DEFINING NATURE: EVOLVING INTELLIGENCE PREPARATION OF THE BATTLEFIELD TO BUILD A THEORTICAL CONSTRUCT FOR THE MULTI-MEDIA OPERATIONAL ENVIRONMENT

A MONOGRAPH
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Second Term AY 97-98

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	21 May 1998	Monograph

4. TITLE AND SUBTITLE
DEFINING NATURE: EVOLVING INTELLIGENCE PREPARATION OF THE BATTLEFIELD TO BUILD A THEORETICAL CONSTRUCT FOR THE MULTI-MEDIA OPERATIONAL ENVIRONMENT

5. FUNDING NUMBERS

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Advanced Military Studies
Command and General Staff College
Fort Leavenworth, Kansas 66027

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Command and General Staff College
Fort Leavenworth, Kansas 66027

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE:
DISTRIBUTION UNLIMITED.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
SEE ATTACHED

14. SUBJECT TERMS THEORY, DOCTRINE, JOINT DOCTRINE, IPB, MEDIA, OPERATIONAL ENVIRONMENT, OPERATIONS, OPERATIONAL ART, LAND, SEA, AIR, SPACE, ELECTROMAGNETIC SPECTRUM, HUMAN TERRAIN, INTELLIGENCE PREPARATION OF THE BATTLEFIELD/BATTLESPACE

15. NUMBER OF PAGES 56

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

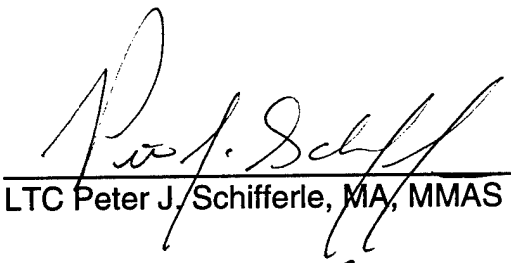
SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Thomas H. Felts

Title of Monograph: *Defining Nature: Evolving Intelligence Preparation of the Battlefield to Build a Theoretical Construct for the Multi-Media Operational Environment*

Approved by:



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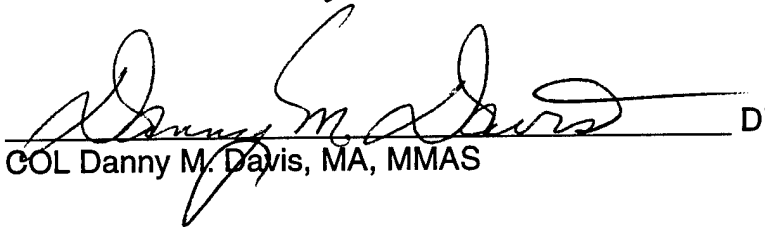

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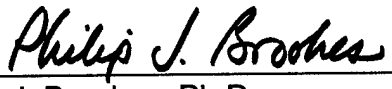

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Accepted this 21st Day of May 1998

ABSTRACT

Defining Nature: Evolving Intelligence Preparation of the Battlefield to Build a Theoretical Construct for the Multi-Media Operational Environment by MAJ Thomas H. Felts, USA, 41 pages.

Future operational concepts contained in Joint Vision 2010 and the accompanying service-level concepts emphasizes full spectrum, full dimensional dominance, allowing the application of force in time and space that cannot be equaled by a potential adversary. A campaign planner must take into account all of the factors that shape the very nature of this form of conflict based primarily on the operational environment and its effects on potential adversaries, both enemy and friendly. The campaign planning model contained in JP 3-0 and JP 5-0, and intelligence preparation of the battlefield (IPB) as described in FM 34-130 are the prescriptive tools for achieving this end. Joint doctrine writers are attempting to expand on this doctrine by pursuing the development of a methodology for Intelligence Preparation of the Battlespace. This monograph is a compliment to this particular effort, and attempts to detail a singular, simple construct for synthesizing the available data that defines a theater of operation and how a given set of belligerents will operate in the given operational environment of the theater.

This monograph will attempt to develop and evaluate a singular environmental theoretical construct for operational planning, based on lines of communication. The construct will specifically expand this context to a discussion of the interaction of operational media (the multi-media operational environment). The monograph will develop the theoretical construct, and will apply it to future operational concepts to determine its flexibility and utility in establishing full-spectrum, full-dimensional dominance.

The monograph will begin the construct by establishing the theoretical terms for lines of communication and the operational media. A clear definition of operational media as they pertain to operations and campaigns will be the necessary start point. The definition of the individual operational media, their characteristics, and their bearing on operations in a theoretical sense - specifically, the conveyance of combat power - will be the next step.

The next focus will be the discussion of the basic "physics" of the various operational media. This discussion will examine the interaction of the individual media, providing the basic terms for the theoretical construct of the multi-media operational environment. The construct will provide a means to apply the characteristics of theater and operational design based on the operational environment defined by the terms of the construct. The construct will introduce the concepts of key points of media interaction and decisive operational media in this context.

The final focus will be the application of the construct to future operational concepts that will prescriptively allow for full spectrum, full dimensional dominance. This section will end with an analysis of strengths and weaknesses of the total construct as compared to these future concepts. The monograph will conclude by outlining the implications of the construct on future operational planning and the development of joint doctrine.

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I. Introduction

> The first, the supreme, the most far-reaching act of judgment that the statesman and the commander have to make is to establish by that test the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into, something that is alien to its nature. This is the first of all strategic questions and the most comprehensive.
>
> Clausewitz
> On War[1]

The boom in information operations catalyzed by the microchip and the multi-media communications explosion has brought the idea of full-dimensional dominance (the operational superiority on any or all of the individual media of operations: human, land, sea, electromagnetic spectrum, air, and outer space) into the fore as an operational concept for future forces. The level of certainty theoretically available to an information-based force allows the commander of that force to apply accurate, effective combat power simultaneously to multiple decisive points in time and space.[2] TRADOC Pamphlet 525-5, Force XXI Operations, sums this concept up in these words:

> Information will allow the conduct of future full-dimensional operations by informing units - perhaps even enemy units, to convince them to surrender - of the full effect of all actions throughout the depth, height, width, and time of the battlespace. Such information will allow greater synchronization of effort, control of tempo, and control of force application.[3]

