooted in several theoretical works as well as key U.S. Army doctrinal publications, the Relative Combat Power Model is a concise, understandable model of what others have thought for years. The source of its enduring value is its simplicity and breadth.

One of the earliest theorists to address the concept of combat power was Colonel J.F.C. Fuller. Having developed an interest in military theory just six years earlier, he delivered a lecture in 1917 which ultimately became the source of the Principles of War.¹³ In 1923, he compiled a book, *The Foundations of the Science of War*, from lectures to encourage military students "to think of war scientifically, for until we do we shall never become true artists of war."¹⁴ *Foundations* struck at the essence of the concept of combat power. Fuller based his Principles of War on elements of three spheres of force: mental, moral, and physical. The mental sphere involved will, imagination, and reason. The moral sphere addressed fear, morale, and courage. The physical sphere included those offensive, protective, and mobile powers used to defeat the enemy. Fuller declared "Destruction of the enemy's physical strength is the canon of the physical school of war."¹⁵ Using the analogy of a prize fighter, Fuller proposed that all military action is a form of hitting, guarding, and moving. In military forces, hitting equated to the firepower

of weapons. Guarding was achieved through the protection of armor, fortifications, and protective masks. Movement resulted from human, animal, and mechanical means to develop firepower against an enemy.¹⁶ Fuller considered the physical sphere the easiest to comprehend and the most tangible of the three spheres. He believed that the physical sphere was so basic to understanding war he referred to it as "the alphabet of war."¹⁷

Despite the overwhelming attention which soldiers devoted to the physical sphere, Fuller recognized that the components of offensive, protective, and mobile power were not the sole determinants of victory. The moral sphere also had a major impact on success.

We may deduce the fact that numerical superiority is only a special interpretation of the meaning of strength... Military force does not merely depend on numbers, or generalship, or political courage, but on all these requirements...It is a compound of all activities which can be utilized in war; and a weakness, or deficiency, in any one of these may spell disaster if circumstances favour the enemy.¹⁸

Fuller used the term *moral* for the intangible factors of courage and spirit. He envisioned a multiplicative relationship between the physical components and *moral*.¹⁹ *Moral* improved the fighting power attained from the physical components. Fuller held the property to be commutative. Improving the physical components also had a corresponding positive impact on *moral*. Fuller did not consider information a physical or moral force. Instead, he saw it as distinctly different from either of these and associated it with the mental sphere.

Fuller did not devote serious attention to the information element of the mental sphere. He recognized the requirement to analyze existing conditions and attempt to turn

situations to one's advantage. He also criticized the senior commanders of World War I for exclusively concentrating on the physical properties of the enemy at the expense of trying to figure out the enemy commander's plan. It would be left to the work of others to appreciate fully the value of information in the conduct of engagements. About the same time Fuller was writing *The Foundations of the Science of War*, another analyst was approaching the problem of modeling the factors which contributed to success in battle from an entirely different perspective.

Frederick W. Lanchester (1868-1946) developed a set of equations which dominated the systems analysis approach to assessing land battles for decades.²⁰ These models were used primarily at the strategic level. "Lanchester equations recognize some of warfare's operational dimensions and allow one to estimate such things as the winner and loser, the daily number of survivors on each side, and the duration of the war."²¹ Lanchester believed his quantitative analysis was fundamental to all comparisons of forces.²² While Fuller praised Lanchester's approach as a valuable idea, he admonished others not to slavishly follow it.²³

Within the operations research community, Lanchester's formulas have recently been disputed. In a 1985 Brookings Institution paper, Joshua Epstein approached the problem of determining the causes of battlefield success from an operations research perspective. His purpose was to use analytical methods to "relate input (prebattle force structures) to outputs (performance in the execution of wartime missions) in a plausible way, explicitly representing -- to the extent possible -- the dominant variables and their interaction over time."²⁴ He found three basic faults with Lanchester's equations:

withdrawal was not reflected in attrition calculations, the models did not make allowances to commanders who chose to trade space for time, and the model did not account for diminishing marginal returns. Epstein cited research which concluded "Lanchester's square law is the poorest among poor alternative choices of deterministic laws."²⁵

In addition to Epstein's criticism of Lanchester's models, current systems theory suggests another problem. Recent books by Michael Waldrop and Peter Senge stressed understanding the non-linearity of systems.²⁶ Waldrop's book *Complexity* stated that much of the science in the past three hundred years has focused on linear systems where the whole is equal to the sum of the parts. Waldrop argued that much of the phenomena in the world is nonlinear, where the whole does not equal the sum of the parts. Interactions which appear slight on the surface can have disproportionate effects. In essence, "everything is connected, and often with incredible sensitivity. Tiny perturbations won't always remain tiny. Under the right circumstances, the slightest uncertainty can grow until the system's future becomes utterly unpredictable -- or, in a word, chaotic."²⁷ Peter Senge, author of *The Fifth Discipline*, noted the same phenomenon occurs in the business management environment. When looking for solutions to problems, he found that small changes in some areas can produce big results. These areas which provide great leverage are typically difficult to find. He observed "there are no simple rules for finding high-leverage changes, but there are ways of thinking that make it more likely. Learning to see underlying 'structures' rather than 'events' is a starting point."²⁸ Unfortunately, Lanchester's law is the epitome of linear

thinking in that the outputs are directly correlated with the inputs. Lanchester's formula made no allowance for interaction among the factors affecting the outcome. It is this interaction which Waldrop believed was so critical to understanding complex, adaptive systems. While this linear perspective may have appeared logical for analyzing battles occurring in the pre-Napoleonic age of massed, unitary armies, the growing complexity of military forces during the nineteenth and twentieth centuries has demonstrated that linear models are of decreasing relevance.

American tactical doctrine quickly adapted Fuller's concepts. Its embrace of Lanchester's concepts would take an additional sixty years. While influenced by theorists, U.S. Army doctrine also adjusted to a host of other influences following World War I. The doctrinal development of combat power and information would ultimately affect how generations of soldiers thought about these concepts.

The first major attempt to describe combat power in a U.S. Army doctrinal publication occurred in 1924 when the U.S. Army published its first revision of the Field Service Regulations²⁹ since the end of World War I. This edition was a dramatic change from its pre-war predecessors and reflected the experiences of fighting against a capable and modern foe. For the first time, the Field Service Regulations established a coherent approach to military operations. They replaced a manual steeped with disjointed aphorisms such as "fire superiority insures success."³⁰ Fuller's Principles of War appeared for the first time as "General Principles of Combat." In the area of planning for combat, the manual urged commanders to remember the unquantifiable aspects of strength when comparing forces.

Numerical inferiority does not necessarily commit a command to a defensive attitude. Superior hostile strength may be overcome through greater mobility, higher morale, and better leadership. Superior leadership often enables a numerically inferior force to be stronger at the point of decisive action.³¹

While not expressed as concisely as Fuller, the American authors clearly understood the importance of intangible factors in conducting tactical analysis of military strength.

The 1924 manual also addressed surprise as a function of information. This was a major departure from Fuller's treatment of the subject.

The effect of surprise is dependent upon rapidity of maneuver, the efficiency of counterinformation measures, and the effectiveness of the means employed to deceive the enemy as to our own dispositions and intentions.³²

This passage suggested several implicit components to surprise. The first was based upon friendly maneuver. By using the term rapidity, one may have inferred the essence of maneuver was to arrive at an unexpected position by defeating the enemy's acquisition system. The second component was counterinformation. This was a direct attack against the enemy's information analysis system. In essence, it used the enemy's acquisition system against him. The final component was deception. Like counterinformation, it was intended to feed inaccurate information to the enemy through passive, rather than active, means.

The concept of surprise in the 1924 manual relied on information. Therefore, information was an enabling function of surprise. To make an analogy to firepower, just as artillery tubes or rounds of ammunition help generate firepower, information helps to achieve surprise. While this concept of information's role would remain essentially

unchanged through the succeeding decades of doctrinal literature, the concept of combat power would continue to evolve with each edition of the Field Service Regulations and its successor, Field Manual (FM) 100-5.

The concept of combat power benefitted from the greater emphasis given to combined arms during the late 1930s. The Army slowly adopted a more holistic approach to warfare than it had in the past. The 1939 edition, actually only a draft, used the term combat power for the first time to address those physical forces mentioned by Fuller. The term combat power would be used in each of the ten succeeding editions of FM 100-5.