Any potential full spectrum, full dimensional application of force, however, is an inherently complex proposition. The availability of nearly perfect information to facilitate the waging of such a campaign still does not serve to mitigate the complexity inherent in operations undertaken to purposefully dominate any or all operational media throughout the spectrum of operations, while denying the same to a potential adversary.[4] A campaign planner must take into account all of the factors that shape the very nature of this form of conflict based primarily on the operational environment and its effects on potential adversaries, both enemy and friendly.[5]

The campaign planning model contained in JP 3-0 and JP 5-0, and intelligence preparation of the battlefield (IPB) as described in FM 34-130 are the prescriptive tools for achieving this end. The current campaign planning model, however, lacks a simple, scientific

method for evaluating the effects of a given operational environment at the operational level of war. Current doctrine for conducting IPB has a decidedly tactical focus, and assumes a readily available, accurate database on a known threat for the purpose of doctrinal templating. It also has a decidedly land-based focus. Joint doctrine writers are attempting to expand on this doctrine by pursuing the development of a methodology for Intelligence Preparation of the Battlespace.[6] This monograph is a compliment to this particular effort, and attempts to detail a singular, simple construct for synthesizing the available data that defines a theater of operation and how a given set of belligerents will operate in the given operational environment of the theater.

This monograph will attempt to develop and evaluate a singular environmental theoretical construct for operational planning.[7] The construct must be built on factors common to any potential campaign, yet be flexible enough for ready application in any given operational environment. The model must also provide a planning context for building full spectrum, full dimensional dominance by friendly forces, while denying the same to any potential adversary. The single environmental context that meets this set of requirements is lines of communication. The construct will specifically expand this context to a discussion of the interaction of operational media (the multi-media operational environment). The monograph will develop the theoretical construct, and will apply it to future operational concepts to determine its flexibility and utility in establishing full-spectrum, full-dimensional dominance.

The monograph will begin the construct by establishing the theoretical terms for lines of communication and the operational media. A clear definition of operational media as they pertain to operations and campaigns will be the necessary start point. The definition of the individual operational media, their characteristics, and their bearing on operations in a theoretical sense - specifically, the conveyance of combat power - will be the next step. The combination of operational media naturally evolves from the discussion of the use of individual media.

The next focus will be the discussion of the basic "physics" of the various operational media. This discussion will examine the interaction of the individual media, providing the basic

terms for the theoretical construct of the multi-media operational environment. The construct will provide a means to apply the characteristics of theater and operational design based on the operational environment defined by the terms of the construct. The construct will introduce the concepts of key points of media interaction and decisive operational media in this context.

The final focus will be the application of the construct to future operational concepts that will prescriptively allow for full spectrum, full dimensional dominance:

- dominant maneuver
- precision engagement
- full-dimensional protection
- focused logistics.[8]

These concepts are the framework for building a future force, and will provide a means of evaluating the suitability of the construct.[9] This section will end with an analysis of strengths and weaknesses of the total construct as compared to these future concepts. The monograph will conclude by outlining the implications of the construct on future operational planning and the development of joint doctrine.

II. The Theoretical Development of the Various Media of Operation

> Accept nothing as fixed. Realize that the circumstances of war are ever-changing, and that, consequently, organization, administration, strategy, and tactics must change also; and if during peace time we cannot change them in fact, we can nevertheless change them *in theory*, and so be mentally prepared when circumstances require that changes should be made.
>
> MG J.F.C. Fuller
> Lectures on FSR III[10]

The monograph will begin by establishing the theoretical terms for lines of communication and the operational media. A clear definition of operational media as they pertain to operations and campaigns will be the necessary start point. The definition of the individual operational media, their characteristics, and their bearing on operations in a theoretical sense will be the next step. The combination of operational media naturally evolves from the discussion of the use of individual media.

Operational Media, the Operational Level of War, and Operational Art

A medium, for the purpose of this study, is a means of conveying power relevant to operations.[11] This definition corresponds with and expands the idea of lines of communication.[12] Medium implies not only a communicative capability - it also implies the properties inherent in a given means of conveyance, open to a degree of quantification and scientific analysis.[13] The definition of medium is particularly salient to the operational level of war, which is fundamentally concerned with "fighting at the right place, at the right time, with the right stuff."[14] "Activities at this level link tactics and strategy by establishing operational objectives needed to accomplish strategic objectives, *sequencing events to achieve the operational objectives, initiating actions and applying resources to bring about and sustain these events.*"[15]

Operational art speaks to the "design" aspects of this level of war, where the operational commander (in our current doctrine, the *joint* commander) creates from a given set of ways and means a strategic end.[16] Given these definitions, an operational medium in a given commander's battlespace is like a canvas upon which the artist creates. The medium allows for certain forms of design, and has intrinsic properties that allow the master to employ it for his creation. This is,

however, an incomplete analogy with respect to operational art. Any given operational environment will contain multiple media upon which the artist not only can create, but must create (or at least consider) if he is to achieve his end. The operational artist cannot consider these media in isolation - all interact in a myriad of combinations, and the combinations may or may not be under the control of the artist. A more complete analogy may be the creative effort of a musical composer or conductor. In this case, the artist must create and orchestrate based on the capabilities of the various classes of instruments (strings, woodwinds, percussion, brass, and keyboards), the multitude of instruments in each class, and the performers themselves.[17] The artist will use these creative media in time and space to create a total, complete symphony, aimed at human perceptions, with the goal of an emotional response.

The operational artist must create in a similarly broad environment, and has as his goal a human response. The ability of the operational artist to use the tools of his creative effort - those various manifestations of power - are at once constrained and opened to unexpected opportunity based on the nature of this operational environment. The challenge that the operational artist must rise to is to quickly understand the instruments upon which he will create - the operational media contained in the "symphony" of the operational environment - and all of their possibilities.[18] A fuller understanding of each of the operational media and their intrinsic properties will serve to better equip and enable the artist toward his creation. Since the human artist is required to impart relevance to any medium as a conveyance of combat power, the media must be categorized based on their level of natural interaction with the human artist. The categories and types of operational media are

- primary media (those that exist naturally, and are first in order of natural interaction with the artist, requiring little or no technological support to convey combat power) – human and land media.

- secondary media (those that exist naturally, in order of the level of natural interaction with the artist; primarily as a function of the technology required to convey combat power) - sea, air, and space media.
- artificial media (that which is artificially generated by man) – electromagnetic medium.