The doctrines which underlie the employment of the combined arms in the offensive are to conserve the combat power of the troops in the attacking echelon, assist them to close with the enemy, and thereafter support their attack until the enemy's power of resistance is finally broken.³³

This passage highlighted a holistic view of combat power. This power was the sum of all factors which ultimately affected the ability of the soldiers to accomplish the mission.

Interestingly, the authors of the 1939 edition did not focus solely on the physical objective of destroying the enemy. Instead, they sought to break the enemy's power of resistance which connotes moral as well as physical factors. Information considerations continued to become more integrated with combat power as the nature of warfare changed.

Improvements in the ability to call and adjust indirect fires contributed to the revision of the passage which specified those elements which enable a force to defeat a numerically superior enemy.³⁴ The new version emphasized improving the effectiveness of fires to counter the enemy's numbers. Information about the enemy's location as well as the effects of the initial friendly rounds were viewed as contributors to the success against a

larger enemy force.

Observations of two years of war in Europe caused alterations to the concept of combat power expressed in the 1939 draft. The 1941 version added "better armaments and equipment" to the leadership, mobility, and firepower factors identified as enabling a force to overcome a numerically superior foe.³⁵ This was one indication of the U.S. Army's growing emphasis on technology. This edition also addressed the role of information as a factor of attaining surprise. "Surprise often compensates for the numerical inferiority of the force."³⁶ Surprise thus functioned in a manner similar to combat power. Commanders produced surprise "through measures which either deny information to the enemy, or positively deceive him, as to our dispositions, movements, and plans."³⁷ Thus, information served as an enabler of surprise. It was a resource just like ammunition is a resource of firepower. Information was a necessary but not sufficient factor of planned surprise. To achieve the desired effect, the commander had to skillfully employ information. These improvements to doctrine in the 1941 edition were carried forward through the 1944 and 1949 editions essentially without change. The sole modification in the latter edition was the substitution of the term maneuver for mobility.³⁸

The concept of combat power resumed its evolution in the 1954 edition of FM 100-5. This edition reflected major changes to the concept of combat power and the use of the term. For the first time, FM 100-5 defined the principles of mass, unity of command, maneuver, and surprise in terms of combat power.³⁹ It further defined mass, noting that it is "essentially a combination of manpower and firepower and is not dependent upon numbers alone; the effectiveness of mass may be increased by superior

weapons, tactics, and morale."⁴⁰ In a discussion of fundamentals of offensive action, the manual provided more insight on the composition of combat power. The manual stated that offensive action required concentrating superior combat power at the decisive point and time. This combat power consisted chiefly of firepower combined with maneuver.⁴¹ The explanation of the principle of maneuver initiated the use of combat power as a relative term between two forces. "Maneuver must be used to alter the relative combat power of military forces."⁴² In this context, combat power was viewed as a valid concept only when compared with an opponent's force in combat. This definition of combat power as either an absolute or relative term would continue to change throughout its doctrinal development. Finally, the 1954 edition recognized the interactive nature of combat power.

Relative combat power is dynamic and can be directly influenced by opposing commanders. It therefore must be analyzed by the commander in its potential relation to all other factors.⁴³

The authors recognized the non-linear nature of warfare and advised commanders to take a holistic perspective.

Up to this point, the doctrinal view of combat power had evolved to contain firepower, maneuver, and leadership. While elements of protection were illustrated in the chapter on defense, it had not yet been integrated into the concept of combat power. The 1962 version further defined the elements of combat power and increased the use of the term. Like the 1954 version, it defined mass, maneuver, unity of command, and surprise in terms of combat power. It went one step further by adding economy of force and security to the list. For the first time, combat power was given a separate section and

defined.

Combat power is a combination of the physical means available to a commander and the moral strength of his command. It is significant only in relation to the combat power of the opposing forces. In applying the principles of war, the development and application of combat power are essential to decisive results.⁴⁴

The 1962 version termed protection, mobility, and firepower "close combat elements."⁴⁵

The explanation of firepower and mobility retained their traditional meanings. Protection was described solely in terms of the amount of armor.

The 1962 edition emphasized the possibility of fighting on a nuclear battlefield. It dwelt heavily on the importance of dispersing forces to prevent major losses from a single nuclear strike, being highly mobile to mass at decisive points and being flexible in adjusting forces to the current situation. The terms dispersion, flexibility, and mobility were repeated so frequently in speeches, articles, and congressional testimony, that, as Andrew J. Bacevich suggests in his book *The Pentomic Era*, they became a mantra.⁴⁶ Bacevich notes that an attendant effect in the 1962 Army doctrine was that the terms dispersion, flexibility, and mobility became icons.⁴⁷ As a result, there was a lack of rigor in the Army concerning what they meant in general and how they would be applied on the tactical battlefield in particular. Another consequence of this almost exclusive focus on the technology of the tactical nuclear weapon was a failure to examine other important doctrinal and organizational changes which were affecting combat power at the time.

In addition to the nuclear battlefield concerns, the 1962 manual was also a product of the Army's attempt to maintain relevancy in a hostile budget environment. The introduction of nuclear weapons during the 1950s caused some civilian decision makers

to question the Army's utility to national defense. By focusing on the potential nuclear aspects of battle, at the expense of conventional aspects, the Army sought to ensure its survival as an institution.⁴⁸ Bacevich related the mood of the times in stating that most Army officers in the late 1950s and early 1960s believed that tactical nuclear weapons would have a decisive impact on the outcome of the next war.⁴⁹

In many ways, the problems handled by the 1962 version closely resemble those we anticipate in 2010. The major difference being the reason behind the need for dispersion in 1962 was the powerful effects of nuclear weapons. In 2010, the weapons themselves may possess only a fraction of the energy equivalent of a nuclear device but will be deliverable with great precision. This employment of relatively small, very expensive warheads suggests use against high value targets. Some of these high value targets will be the enemy's cybernetic resources.

The 1968 edition reflected only one modification to the concept of combat power addressed by its predecessor. The 1962 edition stated "the degree of combat power attained reflects the commander's imaginative planning and leadership and the organization, training, and discipline of his forces as well as their morale and esprit."⁵⁰ In a change which reflected the increasing focus on technical aspects of warfare, the 1968 edition added "firepower, mobility, communications, condition of equipment, and status of supply."⁵¹

Since the 1924 edition, the changes in doctrine were evolutionary. Each version of FM 100-5 generally copied major portions from its predecessor and made marginal changes. Even the 1962 edition which envisioned a nuclear battlefield in many ways

resembled the previous doctrine. While the specifics on how to employ forces had changed, the basic approach to thinking about combat power and information had not. Neither the holistic view of combat power nor the enabling role of information survived the major changes made to the 1976 edition.

The 1976 version of FM 100-5 intentionally focused on the physical aspects of combat power. The TRADOC commander, General William E. Depuy, wanted a doctrine which was compatible with that of the U.S. Air Force and *Bundeswehr*. Since the highly respected *Bundeswehr* intended to stop the Soviets at the Inter-German border, not trading space for time, Depuy emphasized a set-piece defense which sought to win the first fight. Depuy completely recast the manual to change the way the Army thought about war and in doing so, changed the doctrinal concept of combat power. The manual made repeated references to force ratios derived from systems analysis, a technique very popular in the Army since the 1960s. A number of these systems analysis models had evolved from Lanchester's Square Law, developed earlier in the century.⁵² The theory used in the 1976 version of FM 100-5, in essence a deterministic approach, was to gather sufficient information about the technical capabilities of the enemy to be able to predict the results when two forces fought.⁵³ This emphasis on the quantifiable aspects of fighting came at the expense of the intangible ones which were so deeply rooted in our doctrine.

The models used to develop the Active Defense were based on detailed assessments of weapons capabilities. They did not include human factors such as leadership and morale, nor did they assess the impact of maneuver. Hence they produced the firepower bias present in the manual.⁵⁴

The elements of combat power were no longer addressed as a separate consideration but

were integrated into the discussion of other subjects and the requirements for success were much more prescriptive than past editions.⁵⁵

The foregoing analysis of the evolution of combat power and information in U.S. Army doctrine demonstrated that the elements of leadership, firepower, maneuver, and, to a lesser degree, protection have been associated with the term combat power for the greater part of the century. The trend from 1924 to 1968 was to conceptualize combat power more holistically. Like modern systems thinkers, the U.S. Army developed a view that combat power was more than a mere sum of its parts. There were critical interactions which took place between the elements which were important enough to mean the difference between success and failure. This analysis also revealed that information has historically had an important place within the elements of combat power. Information facilitated the aggregation of friendly combat power and a reduction of the enemy's. Only in the late 1960s and 1970s did Army doctrine return to a more reductionist approach, an approach which was being increasingly challenged by those who would have to execute it.