This categorization of the media serves to provide the artist with a baseline for understanding the level of intuition and technical specialization required of a given force to exploit each of the individual media. It also allows the artist to gauge the relative levels of scientific analysis versus intuition he should apply to the behavior (and hence, his exploitation) of combat power on each of the media.

The Human Medium

Humanity is the first-order primary medium - it is the prerequisite, omnipresent operational medium, regardless of the overall nature of any operational environment. This stands to reason, since man is both the origin and object of the creative activity called operational art; man imparts purpose. Military theorist and School of Advanced Military Studies professor Dr. James J. Schneider notes that the "form of an operation" is not created by the army (i.e. the tools of the artist), but by human ideas. He ties this together with the "teleological nature of man," specifically his orientation toward "establishing goals and objectives, determining appropriate courses of action to achieve them, and allocating the appropriate resources to sustain those efforts."[19] Man will also tend to determine if the causes of a potential conflict warrant military ways and means in order to achieve a stated end.[20] These fundamental tendencies serve to compliment Clausewitz' theory that war is "not merely an act of policy, but a true political instrument, a continuation of political intercourse, carried on with other means."[21]

The contemporary insurgency theorist, Dr. Larry Cable, lends further definition to the tendencies of man relative to the use of military force. He defines politics simply as the "quest for, acquisition of, and sustainment of authority."[22] This political authority will characteristically be a reflection of its parent state and society, bearing its strengths and weaknesses, including its

physical, mental, emotional, and spiritual nature. As Michael Howard points out in his discussion of Clausewitz, "war is shaped by the ideas, the emotions and conditions prevailing at the time."[23] Cable expands this idea by describing the coordinates of "human terrain:"

> The north-south axis is where, along the line of evolution (to either insurgency or acceptance of the existing political authority), the society is. The east-west axis is how the people define themselves....the equivalent of the human immune system which recognizes what "is us" and what "is not us," defined by those backbone beliefs and a unique, defining mythology.[24]

Given this statement, Cable goes on to state that insurgencies (those struggles characteristically marked by the quest for legitimate political authority) have a distinguishable pattern relative to the "human terrain." He also argues for the primacy of psychological and political impact in any military undertaking.[25]

Warfare, therefore, is a quintessentially human affair subject to the dictates of human authority, and focused on an outcome at the human level. How does this serve to explain the human medium? How is combat power conveyed in time across this medium? The answer lies in further defining the properties of this medium in relation to the combat power it conveys. Clausewitz' paradoxical trinity is the essential starting point for defining these properties. By noting the relationship between the people (passion), the commander and his army (probability), and the government (reason), Clausewitz has defined the properties of the human medium that relate to the conveyance of combat power – heart, mind, and will. These translate more specifically to emotion, intellect, and volition.[26] These properties enable the human terrain, in a given political context, to convey leadership, information, and protection - the three characteristically incorporeal elements of combat power (leadership being *original*, and information and protection being *epiphenomenal*).[27]

The Clausewitzian model, however, requires two distinct qualifiers regarding the limitations of any scientific analysis of the conveyance of combat power on the human medium. First, the incorporeal nature of this combat power means that it can only be fixed in physical space relative to the individual human beings who possess the properties of emotion, intellect,

and volition.[28] In corporate bodies such as a military force, the ability to isolate this combat power on the human medium is dependent on a number of factors, including the personalities of the leader and led, the size of the corporate body, the level of centralized control, the availability of command and control mechanisms, and a whole host of other variables, both corporeal and incorporeal. Also, in dealing with warfare (or any other "human affair") uncertainty is the norm.[29] The properties of emotion, intellect, and volition dictate that human beings will introduce a perennial element of unpredictability to any undertaking. The patterns of behavior of combat power on the human medium are quantifiable only insofar as the social sciences, through various mathematical analogies and the tools of scientism, can achieve a definition of human behavior in general.[30]

The Land Medium

Land is the second-order primary medium - it is the necessary substrate for human existence, providing shelter, subsistence, fresh water sources, and the surface-level atmospheric conditions of viable oxygen content and air pressure.[31] It is the medium upon which man lives; if a human operates on any other medium, he must set artificial "land conditions" for any degree of sustained operations.[32] It is one of the two permanent operational media, space being the other. Land, however, is solid. It can be occupied and possessed. It allows for the establishment of permanent infrastructure. Also, one terrain feature will not drastically change relative to another. All media must terminate at some point through some means with the land. The land provides the infrastructure and permanent basing that enables interaction with the human medium and conditions for operations on the other media. This relative permanency of land lends to its natural protective qualities (cover and concealment) and its positional advantage (or disadvantage, as the case may be) to the holder.[33]

Jomini provides the most succinct yet most comprehensive set of precepts for operations on the land medium. His "small number of fundamental principles of war," including concepts such as theater of operations, base of operations, lines of operations, and the relationship of

marches and positional advantage, serve to define operations on the land medium in distinctly geometric terms. These terms, by extension, provide the lexicon still in use to conceptualize military operations in general. According to Jomini, all of these terms and "principles" converge on the application of "the fundamental principle of war....to throw the mass of the forces upon the decisive point, or upon that portion of the hostile line which it is of the first importance to overthrow."[34]

Given the properties of solid permanence, the land medium is capable of conveying maneuver, firepower, and protection, the three characteristically corporeal, physical elements of combat power.

The Sea Medium

The sea is the first fluid medium exploited by man, the other being the air. It requires relatively simple technological means for exploitation, and is therefore the first in order of the secondary media. The primary value of the sea medium is its communicative qualities relative to the land and human media – a theme that is repeated in the evolution, exploitation, and analysis of the remaining media (air, space, electromagnetic).[35] The sea, in operational terms, is the most efficient means of conveyance - it can convey a larger amount of commerce and physical combat power over time than any other medium. The liquid state of the sea mitigates the effects of gravity and friction: flotation of large commercial and military platforms can be accomplished over extended time and space using relatively little energy. Command and control of operations on the sea are simplified, since combat capabilities are centralized on a sea-going platform that is constructed as a holistic system with a distinct purpose. The vastness of the medium relative to land (the other surface medium), coupled with its relatively unrestricted navigability, make mass and concentration inherent to naval operations.