III. THE WASS DE CZEGE RELATIVE COMBAT POWER MODEL

Some officers did not agree with this weapons-oriented approach to combat power emphasized in the 1976 version of FM 100-5. They felt it ignored leadership factors which could have a tremendous effect on the outcome of battle and were historically emphasized in our doctrine.⁵⁶ One of those who disagreed with the reductionist approach taken by the 1976 version of FM 100-5 was Huba Wass de Czege. His thoughts about the

relationship of leadership to the quantifiable elements would change the Army. While a student at the U.S. Army Command and General Staff College, Wass de Czege wrote his original version of "Understanding and Developing Combat Power."⁵⁷ In 1976, Wass de Czege perceived the Army was in a dilemma. While the Soviets were continually building up their forces and becoming more powerful, the U.S. Army was facing major budget reductions. To make matters worse, these events were occurring in an environment of rapid technological change. Wass de Czege observed two methods being used to set priorities: an intuitive approach and a systems analysis approach. The intuitive approach relied on intuition and experience of the senior commander to determine the relative combat power of the opposing forces.⁵⁸ The systems analysis approach attempted to be more objective and scientific by comparing the quantifiable aspects of the forces involved. He found both approaches unsatisfactory.⁵⁹ The purpose of his paper was to investigate those things needed for battlefield success.⁶⁰ The resulting model reflected the traditional view of combat power which emphasized leadership and other intangible factors. It also went far beyond the traditional concept by analyzing each element in several levels of detail. This analysis made the model a practical tool for the tactician.

As Shannon noted, models could be predictive or descriptive.⁶¹ Wass de Czege seemed to opt for the descriptive approach to understanding combat power. He recognized his model would be a simplification of reality but designed it in such a way as to incorporate the many factors which contributed to combat power. He stated:

Any time one attempts to simplify aspects of the real world, one runs the risk of leaving something out. But since human minds are not capable of dealing simultaneously with all aspects of reality, simplified models are

absolutely essential to any rigorous thinking.⁶²

One noteworthy feature of the model was its simplicity. At its basic level, the model contained only four elements: firepower, maneuver, survivability, and leadership. The basic analytical model contained the following equation:

THE RELATIVE COMBAT POWER MODEL⁶³

$$L_f(F_f+M_f+S_f-D_e) - L_e(F_e+M_e+S_e-D_f) = \text{The Outcome of Battle}$$

L_f - friendly leadership effect

L_e - enemy leadership effect

F_f - friendly firepower effect

F_e - enemy firepower effect

M_f - friendly maneuver effect

M_e - enemy maneuver effect

S_f - friendly survivability effect

S_e - enemy survivability effect

D_e - enemy degrading of friendly
firepower, maneuver and survivability
effects

D_f - friendly degrading of enemy
firepower, maneuver and survivability
effects

Figure 1

The equation form of the model helped to understand the factors' relationships. Wass de Czege believed many of the factors would remain unknown until the decisive moment on the battlefield.⁶⁴ The model emphasized leadership as the force which combines the maneuver, firepower, and survivability effects at the decisive point. Success there depended upon achieving greater relative combat power than the enemy.

Had Wass de Czege stopped at this point in the development of his model, he would have achieved a concise, coherent statement of the foundations of U.S. Army doctrine. One innovative aspect of his model was the additional levels of abstraction he developed to refine the conceptual model into a practical framework for planners. The second and third levels of abstraction were actually levels of increasing resolution. (See

Appendix) Each additional level added more detail and solidity to the concept at the expense of increasing complexity. The first level containing the four elements was incorporated into Army doctrine beginning with the 1982 version of FM 100-5 and has remained in all succeeding editions. Unfortunately, the additional levels of abstraction did not become doctrine and are relatively unknown to the Army.

The second level of abstraction divided the four basic variables into eighteen subordinate variables. The third level of abstraction increased the resolution by further dividing those variables into sixty-four. These additional levels of detail enabled the leader to identify all the elements which he could affect. "This analytical framework is designed to assist the leader ... in asking the right questions."⁶⁵ While examining the third level of abstraction variables, these questions are:⁶⁶

1. What can be done here to maximize or fully apply my combat power?
2. What actions can I take to degrade the enemy's capability in this area?
3. What actions must I take to counter the enemy's ability to degrade my capability in this area?

Within the component of firepower, Wass de Czege integrated information into the target acquisition function. This function incorporated the tasks of intelligence analysis, location and functioning of observers and sensors, and the transmission of target data. These tasks primarily focused on friendly efforts to acquire, process and disseminate information about the enemy. The element of maneuver incorporated friendly, terrain, and enemy information within the function of tactical analysis. The friendly information component was understanding your own unit capabilities. For terrain, it mentioned knowledge of terrain effects. In the area of enemy information, the

model addressed intelligence. The role of information within the element of survivability primarily concerned actions to protect enemy acquisition of friendly information. It specifically addressed efforts to counter enemy intelligence acquisition means as well as measures to reduce the signature of friendly forces. Under the heading of exposure limitation, it specified measures to minimize potential target size, potential target exposure time, and complicate potential target tracking. The role of information in leadership was relatively undeveloped. The model did not express specific tasks within the component of leadership which explicitly incorporated information. Thus, while Wass de Czege's model does not specify information as a component of the first level of abstraction, equivalent in prominence to firepower, maneuver, survivability and leadership, it does incorporate information into the subordinate echelons of the model.

In addition to combat power, Wass de Czege also modeled the phenomenon of doctrinal change. A paper in 1984 differentiated between various types of doctrine. His model recognized that some doctrine must change with the development of new equipment or the likelihood of fighting in new conditions. Other doctrine must remain essentially fixed to provide a firm foundation for development of tactics, techniques, and procedures. Like the Principles of War, some of the components in the Relative Combat Power Model have roots in J.F.C. Fuller's *The Foundations of the Science of War*. The components have also been demonstrated to remain stable for the greater part of this century. Wass de Czege made an important observation concerning the relationship of doctrinal change to time. "The top layer of techniques should change most often. The bottom layer of principles should be stable over a long time."⁶⁷ This has implications for

viewing potential changes to the combat power model which we will discuss in the next section on information warfare in 2010.

Elemental Components of Doctrine⁶⁸

Frequent changes	Conditions, hardware, and situation specific doctrinal techniques
↕	Methods in tactics, logistics, staff procedures, combined arms integration. etc.
Some changes	Fundamental organizational and coordinating ideas
↕	Fundamental ideas determining approaches to and "styles" of war.
Stable over time	Abstract Theories and Principles (i.e. 9 Principles of War)

Figure 2.

To this point, this paper has looked backward in time to examine the doctrinal development of the concept of combat power and to analyze Wass de Czege's Relative Combat Power Model. This analysis of doctrine showed that information has been accorded importance and integrated into combat power throughout this century. While the magnitude of information in future operations may change from our previous experience, the concept is neither new nor revolutionary. The next section looks into the future to analyze the conduct of information warfare in 2010. It begins with a look at the changes in the battlefield environment from 1995 to 2010 then focuses on the tactical level of warfare.

IV. INFORMATION WARFARE IN 2010

This section addresses information warfare in 2010 and answers the question:

Does our vision of war in 2010 so radically change that information deserves a place in the relative combat power model? Emerging doctrine recognizes the challenge of looking to the future. An Armor Center publication, Special Text (ST) 71-3, examined the impact of these innovations on the heavy brigade and admitted "no one can predict to a reliable degree what the future battlefield will look like."⁶⁹ With the multitude of evolving concepts it is difficult, if even possible, for one person to foretell which trends will predominate in fifteen years. While prognosticators abound, their performance record has historically been less than stalwart, particularly in times of major changes. In their book, *Unbounding the Future*, futurists Eric Drexler, Chris Peterson, and Gayle Pergamit state:

Perspective from within a bursting revolution is always a problem because the long view is obscured by compelling immediacies and the sudden traffic of people new to the subject, some seizing opportunity, some viewing with alarm. Both optimists and pessimists about new technologies are notorious for their tunnel vision.⁷⁰

Doctrine, the commonly understood and applied principles which guide the application of force, is one method of guiding an organization through change.⁷¹

The U.S. Army has chosen to make doctrine, which depends upon a comprehensive vision of future, its instrument of change.⁷² The U.S. Army's Training and Doctrine Command Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century* identifies several major trends which will shape warfare over the next fifteen years: the refinement of knowledge-based warfare, the continued merging of the

strategic, operational, and tactical levels of war, and the changing notion of time. These factors, while potentially changing the execution of warfare, may also affect how we think about combat power and information. Unfortunately, as the following discussion suggests, information, knowledge-based war, and the role of information on the future battlefield may not be commonly understood by those who will have to fight.