The liquid medium allows operations below the surface, as well as in the air above the surface; the ability to launch large, self-sustained platforms on the medium allows for this. The air is a separate operational medium. Operations below the surface, however, are subject to the

same properties of the sea medium as surface operations, and also add two additional properties: stealth and a three-dimensional navigation capability in space. The critical property of the sea medium exploited by both surface and sub-surface operations - the ability to use the buoyancy of the liquid medium to move combat power en mass - dictates that the sea medium below the surface is a branch of the sea medium proper, and not a medium unto itself. The same can be said for riverine waters, where the properties of navigability are mitigated by the proximity to land. The trade-off in this case is that (like subsurface operations offer stealth and three-dimensional navigation) rivers offer tremendous opportunities for natural interaction with the land and human media.

The relative efficiency of the sea and its proximity to land (through rivers and coastlines) is directly related to the relevance and importance of the interaction of the sea medium with the human medium (the medium of emotion, intellect, and volition). Mahan states,

> "The principle conditions affecting the sea power of nations may be enumerated as follows: I. Geographical position (in relation to continental threats). II. Physical conformation, including, as connected therewith, natural productions and climate. III. Extent of territory (specifically the length of coastline and the character of its harbors). IV. Number of population. V. Character of the people. VI. Character of the government, including therein the national institutions."[36]

Corbett would elaborate on this idea:

> "The object of naval warfare must always be directly or indirectly either to secure the command of the sea or to prevent the enemy from securing it....Naval strategy is (that part of maritime strategy) which determines the movement of the fleet, when *maritime strategy* has determined what part the fleet must play *in relation to the action of land forces*....Since men live upon the land and not upon the sea, great issues between nations at war have always been decided – except in the rarest cases – either by what your army can do against your enemy's territory and national life, or else by the fear of what the fleet makes it possible for your army to do."[37]

The sea medium, with the properties of liquidity, vastness, and navigability, is capable of conveying the same three physical elements as the land medium (maneuver, firepower, and protection) both at sea (naval operations), and in relation to the land and human media (maritime operations). This can be done en mass, both on and below the surface, and with the ability to

simultaneously provide self-sustainment and temporary command of the other media from a sea-borne platform.

The Air Medium

The air is the other fluid medium exploited by man. It is dependent on a relatively high level of technological means for exploitation, and is therefore the second in order of the secondary media. The value of the air lies in its ability to convey physical combat power rapidly from one point on the surface to another. The gaseous state of air mitigates the effects of gravity and friction, but at greater cost in efficiency relative to the liquid sea medium. Flight of commercial and military platforms can be accomplished rapidly over three-dimensional space above the earth's surface using a large expenditure of energy relative to payload when compared to the sea medium. Also, given the energy required to sustain flight, the medium cannot be exploited over an extended period without a surface base of operations.

The ability to break from the constraints of the surface media (land and sea), however, and gain a rapid positional advantage makes the air a characteristically offensive medium of operations. As Douhet states, "Because of its independence of surface limitations and its superior speed - superior to any other known means of transportation - the airplane is the offensive weapon par excellence."[38] The air, like the sea, is a relatively vast medium, with this vastness extending over the entire surface of the earth and to an altitude restricted only by the height of the atmospheric edge of the biosphere.[39] It allows for relatively unrestricted navigation between any two points on the surface of the earth or in the atmosphere. It is also a transparent medium, allowing for line of sight (for both observation and electromagnetic propagation) that is restricted only by weather and the permanent features of the land.

The surface is ultimately the object of air operations, since the temporal nature of these operations (relative to their energy requirements) dictate the requirement for the establishment and protection of surface bases to allow for the effective, continuous use of the medium.[40] According to preeminent air theory, however, the prerequisite for conducting air operations and

establishing these bases - indeed, the prerequisite for any successful campaign - is command of the air.[41] Warden states in The Air Campaign:

> "Central to our thesis is the idea that air superiority is crucial, that a campaign will be lost if an enemy has it, that in many circumstances it alone can win a war, and that its possession is needed before other actions on the ground or in the air can be undertaken."[42]

The importance of air superiority in Warden's model, however, is still relative to surface factors that "affect the air superiority campaign: material, personnel, and position."[43] Hence, the utility of the air medium is similar to that of the sea: its communicative qualities relative to the land, human, and sea media.

The air medium, with its properties of gaseousness, vastness, navigability, and transparency, is capable of conveying the same three physical elements as the land medium (maneuver, firepower, and protection) more rapidly than the land or sea media to more places in the biosphere. The air medium, however, requires a higher energy output relative to payload, and requires a surface base for extended operations.

The Space Medium

The space medium is unique among the other media in that it exists naturally and permanently outside of the biosphere. It is wholly dependent on technological means on multiple operational media for exploitation, and is therefore third in order of the secondary media. The value of the space medium lies in its ability to convey relatively permanent platforms that provide reconnaissance and surveillance, warning, navigation, environmental monitoring (weather), communications, and (potentially) firepower relative to the media constrained to the biosphere.[44] It is the most spatially vast operational medium, and it surrounds the media constrained to the biosphere (human, land, sea, air).[45] Like air, the space medium is a transparent medium, allowing for line of sight that is restricted only by weather and the permanent features of the land.

The vacuum of the space medium begins outside the limits of the atmosphere, providing the only frictionless medium. Once a platform is in orbit, it can sustain its position for months

and even years without expending fuel - the platform enjoys a degree of permanence only associated with the land medium. The permanence of this medium, however, is relevant to the conveyance of combat power based on the ability of a platform to travel indefinitely in the frictionless vacuum of outer space. This permanence relative to platforms means that the space medium can support a permanent infrastructure of satellites operating as "constellations" that can provide global coverage to support a multitude of functions. These platforms will also move at extremely high velocity (termed hypervelocity) in this frictionless environment, providing a rapid global coverage capability, and (potentially) large kinetic energy firepower relative to size.[46]

The same laws of physics that allow a body to remain in orbit in outer space, however, preclude the ability to navigate freely. Once a platform is in orbit, it is constrained to operating in that orbit, unless energy is expended to modify the orbit. The movement of the platform is constant and predictable, barring any external modification - it is quasi-positional as opposed to maneuvering.[47] Also, tremendous energy relative to payload is required to boost a platform to its working altitude in space. This economically precludes the ability to maintain, sustain, or change a platform once it is launched - it is inaccessible.[48] Fuel for repositioning is therefore finite and terminal, given current technology.