The first of the changes in the conduct of battle concerns the role of information. A number of current ideas about the future revolve around the concept of knowledge-based warfare.

The concept of attacking the enemy where he cannot resist can be described as knowledge-based warfare, and will characterize future conflict in the information age. The pace of future conflict, coupled with the order of magnitude enhancements in lethality, will replace firepower or attrition-based courses of action.⁷³

The key points are the tremendous increases in lethality at selected points and the improvement of our ability to acquire quickly information about the enemy and to transmit that information to the shooter.

In addition to a major change in the amount and quality of information available to a commander, war in 2010 will manifest a continued compression of the strategic, operational, and tactical levels of war. Special Text 71-3 states "tactical outcomes will have an increasing and significant impact on higher levels of warfare."⁷⁴ This will require tactical commanders to have a greater comprehension of the desired strategic and operational end states and to maintain cognizance of the changing strategic and operational situations.

A third major change in the environment of warfare is time. The speed at which information will travel will reduce the transmission time of critical information to national decision makers. This, as well as other societal factors, will result in wars occurring more frequently. The Joint Vision 2010 memorandum stated "conflict between and within states is likely to become increasingly frequent and violent."⁷⁵ Increased frequency of war may be accompanied by short duration conflicts. David Langford, author of *War in 2080*, wrote "the next all-out war will very possibly be fought in hours, while even a 'slow-motion' war of resolution is unlikely to extend over more than a week."⁷⁶

Linked with the concept of short wars is the concept of simultaneity. The Joint Vision 2010 memorandum states that continued improvements in technology may facilitate massing of combat power effects without the simultaneous massing of forces. This may fundamentally change the traditional execution of maneuver. While forces will still seek positions of relative advantage, these positions might be discontinuous with other friendly forces' positions.⁷⁷

Geographic dispersion should enhance survivability. Smaller, separated forces will emit a less distinct signature of friendly positions, intentions, and vulnerabilities. This dispersion will also enable firepower effects to be shifted rapidly from one target to another without a concurrent movement of forces. Therefore, a second potential change to the concept of maneuver is a reduced need to reposition between engagements. Repositioning frequency will be dictated by the enemy's ability to detect and mass against friendly platforms and is thus situation dependent. Rapid attack of multiple targets will

lead to the enemy's perception of near-simultaneous attack. Simultaneity may contribute to what ST 71-3 refers to as "the increasingly chaotic nature of the future battlefield."⁷⁸

These three trends, knowledge-based warfare, compression of the levels of war, and changing notions of time, affect the environment in which information will be a factor. These trends may also affect how we think about the relationship of combat power and information. All three trends appear to increase the quality and quantity of information required to be successful and the relative importance of information to victory.⁷⁹ These trends help visualize the environment of battle in 2010. Emerging doctrine also specifies methods of employing forces which appear to rely on information to achieve success.

Special Text 71-3 identifies depth and simultaneous attack as the key unifying concepts for operations at all echelons in Force XXI engagements. "Depth and simultaneous attack are defined as the simultaneous application of combat power against an enemy throughout the depth and breadth of the battlefield -- to accelerate the defeat of the enemy."⁸⁰ Termed parallel warfare by a Joint Staff memorandum, this concept of fighting envisions the simultaneous use of overwhelming combat power throughout the area of operations to paralyze the enemy.⁸¹ This method of fighting is intended to facilitate an earlier termination of conflicts with corresponding savings in casualties and cost.⁸² The concept of depth described in emerging doctrine is different from that of the 1980s which focused on the Soviet second echelon forces. Instead, the new concept of depth conceptualizes fighting not just deep into the enemy's rear, but throughout the expanse of the battlefield. To conduct simultaneous operations in depth, a commander

needs detailed information about the enemy and friendly forces.

Inherent in parallel warfare is the need to know the location of the enemy's decisive points and the protection of the friendly force. A decisive point is defined in FM 100-5 as "a point, usually geographical in nature, that, when retained, provides a commander with a marked advantage over his opponent."⁸³ An advantage of the pre-information age concept of massing forces at the decisive point was the protection it afforded to critical battle command nodes. Typically, the commander, critical assets and important logistics nodes were protected by the mass of the maneuver force. In parallel warfare, these friendly decisive points may become unprotected as the mass disperses to attack enemy decisive points simultaneously.

Parallel warfare may only be effective in situations where friendly forces have an information superiority over the enemy. If deep and simultaneous attacks are attempted in situations with information parity, friendly force decisive points would be vulnerable to destruction while attacking the enemy. In an information parity situation, it might be beneficial for the weaker force to await the other's initial attack before launching its own.

The Joint Staff memorandum also analyzes five implications of expected technological changes. Its examination of anticipated improvements in weapons precision, lethality, and protection concludes that precision and lethality will outstrip protection. The Joint Vision 2010 memorandum expects these changes to result in increasingly rapid, decisive encounters.⁸⁴ The memorandum adds that due to the limited protection offered by equipment, units will have to disperse more. Related to this increased dispersion is greater invisibility of forces. The memorandum postulates that the

stealth technology of today will find broader application for land combat forces. A contrary trend will simultaneously increase the detectability of forces. More sophisticated acquisition means will be able to isolate targets on the battlefield. Continued focus on systems integration will result in more sharing of information between systems and a corresponding increase in speed of transmission of information both vertically and horizontally. Finally, the Joint Vision 2010 memorandum anticipates a marked increase in the availability of non-lethal technologies which will provide alternative means of engaging the enemy.

Underpinning all five of these advances is a reliance on information superiority. The draft FM 100-6, *Information Operations*, is unambiguous. "The role of information is central to potentially revolutionary advances."⁸⁵ Precision weaponry is useless unless the targeting system can accurately pinpoint the enemy force. This targeting system will rely on the information system for its inputs. Detectability improvements will likewise require an information system to funnel the target data to the shooter more rapidly than the target can reposition. Systems integration will provide an important advantage to the force which can use information more efficiently. Effective use of non-lethal measures such as jamming will require early target detection information to be effective. The concept of parallel warfare and the five areas addressed by Joint Vision 2010 provide a blueprint for the application of force against an enemy. Information operations translate a portion of this blueprint into battlefield activities aimed at the cybernetic vulnerabilities of the enemy. While the Joint Vision 2010 document prioritizes information on the future battlefield, the use of information for target acquisition and sensor to shooter links

are neither new nor revolutionary. Instead, these concepts have evolved over the twentieth century. While FM 100-6 is unambiguous on the role of information superiority, current doctrine is less clear on a common understanding of the meaning of information, knowledge based warfare, and the role of information in the conduct of battle.

While Webster's dictionary defines information as "knowledge obtained from investigation, study, or instruction,"⁸⁶ multiple other definitions offer alternate meanings. Field Manual 34-1, *Intelligence and Electronic Warfare Operations*, defines information as "unevaluated material of every description that may be used in the production of intelligence."⁸⁷ The draft FM 100-6 seems to take a different tact when it defines knowledge-based warfare as "the concept of attacking the enemy where he cannot resist."⁸⁸ Thus, knowledge-based warfare appears to be dependent upon information superiority to be feasible. Yet another variation on the same theme is the emerging concept of information operations and the apparent ambiguity concerning whether these operations are an element of or support combat power.

The draft FM 100-6 states that information operations are "all operations that gain information and knowledge that enhances friendly execution of operations while denying the adversary similar capabilities by whatever means possible."⁸⁹ This definition contains two important elements which affect the application of the concept. The first is that information operations enhance other combat operations to bring about the enemy's defeat. Information operations thus enable combat units to accomplish their missions more effectively and efficiently. The second element is the positive and negative

components of the definition. To conduct information operations, friendly forces must gather knowledge about the enemy while preventing the enemy from gathering knowledge about friendly forces. This effort could be hindered by the current lack of common understanding of information. Different services, agencies, and units may have varying understandings of these information acquisition and protection requirements. The result could be gaps in acquisition and lapses in protection. The definition's two properties, a means to combat and the positive and negative aspects, provide a foundation for a study of the purpose of information operations.