The unique characteristics of the space medium, coupled with its provocative yet relatively uncharted capabilities, have given rise to at least one candidate theory for outer space as a unique, distinctive medium for conveying combat power. Michael R. Mantz, an Airpower Research Institute research fellow, provides this theory:

> "Space combat power can be applied decisively (and independent of air power) by striking at the national elements of value of the enemy. Unlike air power, space control may not be a prerequisite for the exploitation of space (e.g., space combat support and space strike). Like air power, space power must be centrally and independently controlled."[49]

Given the properties of a vast, frictionless vacuum relative to the gravitational effects of the earth and the biosphere (with its associated operational media), the space medium can convey protection, constrained maneuver, and (potentially) firepower.

The Electromagnetic Medium

The electromagnetic spectrum constitutes the only energy-based operational medium. Although electromagnetic radiation exists naturally in various forms in the universe, the electromagnetic medium as a conveyance of combat power is wholly dependent on the artificial generation of energy (separate from naturally occurring electromagnetic energy) to produce a carrier wave.[50] It is, therefore, artificially generated as a medium of operation by man. The value of the electromagnetic medium currently lies in its ability to rapidly (at the speed of light) convey information in and through a variety of environments.[51] Energy moving in the electromagnetic spectrum travels with the dynamics of a wave, and therefore has a wavelength (the distance from one wave peak to the next), frequency (the rate at which a wave passes a given point), and amplitude (the distance from the peak to the trough of a given wave). All of these characteristics can be adjusted within the electromagnetic spectrum to result in radiation with different propagation properties (including ability to penetrate, distance it can travel, and amount and type of information it can carry - a given wave's propagation characteristics).[52] The other common property of all energy emitted in the electromagnetic spectrum is that the "waves" can be modulated (varied in frequency, amplitude, phase, or intensity) in order to send information or create directed energy effects. The electromagnetic spectrum is also the only medium that can operate simultaneously and continuously both inside and outside of the biosphere.[53]

Schneider, in his article entitled "Black Lights: Chaos, Complexity, and the Promise of Information Warfare," discusses the profound nature of the value of the electromagnetic medium as a rapid conveyance of information. Schneider notes that "information and control represent two sides of the same coin.....the notion of control exists on all levels of human activity, and forms the basis of society. The primordial urge to dominate and regulate both nature and the environment puts control at the center of the evolutionary spiral."[54] Schneider then describes successive crises of control in the history of human existence, and how information processing capabilities historically provide the resolution to these crises. Schneider's ultimate focus is the

control crisis posed by the industrial revolution.[55] In this crisis, machines integrated into complex systems (such as railroads, factories, and military organizations) allowed for speed of movement and production, as well as broad distribution in space. Elaborate control systems to provide relevant, applicable feedback were required to regulate the application and output of these systems. These control systems, however, could not be optimized without the rapid movement of information; this was the control crisis. The electromagnetic spectrum - first in the form of the telegraph, then telephone and radio - would provide the means to move information rapidly and exert this control.[56] In Schneider's estimation, "the continuous fluid and wavelike nature of lightning-fast information can control all aspects of full spectrum dominance as outlined in Joint Vision 2010."[57] The value of the electromagnetic medium, therefore, is more fully understood given the hand-in-glove relationship of information to the control of complex systems. The electromagnetic medium serves to supplement the control (through rapid feedback/feedforward of information) of the conveyance of combat power on all the media of operations. Developing theory in the exploitation of this medium emphasizes the information-conveying qualities of the medium, and parallels that of Corbett relative to the sea:

> "The struggle for the control of the electromagnetic spectrum is called electronic combat because the spectrum is the channel through which information must pass. Just as control of vital sea lanes allowed Britain to dominate the world for most of the 1800s, so will control of the electromagnetic spectrum allow armies to dominate local wars now and in the future."[58]

The *control* of the electromagnetic medium is, therefore, a critical enabler to the ability to *control* the conveyance of combat power on all the media, especially when considering a *complex system* of simultaneous military operations.

Given its relatively unrestricted propagation and modulation properties, both inside and outside the biosphere, the electromagnetic medium is capable of conveying information (specifically in support of communications, surveillance, navigation, and weapons guidance - the stuff of "control"), firepower (in the form of directed energy) and protection.[59]

Extending Theory from Individual to Multiple Media

This chapter has provided definition to the concept of operational media as they pertain to operations, operational art, and the operational environment. The examination of each of the operational media in this context forms the first level of a theoretical construct, providing a stepping stone for discussing the combination of these media in a multi-media environment. This discussion also provides certain trends concerning the interrelationships of the media:

- The human and land media have a certain preeminence as the primary media. Humans subsist on the solid, permanent land medium, and require no technological "bridge" for its exploitation. Also, humans are both the creative power and the focal point of any human creation. The remaining media gain relevance through their interaction with the primary media. The primary media (most especially the human medium) tend to be the focus of the *effects* of combat power. *Control* of the primary media tends to be less tenable or desirable, although not out of the question.[60]
- The secondary media possess unique properties that allow for the enhanced conveyance of certain forms of combat power, but ultimately gain their relevance through interaction with the primary media. These media, therefore, tend to be the object of *control* as opposed to *effects*.
- The artificial medium - the electromagnetic medium - is a critical enabler to the ability to control the conveyance of combat power on all the media.
- Each of the operational media theoretically provides distinct opportunities to the artist who understands how to create on them. These opportunities are defined by the inherent properties of each of the media. This level of definition therefore also provides the artist with a frame of reference for considering, either scientifically or intuitively, the flow of combat power in a given operational environment, subject to the availability of the various operational media.

The reality of the operations, past and present, is that more than one operational medium will be used at any point in time. The next chapter will therefore serve to merge the behavior of combat power on individual media with the trends of media interrelationships to develop a coherent theory - the second level of our construct - for defining the multi-media operational environment.

III. The Physics of Operations in a Multi-Media Environment

> The notes do not exceed five, but the changes of the five notes can never be fully heard. The colors do not exceed five, but the changes of the five colors can never be completely seen. The flavors do not exceed five, but the changes of the five flavors can never be completely tasted. In warfare the strategic configurations of power (*shih*) do not exceed the unorthodox (*ch'i*) and orthodox (*cheng*), but the changes in the unorthodox and the orthodox can never be completely exhausted. The unorthodox and the orthodox mutually produce each other, just like an endless cycle. Who can exhaust them?
>
> Sun Tzu
> Art of War[61]

Previous chapters have established the terms for discussing the individual media likely to be used in the multi-media operational environment inherent in modern military operations. The operational artist is, therefore, provided with a multitude of tools to create for the purpose of a wholly human outcome - the achievement of strategic objectives dictated by political authority, carried out over the available operational media through the conveyance of force, or combat power. The next logical step, then, is to begin to define the terms for the interaction of these operational media - to define the physics of the multimedia operational environment. The first two chapters defined necessary terms so that this chapter could discuss the relationships and interaction of matter, energy, motion and force - the raw stuff of combat power - on multiple media.[62]

This chapter will endeavor to posit the laws of media interaction using the terms previously established. These laws and their corollaries will serve as the second level of a theoretical construct, defining the nature of multi-media operational environments for the operational artist. The orchestral analogy remains solid: the argument moves from a discussion of the characteristics of individual classes of instruments, and moves to the combinations of these instruments for the purpose of establishing melody, harmony, resonance, or even dissonance within the shifting, moving dynamics and rhythm of the symphony.

The First Law - the Law of Mandatory Minimum Media Combinations

The first law states that at least two or more media must be in use at all times in order to convey all the elements of combat power simultaneously. The logic of the first law derives from the assumption that any campaign will include the use of all the elements of combat power. Wass de Czege discusses maximizing combat power through the interrelations of Army functions; having established the interrelation of the elements of combat power, he expounds on a clear, simple, yet rigorous analytical framework for bringing our capabilities "to bear fully, (while ensuring that) the enemy loses his apparent preponderance."[63] Also, the principle of economy of force dictates that "no part of the force should be left without purpose....employ *all* combat power available...."[64] Given this view of bringing the maximum combat power to bear, combined with the limitations of the individual media to convey only certain elements of combat power, at least two media must be in use to convey all the forms of combat power at the same time. The first law has three corollaries related to the properties of three of the individual media of operations.

The first corollary of the first law states that the human medium must always be one of the two minimum operational media. The first corollary derives from the properties and tendencies of the human medium previously noted in Chapter II, and the fact that the human medium is the only medium that conveys leadership. Hence, it must be prerequisite and omnipresent to any military undertaking on any of the operational media. According to Wass de Czege's analysis, leadership is the element "upon which all others depend."[65]

The second corollary of the first law states that the electromagnetic medium is a wholly supplementary medium; it cannot, in combination with another single medium, convey all the elements of combat power. The second corollary derives from the inherent limitations of the behavior of combat power on the electromagnetic medium. Munro notes that directed energy firepower is a current capability conveyed on the electromagnetic medium. Even with this conveyance capability, however, the electromagnetic medium cannot convey mass through space and time - resulting in maneuver. This wholly supplementary nature does not mitigate the

criticality of the medium. The electromagnetic medium, as established in Chapter II, serves to supplement the control (through rapid feedback/feedforward of information) of the conveyance of combat power on all the media of operations. The artist, however, will not be able to convey maneuver (or firepower, given present capabilities) if he chooses to operate using a minimum human - electromagnetic medium combination.

The third corollary of the first law states that the space medium cannot be used without combination with the electromagnetic medium. This corollary also derives from the inherent limitations of the behavior of combat power on the medium. The space medium, given its vastness and inaccessibility, is rendered irrelevant without the communicative capabilities of the electromagnetic medium to convey (in real time) the information derived from or relayed through space-based platforms. Also, the limited ability of those platforms to maneuver, as well as the monitoring of their status, is contingent upon information conveyed to the biosphere along the electromagnetic medium. These platforms represent the ultimate example of the crisis of control noted by Schneider, given their speed and distribution in the vastness of outer space. On this particular medium, this control crisis must be resolved through the conveyance of rapid information across the electromagnetic medium. Any use of the space medium will therefore require the artist to use a minimum of two additional media: human - electromagnetic.

To recap the first law, at least two or more media must be in use at all times in order to convey all the elements of combat power simultaneously. This law has three related corollaries:

A. The human medium must always be one of the two minimum operational media.

B. The electromagnetic medium is a wholly supplementary medium; it cannot, in combination with another single medium, convey all the elements of combat power.

C. The space medium cannot be used without combination with the electromagnetic medium.

The Second Law - the Law of Multi-Media Advantage

The second law states that the relative advantage belongs to the adversary who can apply the greatest combat power on the largest number of media simultaneously. The extension of the

logic applied to the derivation of the second law is that, like there is a theoretical minimum threshold for the effective use of multiple media to convey "all combat power available," the use of the maximum operational media available, while denying a "preponderance to the enemy" must be the object of the operational artist.[66] The second law is probably the easiest to understand and accept. It works from the basis of sheer weight of numbers, and assumes a closed system approach to the use of individual media. This law has three related corollaries.

The first corollary of the second law states that asymmetric advantage is obtained by conveying combat power on a medium or combination of media that a potential adversary is either cognitively or physically not able to match.[67] The second law with its first corollary allows us to posit a definition of asymmetric advantage at the operational level in an environmental context: the ability to operate on a medium of our choosing at will, while the enemy can neither operate on that medium nor counter our operations thereon.[68]

The second corollary of the second law states that the complexity of operations is directly related to the number of operational media simultaneously in use and interacting at any one point in time. This corollary derives from the fact that multi-media operations are not a parallel grouping of independent, closed systems; the media in and of themselves represent open systems, and they will interact with one another. This interaction is essential for

- the exchange of effects (force, energy, motion, mass - the stuff of physics...or in our case, combat power) from one medium to another.
- the efficient and effective use of combat power resulting in a multiplying effect (consider the musical analogy and the idea of resonance).[69]
- The massing and concentration of combat power in time and space.