The draft FM 100-6 notes that the purpose of information operations is to enhance and facilitate operations described in FM 100-5.⁹⁰ This purpose implies the role of information operations as a supporting effort for combat operations. The manual then describes the objective of information operations as attaining information superiority over the enemy in order to enable the total force to dominate the adversary with less risk, in shorter time frames and at less cost in resources.⁹¹ A statement in FM 100-6 elaborates upon the concept of information dominance. It defines dominance as

a relative advantage between the friendly commander's decision process and that of the adversary, and to use that advantage to enhance and enable the elements of combat power. Information operations is an essential foundation of knowledge-based, combined arms warfare⁹²

To execute knowledge-based warfare which requires information superiority, the U.S. Army will have to execute information operations to achieve the required information dominance. Information operations are a supporting, but essential, part of all combat operations in 2010 battles. This analysis indicates the role of information operations is

analogous to the tenets of Army operations identified in FM 100-5.⁹³ Just as the tenets describe successful combat operations, information operations describe successful knowledge-based warfare.

Doctrine concerning the execution of information operations devotes considerable emphasis to disrupting the enemy's acquisition and use of information as opposed to protecting the flow of friendly information. Field Manual 100-6 notes "by attacking and confusing his sense of the battlefield, friendly forces gain information dominance and a subsequent relative advantage in the application of combat power."⁹⁴ Force XXI doctrine makes frequent references to battlespace domination. Information warfare doctrine requires commanders to achieve this domination in two spheres: the maneuver battlefield and an information domain. As FM 100-6 stated, "to achieve information dominance, the commander must be able to dominate both the traditional maneuver oriented battlefield, and an information domain, termed the Military Information Environment (MIE)."⁹⁵ The paradox which emerges is while information enables massing combat power at the critical time and place, a commander must already dominate the maneuver battlefield to achieve information dominance.

In addition to attacking the enemy's information acquisition systems, emerging doctrine focuses on attacking his command systems. Field Manual 100-6 argues "C2-attack will slow the adversary's tempo, disrupt the adversary's planning and decision cycles, disrupt the adversary commander's ability to generate combat power."⁹⁶ Information operations will thus enable commanders to degrade the enemy's combat power. The attacks on the enemy's command system will not likely emanate from just

one point on the battlefield. To achieve surprise and reduce the enemy's ability to detect friendly forces, units will disperse throughout the area of operations. Field Manual 100-6 expects friendly information superiority will "permit surprise and the decisive destruction of the adversary from dispersed positions."⁹⁷ This dispersion will also enable rapid shifting of massed effects as opportunities present themselves. While providing commanders with an unprecedented ability to mass forces repeatedly across the battlefield in short periods of time, this capability may challenge existing staffs and planning processes to the failure point. The required planning and preparation processes may not be able to sustain this tempo unless they undergo revolutionary changes synchronous with those in the information acquisition and transmission realms.

From the friendly side, information operations enable swift concentration of combat power. Based on the relevant common picture, FM 100-6 suggests commanders will be better able to continuously integrate combat power in near-real time.⁹⁸ The doctrine provides a different purpose in concentrating this combat power. "Tactical commanders leverage their information superiority to employ weapon systems, including joint assets, to regulate enemy actions and tempo by influence of force."⁹⁹ Instead of focusing on a climactic battle with major portions of both forces engaged in the same geographic area, the decisive blow seeks to paralyze the entire enemy command throughout his area of operations.

This examination of the role of information in 2010 battle has revealed significant changes in the manner which we expect to fight. With a far better idea of enemy locations, we will be able to disperse our combat forces throughout the area of

operations and concentrate their effects in successive strikes against the enemy's decisive points. These strikes will occur so rapidly as to appear simultaneous to the enemy. These attacks will overwhelm the enemy's command system and virtually paralyze him for the duration of the fight. Friendly forces will also derive several benefits from the dispersion. It will degrade the enemy's ability to determine friendly strengths and courses of action. This dispersion will also extend the tactical unit's battlespace by enlarging the area in which forces can be brought to bear. While the relationship among the elements appears to remain stable for the near future, some Army publications seem to contradict one another on the relationship of information to combat power. This section also suggests another problem.

Unfortunately, information and the related terms such as information operations and knowledge-based warfare may be suffering from the same fate Bacevich ascribed to the mantra of dispersion, flexibility and mobility on the atomic battlefield of the 1950s. These terms have the same danger of becoming icons with an attendant lack of vigor concerning their proper place in our tactical doctrine. This discrepancy in comprehension, by itself, is an argument for not including information in the combat power model. Until information and its associated terms achieve a more convergent definition, their inclusion into doctrine prompts misunderstanding. In addition to these definitional problems, emerging doctrine identifies several trends which may affect the application of information in battle. At a fundamental level, there is a difference in definitions surrounding the terms associated with information. At another level, there is a danger that these terms may be achieving the status of icons without an understanding of

how to apply the concept. At a third level, there is concern that focusing on emerging information technologies will cause us to ignore other aspects of how we view combat power.

V. THE FUTURE RELATIONSHIP OF INFORMATION AND COMBAT POWER

As the previous section demonstrated, current doctrine is inconsistent on this precise relationship of information and combat power. Some references state it is an element of combat power, others state it supports combat power. This important definitional distinction will shape our perception of information's role over the next several decades.

A passage in the draft FM 100-6 indicates one perception of information. "Information Operations integrate all of a unit's information assets and capabilities, with elements of combat power, to achieve information dominance in situations across the range of operations."¹⁰⁰ In this example, information assets and capabilities are considered as separate, but closely related to the elements of combat power. A second example from the same manual elaborates on the supportive role of information. "Information Operations integrate all aspects of information to support and enhance the elements of combat power, with the goal of dominating the battlespace at the right time, right place, and with the right weapons or resources."¹⁰¹

Information is the integrating medium for combat power, but not an element unto itself. An example in ST 71-3 takes a different approach by identifying information as a

resource, much like logistic assets. "Information is the most precious resource on the modern battlefield."¹⁰² This statement, written in the introduction of the tactical manual for a digitized brigade, is interesting in the unequivocal preeminence it places on information. These examples highlight the divergent views afforded information in the framework of combat power. Different passages alternatively view information as a supporting element, as a resource, and finally as an separate element of combat power. There appears to be a relationship between the differences in the uses of information and the lack of convergence on the definition of information. Since the definition lacks common understanding, the emerging doctrine's uses of information lack coherence.

This analysis of the relationship of information to combat power began with the definition of combat power and a tracing of the antecedents of the combat power model. This research showed that concepts of combat power have been part of the foundation of military doctrine in the United States for over fifty years. It was not until 1976 that we saw a full development of the concept in the form of Wass de Czege's Relative Combat Power Model.

This doctrinal heritage in itself does not mean the unmodified concept will be applicable in the future. To rely solely on the past as substantiation for the future evokes images of those who are unwilling to adapt new procedures even when necessitated by changing conditions. Instead, we must be particularly cautious in changing conceptual footings to handle the latest technological evolution.

In many ways, the situation is similar to the one the Army faced with the advent of atomic weapons. To maintain relevancy in a hostile budget environment, the Army

embraced atomic weaponry at the expense of conventional equipment. It focused its resources at developing surface to surface missiles for use at all echelons down to the battalion level. Its neglect of the threads of continuity, those concepts which had proven so important to the Army in the recent past, caused the Army to become temporarily desynchronized from its environment. A passage from Bacevich's *The Pentomic Era* rings strangely familiar to the current discussion of information in combat power.

The incessant emphasis on technology was little more than an artful dodge concealing the emptiness of the Army's thinking. The futurists who proclaimed that changing technology was reshaping the face of warfare succeeded only in laying the Service open to doctrinal fads. Captivated by the prospect of turning the latest technological breakthrough to the benefit of short-term institutional goals, Service leaders charged off to develop the doctrine, tactics, and organization needed to convert technological promise into combat capability. The danger of this approach -- to judge by the 1950s -- was that the Army's unfettered enthusiasm blinded it to the limits of technology in the overall equation of war and to the real problems that technological changes brings in its trail.¹⁰³

This unhinging had serious repercussions when it was time for the Army to again fight its nation's wars. If the concept of information is not properly handled, we risk developing new doctrine which is neither commonly understood or applied. As the prior analysis has shown, the quantum increase in information poses many challenges for the Army. If the Army can keep the role of information in its historical perspective, it will be able to make the necessary changes to the way it thinks about fighting without breaking the organization.