The second corollary is therefore based on the fact that more interaction is inherent in the multimedia operational environment and the result is greater complexity.[70] This complexity is, therefore, the natural price of doing business in a multimedia operational environment. On the surface, the challenges of this greater complexity tend to present greater risk and less certainty of

control of the operational environment. The relative advantage of operating on the maximum number of available media can possibly be enhanced, however, by acknowledging that we gain an advantage by understanding the interrelationships in this *dynamically complex* environment.[71] Peter Senge, in his book The Fifth Discipline, advises us to "recognize the types of structures (for our purposes, the forms of media interaction) that recur again and again....(forming) a rich language for describing a vast array of interrelationships and patterns...(simplifying) life by helping...see the deeper patterns lying behind events and details."[72] Senge's lesson is that we can and should learn to thrive amid this complexity, ahead of a potential adversary. If an artist creates complexity, he is much better prepared to cope with it and adapt to it, providing a cognitive "jump" on a potential adversary. The ability to develop new technologies to more readily exploit the operational media serves to enhance our ability to thrive.[73]

The third corollary of the second law states that the potential for a point in time and space to be a key point of media interaction (an extension of key terrain) is directly related to the number and types of media interactions at that point. This corollary derives from the fact that, in order to achieve the aforementioned exchange or application of effects/resonance/concentration in time in space, the exchange or application must take place at a given *point* in time and space. It is, therefore, a mathematical likelihood that a key point will tend to exist where the largest number of media converge. The relative merit of a key point can also be affected by the type of medium (with its inherent properties of conveyance) that converges at a particular point. Of particular significance is that the interaction of the human medium with the other operational media, in the context of this corollary and the constraints of time and space, takes place at command and control and administrative/political nodes. The human medium does not lend to a natural locational "fix" in three-dimensional space without this level of definition.

To recap the second law, the relative advantage belongs to the adversary who can apply the greatest combat power on the largest number of media simultaneously. This law has three related corollaries:

A. Asymmetric advantage is obtained by conveying combat power on a medium or combination of media that a potential adversary is either cognitively or physically not able to match.

B. The complexity of operations is directly related to the number of operational media simultaneously in use and interacting at any one point in time.

C. The potential for a point in time and space to be a key point of media interaction is directly related to the number and types of media interactions at that point.

The Third Law - the Law of Decisive Media

The third law states that a medium or given combination of media will be decisive in a given period of time in a campaign, but not throughout the entire campaign.[74] The third law derives from the ideas associated with economy of force: employing all combat power available in the most effective way possible, allocating minimum essential combat power to secondary effort. The first and second laws serve to define the polar ends of the minimum and maximum multimedia operations environments. By positing the third law, we can now introduce the concept of the decisive medium as a new concept of theater and operational design. Given that certain media convey certain elements of combat power with varying degrees of efficiency and effectiveness, this is a sound extension in logic of the concepts of economy of force, especially with regards to designation of main and supporting efforts. It also serves to state that the purpose for all operations on all of the available media should be aimed at *achieving mass using the decisive media at the decisive point and time in the battlespace.*[75] This law has three related corollaries.

The first corollary to the third law states that the human medium is always the medium of decision in the beginning and ending phases of any campaign.[76] This corollary is a logical extension from the law itself. As this work has previously established, the human medium is the point of origin for the creative process described as operational art, as well as the object of the creation. It is the medium of conveyance on which the properties of heart, mind and will dictate how leadership and information as combat power will take form. Indeed, the commander can be

considered a key point of interaction for those two forms of combat power, resulting in decision and the application of the other elements of combat power in the multi-media operational environment.

The second corollary to the third law states that the nature of military means dictates that, at some point, physical force (or the threat thereof) must be decisively conveyed along a medium or media capable of conveying physical combat power.[77] This corollary derives from another extension in logic from the third law - specifically, military means equals *physical force* to achieve a political (hence inherently human) end. The use of physical force under the dictates of human authority is, therefore, a natural trait of military means. Military means degrade to hollow diplomacy at best without the threat, real and perceived, of physical force. The decisive media for the application of this physical force must, therefore, be among those media that convey physical combat power - and not the human medium.

The third corollary of the third law states that if a medium is considered decisive in a given period of time in a campaign, priority of effort must be given to protecting and supporting the use of that medium during that period of time. This corollary serves to punctuate the need to ensure that the purpose for operations on all of the available operational media are nested and supporting those decisive media that will convey combat power to the decisive point and time in the battlespace. This corollary extends the concept of nesting the purpose of operations on the various media at any point in time: to ensure that conditions are set for the successful conveyance of combat power along the decisive media when that conveyance is required.

To recap the third law, a medium or given combination of media will be decisive in a given period of time in a campaign, but not throughout the entire campaign. This law has three related corollaries.

A. The human medium is always the singular medium of decision in the beginning and ending phases of any campaign.

B. The nature of military means dictates that, at some point, physical force (or the threat thereof) must be decisively conveyed along those media capable of conveying physical combat power.

C. If a medium is considered decisive in a given period of time in a campaign, priority of effort must be given to protecting and supporting the use of that medium during that period of time.

The Application of the Laws of Media Interaction

The establishment of the laws of multimedia interaction opens the door to the application of this singular environmental context for campaign planning in a number of ways. By positing these laws in a single environmental context, we achieve a simple, flexible, adaptable frame of reference for constructing a view of the battlespace of a given theater of operations. This framework allows for the quantification of variables relative to the scientific, quantifiable aspects of the conveyance of combat power on any of the media, down to multiple levels of abstraction and definition[78], as time and resources permit. The framework also serves to expand the users grasp of the operational environment by providing a context for applying conceptual terms, introducing new concepts designed to enhance battlefield visualization, and providing a mental impetus for defining the battlespace in terms that identify multiple opportunities for success.

The definition and resolution of certain concepts of theater and operational design is probably the most significant contribution provided by the laws of media interaction. Lines of operation are defined in a more singular nature - in the context of the medium on which the line of operation exists. This concept matures to include the decisive operational media on one end of the scale, and the idea of environmental culmination (due to a lack of the required minimal operational media) on the other end. Of particular note is the movement toward the resolution of decisive points through a graphic assessment of the critical nodes of media interaction. An understanding of these key points may not of themselves lead to identification of a decisive point, but key points in the operational context can lend a degree of resolution and focus to named areas of interests, as well as to target identification. All of these analytical tools will tend to magnify the importance of certain points in space relative to others, and will help the artist apply the tools

of his craft more efficiently and effectively. The higher degree of resolution of these concepts allows for the conditions for the application of knowledge-based force, in the Toffler vernacular - where the application of force is done with precision, as opposed to mass.[79]

A second benefit of the laws of media interaction is a viable environmental context for defining conceptual terms as they pertain to the operational level of war. Asymmetry and complexity find definition in the singular environmental context of the interaction of multiple media. The laws allow the operational artist to emphatically determine if he has asymmetric advantage, the level of complexity inherent in a given operational environment, and the magnitude of risk he will assume in order to operate in a non-linear fashion.