There have been several cogent reasons advanced for changing our doctrinal models to incorporate information. One argument for adding information to the combat power model is to accord it due emphasis. Since we expect to have such a far better

picture of the friendly and enemy situations and will rely on that information to conduct our operations, some argue we must give special consideration to it. A second reason for modifying the model to include information is to recognize information as a means to attack the enemy or defend against his attacks.

The problem with these arguments is that they fail to take into account information's role in developing combat power. While information may become more important by 2010, its role on the battlefield remains essentially as a resource. We refer to physical resources as logistics and cognitive resources as information. Both can be attacked and destroyed; both must be protected to ensure success. As a cognitive resource, information is not physically destroyed. Rather, its transmission or storage devices are interrupted or corrupted so that the intended receiver does not receive the message. None of these ideas about information are new, they have been in U.S. Army doctrine for decades. The primary difference is that today we can anticipate a dramatically increased quality and quantity of information in the near future. Since the manner in which we think about information is not changing, this monograph suggests not altering the Relative Combat Power Model.

Another reason to avoid changing the combat power model is that each modification can weaken the understanding of the concept. The Army's doctrinal history in the twentieth century has shown the longer a concept goes without change, the more universally understood it becomes. In a 1984 paper on preparation for war, Wass de Czege touched on the insignificance of published doctrine unless it was internalized by the Army.

Doctrine includes all internalized ideas and practices associated with warfare or preparing for war. Its meaning here is limited to those ideas which actually guide an army's actions and, therefore, thus defined, doctrine is not necessarily what is written or decreed, but what is actually practiced by soldiers and their leaders.¹⁰⁴

This statement highlights the importance of universal understanding. A concept only becomes valid doctrine after being both understood and, at least marginally, agreed upon by a large enough percentage of those who would need to apply it. The Relative Combat Power Model, having been a feature of the U.S. Army's capstone doctrinal manual for over thirteen years, probably meets the criteria. This universal understanding facilitates a corporate internalization of the concept. Even the simplest change may take years to achieve a similar level of comprehension.

Arguments to change the combat power model to incorporate information or logistics identify a failure to understand the model's second and third levels of abstraction. An statement from ST 71-3 exemplifies this problem. "Logistics are embedded functions within the dynamics of combat power; maneuver, firepower, protection, leadership, and information."¹⁰⁵ It is unfortunate the authors did not draw the same conclusion about information.

Information dominance is a desire which is neither revolutionary nor even new to warfare. The entire discipline of espionage has information acquisition as its goal. Surprise is likewise inextricably linked with the concept of information superiority at least one place and time on the battlefield. Even if not stated explicitly, the American concept of combat power has thus always included information within its structure. The most significant change for fighting engagements in 2010 will be the quantum increases

in both quantity and quality of information available to tactical commanders.

VI. CONCLUSIONS

This monograph has examined the relationship of information to combat power in the context of 2010 tactical engagements. The conclusions of this study are intended solely to serve as an interlocutor. It is but one perspective in a continuing discussion of the relationship.

The concept of combat power is rooted in theory and doctrine and has implicitly incorporated the element of information. Starting with J.F.C. Fuller's *The Foundations of the Science of War* as a theoretical base, the concept emerged in U.S. Army doctrine from 1924 to 1941. Doctrinal publications of the 1950s and 1960s refined and emphasized combat power.

J.F.C. Fuller's book established the theoretical foundation of combat power. He divided man's activities into three orders: the physical sphere, the moral sphere, and the mental sphere. The physical sphere was the commander's traditional focus. It concerned the forces which conducted the actual destruction of the enemy on the battlefield. The components of the physical sphere are firepower, protection, and movement. Unlike Lanchester's model, Fuller also incorporated unquantifiable elements into his tactical analysis. He believed courage and spirit from the moral sphere multiplied the physical component's effects. He also held that the mental powers of analysis of enemy intentions should be afforded more attention. American doctrine was to incorporate many of Fuller's theories of combat.

Early U.S. Army doctrinal publications of the 1920s, 30s, and 40s developed the American interpretation of combat power and addressed the concept of information through their stress on surprise and security. The 1924 edition incorporated many of Fuller's concepts and embraced the idea that the intangible elements of leadership and morale can have a significant impact on the outcome of battle. The 1924 edition also specified the doctrinal role of information. This role envisioned information as a means to attaining surprise and was carried forward in succeeding doctrinal publications essentially unchanged. Beginning with the 1939 edition, doctrine writers used the term "combat power" to refer to the collective effects of the forces of firepower, mobility, protection, and leadership.

Doctrinal manuals of the 1950s and 60s developed the elements of combat power and information based on the experiences of World War II and Korea. The manuals emphasized the imperative to synchronize the various arms at the decisive point to achieve a synergistic effect. The doctrine also placed a far greater emphasis on combat power by defining a majority of the principles of war in its terms.

This review of twentieth century theory and doctrine indicates that neither the concept of combat power nor information are recent innovations. On the contrary, both are deeply rooted in Army doctrine. Despite their prior existence, it took Wass de Czege's model to merge the two concepts into a coherent framework. Wass de Czege's Relative Combat Power Model explicitly incorporates information into the elements of combat power. The model comprises three levels of abstraction which provide increasing degrees of specificity. One of the major sources of confusion with the model is the

Army's limited understanding of it. Since only the first level of abstraction - the four basic elements - became doctrine beginning with the 1982 version of FM 100-5, many are unable to appreciate the existing inclusion of information into the components of firepower, maneuver, survivability, and leadership.

An analysis of emergent doctrine indicates that the concept of information and its associated terms of information operations and knowledge-based warfare currently suffer from a lack of common understanding. There is a fundamental difference in definitions surrounding the terms associated with information. The term information has different meanings to different users. There is also a danger that these terms may be achieving the status of icons without an understanding of how to apply the concept. The explosion of information technology and usage in recent decades has exacerbated the problem by elevating the term information to the status of an icon in much the same way that tactical nuclear weapons technology did with flexibility, mobility, and dispersion in the 1950s. Eliot A. Cohen, in his paper "Making Do With Less, Or Coping With Upton's Ghost," warned of this tendency of doctrinal terms to become icons. While we hold doctrine to be a guide to action, "it is not a long step from coherence to orthodoxy and from orthodoxy to ossification."¹⁰⁶ Finally, there is concern that a focus on emerging information technologies will cause us to ignore other aspects of how we view combat power. Some may view information as a panacea for the Army's future tactical problems. Bacevich's analysis of the Army in the 1950s reached a conclusion which seems appropriate to the current environment. He stated "soldiers must recognize that technology alone cannot guarantee fighting power; indeed in some respects the pell-mell pursuit of technology can

upset the sensitive balance of human factors that invests a force with genuine qualitative superiority in combat."¹⁰⁷ Thus, the Army cannot let information become so dominating in its thoughts, in essence a Utopian ideal, that the Army loses perspective on the other elements of combat power which create the conditions for success.

Despite these definitional and conceptual problems, indications are that information will become more important in future war. The nature of warfare is changing from a blunt, sledgehammer approach of destroying the enemy to one symbolized by a razor-edged arrow, expertly aimed at the enemy's vital organs. The sledgehammer approach, essentially attrition-based, relied on vast quantities of comparatively simple materiel and ammunition. The rationale being that sheer quantity could negate any marginal effects of quality. Problems in accuracy could be overcome by saturating the target area until the target was eventually destroyed. Information provides the ability to radically depart from the sledgehammer approach. Acquisition and precision targeting of the enemy's critical nodes could eliminate the enemy's ability to fight effectively. He will essentially be unable to bring his combat power to bear.

Battles will be fought differently in the future. Commanders will use information to target enemy decisive points while simultaneously protecting their information systems from enemy attack. The quantitative and qualitative increases in battlefield information will affect how often and to what extent we consider information in future battles.

This monograph, however, concludes that this increased importance afforded information while appropriate, does not justify altering the Relative Combat Power Model, a simple yet understandable device which continues to reflect the elements critical

to success on the battlefield. Bacevich's recounting of an old Roman adage seems ominously relevant:

We trained hard, but it seemed that every time we were beginning to form up into teams, we would be reorganized. I was to learn later in life that we tend to meet any new situation by reorganizing, and a wonderful method it can be for creating the illusion of progress while only producing confusion, inefficiency, and demoralization.¹⁰⁸

Current debate surrounding information and its relation to the elements of combat power is healthy and absolutely essential. However, this debate must remain outside the arena of doctrine until we collectively understand what information means and how it applies to other factors. To make changes before we attain this common understanding threatens to invite frustration and cynicism.

One of the Army's greatest challenges today is to develop doctrine in front of the technological wave of advances. Since technology is changing at an ever rapid pace, there is an unprecedented requirement to make simultaneous intellectual advances to remain ahead. The growth of ideas, unlike the production of silicon chips, does not have a linear correlation to increasing inputs. Instead, the emergence of ideas and their resultant doctrine tends to grow at unpredictable rates.

Armies are conservative organizations; they adapt themselves slowly to new environments, and especially to new mental surroundings. To-day a new epoch of war is dawning, and we are surrounded by a veritable fog of new ideas. We must neither accept them as they stand nor pass them by, but we must examine them and test out their values. What are they, and what changes do they foretell?¹⁰⁹

Fuller wrote this passage on the eve of the mechanized warfare to change the way soldiers thought about battle. On the threshold of information warfare, we must once again

examine our perceptions and consider the manner in which we will integrate information into our doctrine.

THE RELATIVE COMBAT POWER MODEL'S

THREE LEVELS OF ABSTRACTION¹¹⁰

FIREPOWER

Volume of Fire

- Number of Delivery Means
- Supply Capability
- Rate of fire of weapons systems

Lethality of Munitions

- Design Characteristics
- Explosive Energy

Accuracy of Fires

- Weapon and munition design
- Crew Proficiency
- Terrain effects
- Visibility

Target Acquisition

- Intelligence and intelligence analysis
- Location and functioning of observers
- Transmission of target data

Flexibility of Employment

- Weapons ranges
- Mobility
- Signature Effects
- Fire Control Systems
- Tactical Employment doctrine

MANEUVER

Unit Mobility

- Physical Fitness and health
- Unit teamwork and esprit
- Unit equipment capabilities
- Unit equipment maintenance
- Unit mobility skills

Tactical Analysis

- Intelligence and Knowledge of enemy
- Understanding of terrain effects
- Understanding of own unit capabilities

Management of Resources

- Equipment Utilization
- Supplies Utilization
- Personnel Utilization
- Time Utilization
- Utilization of Energies of Subordinates

Command, Control and Coordination

- Span of Control
- SOPs and Doctrine
- Staff Efficiency
- Communications Efficiency

SURVIVABILITY

Concealment

- Camouflage
- Stealth
- Equipment Design
- Counter enemy intelligence acquisition

Exposure Limitation

- Minimize potential target size
- Minimize potential target exposure
- Complicate potential target tracking

Damage Limitation

- Individual protective equipment design
- Use of Natural Cover
- Use of Artificial Cover
- Combat vehicle design
- Medical treatment and evac system
- Combat equipment cannibalization
- Alternate C2 Arrangements
- Providing Replacements
- Misc efforts to maintain cbt effectiveness of units

LEADERSHIP

Technical Proficiency

- Training
- Experience

Understanding of Unit Capabilities

- Training
- Experience

Analytical Skills

- Selection
- Training
- Experience

Communication Skills

- Selection
- Training

Dedication, Commitment, & Moral Force

- Selection
- Motivation

Understanding of Battlefield Effects

- Combat Experience
- Training

ENDNOTES

1. Memorandum, The Joint Staff, DJS, 23 June 1995, subject: Joint Vision 2010, p. 19.
2. David Langford, *War in 2080* (New York: William Morrow, 1979), 11.
3. When he wrote this paper, Colonel Wass de Czege was serving as director of the newly established School of Advanced Military Studies at Fort Leavenworth. Prior to assuming this position, he had commanded an infantry battalion at Fort Lewis and served as the chief of Doctrine Branch in the Department of Tactics at the U.S. Army Command and General Staff College. He received a B.S. from the U.S. Military Academy in 1964 and an M.P.A. from Harvard University in 1972. He is also a graduate of the USACGSC and the U.S. Army War College. He later commanded an infantry brigade at Fort Ord, served in several positions in NATO and was the Assistant Division Commander at Fort Riley. He retired in 1993.
4. Huba Wass de Czege, "Preparing for War: Defining the Problem," 1984, p. 15.
5. U.S. Army, Special Text 71-3, *Tactics, Techniques, and Procedures for the Digitized Brigade* (Fort Knox, Kentucky: HQ, U.S. Army Armor Center), 7-1.
6. *Ibid.*, 1-3.
7. Specific examples of the migration of information into the combat power model are TRADOC Pam 525-5 and ST 71-3. "Overmatches in the elements of combat power--maneuver, firepower, protection, leadership, and ultimately, information -- will prove essential to maintaining the edge against potential adversaries" TRADOC Pam 525-5, p. 3-9. "The increasingly chaotic nature of the future battlefield demands that commanders possess a greater capacity to apply the dynamics of combat power to meet diverse situations. To accommodate this requirement, the dynamics of combat power take on a new dimension for application as a practical tool or mental model for leaders to employ combat power." ST 71-3, p. 6-2.
8. *Ibid.*, 6-2.
9. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1986), 11.
10. Some operations research techniques sought to predict outcomes of tactical engagements based on mathematical models. For a discussion of this methodology, see James G. Taylor's *Force on Force Attrition Modelling* (Arlington, Va.: Operations Research Society of America, 1981).
11. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1982), 2-4.

12. Robert E. Shannon, *Systems Simulation: the Art and Science* (Englewood Cliffs, New Jersey: Prentice-Hall, 1975), 4.
13. J.F.C. Fuller, *The Foundations of the Science of War* (London: Hutchinson and Co., Ltd., 1926; reprint, Fort Leavenworth, Kansas: U.S. Army Command and General Staff College Press, 1993), 14.
14. Fuller, 16. While brilliant, his book is an exceedingly tough read. John Trythall, a biographer of Fuller, complained "It is difficult to read and pitched at a level of abstraction which makes comprehension a slow and arduous business for the reader." Anthony J. Trythall, *'Boney' Fuller: Soldier, Strategist, and Writer 1878-1966* (New Brunswick, New Jersey: Rutgers University Press, 1977), 110.
15. Fuller, 144.
16. Ibid., 149.
17. Ibid., 174.
18. Ibid., 204.
19. Ibid., 145.
20. According to James G. Taylor, author of *Force-on-Force Attrition Modelling*, Lanchester's Square Law serves as a point of departure for all attrition modelling. The equation for the Square Law is:

$$b(x_0^2 - x^2) = a(y_0^2 - y^2)$$

Where:

a,b = positive constants, called Lanchester attrition rate coefficients, i.e. its side's firepower
 x,y = number of soldiers at time t after the battle begins

$$\frac{dx}{dt} = -ay, \quad \frac{dy}{dt} = -bx, \quad x(0) = x_0, \quad y(0) = y_0,$$

therefore $x(t)$ = the number of x at time t after the battle begins

This model shows that the change(decrease) in the strength in x over time is equal to y 's attrition rate coefficient (or firepower) times y 's strength at the time of the battle. X will win if and only if $x_0/y_0 > \sqrt{a/b}$

James G. Taylor, *Force-on-Force Attrition Modelling* (Arlington, VA: Operations Research Society of America, 1981), 23.

"The single most comprehensive presentation of Lanchester equations in James G. Taylor, *Lanchester Models of Warfare*, 2 vols. (Arlington, Va. : Operations Research Society of America, 1983)" Joshua M. Epstein, *The Calculus of Conventional War: Dynamic Analysis without Lanchester Theory* (Washington, D.C.: The Brookings Institution, 1985), 3.

21. Ibid.

22. Lanchester's feelings about the use of mathematical models are best captured in the following passage from his book on the employment of aircraft in war.

There are many who will be inclined to cavil at any mathematical or semi-mathematical treatment of the present subject, on the ground that with so many unknown factors, such as the morale or leadership of the men, the unaccounted merits or demerits of the weapons, and the still more unknown "chances of war," it is ridiculous to pretend to calculate anything. The answer to this is simple: the direct numerical comparison of the forces engaging in conflict or available in the event of war is almost universal. It is a factor always carefully reckoned with by the various military authorities; it is discussed ad nauseam in the Press. Yet such direct counting of forces is in itself a tacit acceptance of the applicability of mathematical principles, but confined to a special case. To accept without reserve the mere "counting of the pieces" as of value, and to deny the more extended application of mathematical theory, is as illogical and unintelligent as to accept broadly and indiscriminately the balance and the weighing-machine as instruments of precision, but to decline to permit in the latter case any allowance for the known inequality of leverage.

Lanchester, *Aircraft in Warfare: The Dawn of the Fourth Arm* (London: Constable, 1916), 46-7.

23. Ibid. In his introductory text on simulation, Shannon stated models either had a descriptive or prescriptive purpose and could be classified in a number of ways. One classification scheme that applies to the discussion of combat power models is the distinction between deterministic and stochastic models. A deterministic model is one whose output is uniquely determined by the input while stochastic models have an uncertain output for a given set of inputs. The Wass de Czege Model central to this monograph is an example of a stochastic model. Lanchester's deterministic models became the basis of the operations research approach to determining combat power.

24. Epstein, 1.

25. Herbert K. Weiss, "Combat Models and Historical Data: The U.S. Civil War," *Operations Research*, 14 (Sept-Oct 1966), 767.

Lanchester's law is considered a deterministic model where the output is uniquely determined by the input. Another approach is the stochastic model where output is uncertain for a given input.

While stochastic models begin to introduce some of the friction of reality, they lack an allowance for interaction with the environment.

26. Michael Waldrop, *Complexity: The Emerging Science at the Edge of Chaos* (New York: Simon and Schuster, 1992) and Peter Senge, *The Fifth Discipline* (New York: Currency Doubleday, 1994).
27. Waldrop, 66.
28. Senge, 65.
29. U.S. Army, *Field Service Regulations* (Washington, D.C.: War Department, 1924), 77.
30. U.S. Army, *Field Service Regulations* (Washington, D.C.: War Department, 1914), 77.
31. U.S. Army, *Field Service Regulations* (Washington, D.C.: War Department, 1924), 77.
32. Ibid.
33. U.S. Army, Field Manual 100-5 (Tentative), *Operations* (Washington, D.C.: War Department, 1939), 137.
34. Ibid., 28.
35. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: War Department, 1941), 22.
36. Ibid., 23.
37. Ibid.
38. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1949), 22.
39. The manual stated "maximum available combat power must be applied at the point of decision." U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1954), 26.
40. Ibid.
41. Ibid.
42. Ibid.
43. Ibid., 32.

44. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1962), 48.
45. *Ibid.*, 34.
46. Andrew J. Bacevich, *The Pentomic Era: The U.S. Army Between Korea and Vietnam* (Washington, D.C.: National Defense University Press, 1986), 70.
47. *Ibid.*, 150.
48. For a discussion of the institutional survival aspects of the Pentomic era, see Bacevich, pp. 7-48.
49. Bacevich, 54.
50. *Ibid.*, 48.
51. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1968), 5-2.
52. Lanchester's Square Law sought a discrete outcome for a given set of inputs. Models which used this approach were termed deterministic and differed from those models which were not as predictive, in that they specified a range of possible outcomes and were termed stochastic.
- Taylor, 21.
53. Aaron Blumenfeld, "AirLand Battle Doctrine: Evolution or Revolution?: A Look Inside the U.S. Army," BA Thesis, Princeton University, 1989, 17.
54. Blumenfeld, 28.
55. To win in battle, four prerequisites must be met:
1. Adequate forces and weapons must be concentrated at the critical times and places. The combination is combat power.
 2. The battle must be controlled and directed so that the maximum effect of fire and maneuver is concentrated at decisive locations.
 3. The battle must be fought using cover, concealment, suppression, and combined arms teamwork to maximize the effectiveness of our weapons and to minimize the effectiveness of enemy weapons.
 4. Our teams and crews must be trained to use the maximum capabilities of their weapons.

U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1976), 3-3.

56. Writing many years earlier, Liddell Hart expressed the same attitude. "The cult of numbers is the supreme fallacy of modern warfare. The way it persists is testimony to the tenacity of stupidity. Even Napoleón, the god of war old-style, declared: 'In war it is not men, but the man who counts.'" Sir Basil H. Liddell Hart, *Thoughts on War* (London: Faber and Faber, Ltd. 1944), 69.
57. Huba Wass de Czege, "Understanding and Applying Combat Power," 1976.
58. Wass de Czege, 2.
59. He wrote "the author believes that neither of the above methodologies are sufficient for a clear and rigorous understanding of combat power." Huba Wass de Czege, "Understanding and Developing Combat Power," 1976, 5.
60. Ibid.
61. Shannon, 4.
62. Ibid., 6.
63. Ibid.
64. Ibid., 7.
65. Ibid., 8.
66. Ibid., 9.
67. Ibid., 17.
68. Ibid., 16.
69. U.S. Army, ST 71-3, 2-1.
70. Eric Drexler, Chris Peterson, and Gayle Pergamit. *Unbounding the Future* (New York: William Morrow, 1991), 3.
71. Richard M. Swain, "Filling the Void: The Operational Art and the U.S. Army," Unpublished paper, School of Advanced Military Studies, Ft. Leavenworth, KS., 12.
72. U.S. Army, TRADOC Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century* (Ft. Monroe, VA: HQ, U.S. Army Training and Doctrine Command, 1994), 1-3.
73. U.S. Army, ST 71-3, 6-2.

74. Ibid., 2-6.

75. Memorandum, The Joint Staff, DJS, 23 June 1995, subject: Joint Vision 2010, p. 2.

76. Langford, 142.

77. These battlefield movements may occur earlier relative to the fight than has traditionally been the case since defensive information measures would assist in denying the acquisition of friendly forces by the enemy. Ideally, forces would be able to maneuver into the area of operations early and remain dispersed and undetected for the duration of the battle.

78. U.S. Army, ST 71-3, 6-2.

79. Other trends which are not currently estimated to impact by 2010 but will be in the distant future are worthy of note because of their revolutionary potential. Their arrival is difficult to precisely pinpoint but there is growing confidence in their ultimate occurrence. These are the concepts of fusion technology and nanotechnology.

Fusion technology envisions a discovery that will enable nuclear fusion to occur without a fission impetus. In theory, this would produce clean nuclear energy and permit a dramatic proliferation and miniaturization of reactors. This proliferation and mobility would permit the development and use of directed energy weapons at the tactical level. This would permit the employment of laser artillery which "will become possible and perhaps even moderately cheap - overcoming the problems of firing through air by the simple expedient of pumping out vastly more power to compensate for the losses."

Nanotechnology is the design of systems at the molecular level. It could result in dramatic increases in mechanical efficiency. Eric Drexler gave an example of the capabilities of nanotechnology in his book *Unbounding the Future* by comparing the capabilities to that of a tree's conversion of solar energy. "Trees give a hint of what molecular nanotechnology will be like, but nanotechnology won't be biotechnology because it won't rely on altering life." Instead of changing living structures, nanotechnology will enable the design of molecular sized computers, switches and communications devices. The net effect of these new capabilities will be major increases in lethality.

80. U.S. Army, ST 71-3, 4-5.

81. Memorandum, The Joint Staff, p. 8.

82. Ibid.

83. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1993), Glossary-2.

84. Ibid., 5.

85. U.S. Army, ST 71-3, 3-1.
86. *Webster's Seventh New Collegiate Dictionary* (Springfield, Massachusetts: G. & C. Merriam Company, 1972), 433.
87. U.S. Army, Field Manual 34-1, *Intelligence and Electronic Warfare Operation* (Washington, D.C.: U.S. GPO, 1994), Glossary-6.
88. *Ibid.*, 6-2.
89. U.S. Army, Field Manual 100-6 (Working Draft), *Information Operations* (Washington, D.C.: HQ, Department of the Army, 8 July 1995), ii.
90. *Ibid.*, iv.
91. *Ibid.*, 3-2 and 2-2.
92. *Ibid.*, 6-13.
93. U.S. Army, Field Manual 100-5, *Operations* (Washington, D.C.: HQ, Department of the Army, 1993), 2-6.
94. *Ibid.*, 2-23.
95. *Ibid.*, 1-1.
96. *Ibid.*, 3-13.
97. *Ibid.*, 6-36.
98. *Ibid.*, 6-14.
99. *Ibid.*, 6-37.
100. *Ibid.*, iii.
101. *Ibid.*, 2-3.
102. U.S. Army, ST 71-3, 2-10.
103. Bacevich, 148-9.
104. Wass de Czege, "Preparing for War: Defining the Problem," 4.
105. U.S. Army, ST 71-3, 5-25.

106. Eliot A. Cohen, "Making Do With Less, Or Coping With Upton's Ghost," (Carlisle, PA: Strategic Studies Institute, 1995), 11.
107. Bacevich, 156.
108. Bacevich, 156-7.
109. Fuller, 258.
110. Wass de Czege, "Understanding and Developing Combat Power," 1976, 7(a) - 7(b).

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