The combination of the first two applications allows for the assessment, within the context of the multi-media operational environment and its associated laws, of adherence to the principles of war as an evaluation criteria for a course of action. The operational artist can use the laws to determine if he is using the given multimedia environment to its greatest environmental advantage with regards to the principles of war.

Finally, the framework of the multimedia operational environment as defined by the laws of multimedia interaction allows for a basis of pattern analysis. As previously discussed, the framework lends itself to a degree of quantification. The laws also show that the framework, to extend Senge's logic regarding dynamic complexity, has a certain degree of plasticity - the environment can be analyzed and shaped to enhance our advantage while reducing the advantage of a potential adversary. The framework thus provides a means for viewing the battlespace with an eye toward establishing a creative advantage by mastering the multitude of instruments available before the enemy. The artist can reduce the enemy's options for the application of military force to a manageable level. He can simultaneously identify, exploit, and protect his own options. In the author's opinion, this is the essence of operational art and campaign planning.

The application of the laws of media interaction now requires examination based on the requirements for future operations. This chapter has endeavored to posit the laws of media

interaction using the terms established in the first level of the theoretical construct. These laws and their corollaries serve as the second level of the theoretical construct, defining the nature of multi-media operational environments for the operational artist. The next chapter will outline a view of future operations based on official joint and service-level concepts, combined with concepts developed by leading future theorists. The requirements for this future operational environment will serve to "proof" the laws for accuracy and utility.

IV. Examining Theory in the Context of Future Operations

> Accelerating rates of change will make the future environment more unpredictable and less stable, presenting our Armed Forces with a wide range of plausible futures. Whatever direction global change ultimately takes, it will affect how we think about and conduct joint and multinational operations in the 21st century. How we respond to dynamic changes concerning potential adversaries, technological advances and their implications, and the emerging importance for information superiority will dramatically impact how well our Armed Forces can perform its duties in 2010.
>
> Joint Vision 2010,[80]
> Concerning dynamic changes to the
> strategic and operational environment

The final focus for the monograph will be the application of the theoretical construct to future operational concepts as a means of evaluating both the applicability and suitability of the construct and the suitability of our future concepts for warfighting. The positing of a theoretical construct requires this comparative analysis, as opposed to a singular evaluation. The monograph will conclude by outlining the implications of the construct on future operational planning and the development of joint doctrine.

Future Operational Concepts

Joint Vision 2010 is the core document in which America's armed forces describe a holistic, joint-warfighting view of future operations. Full spectrum, full dimensional dominance is the key characteristic of future operations, achieved through the application of the new operational concepts. It notes that the patterns of past operations normally followed the application of mass applied sequentially. The pattern of 2010 operations will be massed effects through the tailored application of joint combat power:

> "All of this suggest that we will be able to accomplish the effects of mass and the necessary concentration of combat power at the decisive time and place with less need to mass forces physically than in the past....In sum, by 2010 we should be able to enhance the capabilities of our forces through technology. This will, in turn, expand our greatest advantage: the adaptability, initiative, teamwork, and commitment of our people at every level."[81]

This pattern of massed effects through the tailored application of combat power is the basis for a new framework found in the improved command, control, and intelligence which "can be

assured" by information superiority. The result is a transformation of the traditional functions of maneuver, strike, protection, and logistics to the new operational concepts of dominant maneuver, precision engagement, full-dimensional protection, and focused logistics, providing a new conceptual framework.[82]

Dominant maneuver refers to the multidimensional application of information, engagement, and mobility capabilities to position and employ widely dispersed joint air, land, sea, and space forces to accomplish the assigned operational tasks, allowing our forces to gain a decisive advantage by controlling the breadth, depth, and height of the battlespace.[83] Precision engagement refers to a system of systems that enables our forces to locate the objective or target, provide responsive command and control, generate the desired effect, assess our level of success, and retain the flexibility to reengage with precision when required.[84] Full-dimensional protection refers to the control of the battlespace to ensure our forces can maintain freedom of action during deployment, maneuver, and engagement, while providing multi-layered defenses for our forces and facilities at all levels.[85] Focused logistics refers to the fusion of information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while enroute, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical levels of operations.[86]

The overriding attitude of this view of operations is that each of these new concepts will reinforce the others and will allow us to achieve massed effects in warfare from more dispersed forces. This synergy will greatly enhance our capabilities in high intensity conventional military operations. The concept warns "not to assume that all the new concepts will be equally valuable in all operations. The four new concepts taken together, however, will enable us to dominate the full range of military operations."[87]

These overarching concepts are pitted against potential adversaries that may include states or groups opposed to or threatening US interests. The global strategic environment will be characterized by greater global interaction, the breakdown of traditional borders and associated

interstate controls, wider general access to technological means, the general availability of weapons of mass destruction (in which small numbers can alter the fragile balance of power in particular regions), and the opening of the continental U.S. to targeting by various means.[88] The most vexing adversary will be the one who can use technology to make rapid improvements in its military capabilities that provide asymmetric counters to US military strengths, including information technologies.[89] The result is a wider range of threats, with emerging unpredictability, employing combinations of techniques and technologies that challenge us at varying levels of intensity. This adversary will operationally probe to find chinks in our physical capabilities, and ways to affect our resolve.

Given this description of future operations, we can now overlay both levels of the theoretical construct defining the nature of the multimedia operational environment. This will serve to evaluate the relative suitability of both the construct and the Joint Vision 2010 concept. This evaluation will cover the first level of the construct described in chapter II, and each of the three laws of media interaction described in chapter III. The concepts of dominant maneuver, precision engagement, and focused logistics will provide the basic framework for the discussion of these various facets of the construct. Full dimensional protection shares much of its conceptual roots with dominant maneuver, particularly with regard to control of the battlespace. The evaluation will, therefore, treat full dimensional protection under dominant maneuver to reduce redundancy. The chapter will conclude with a discussion of components of the overall theoretical construct that the concepts in Joint Vision 2010 do not address.

The First Level of the Construct

The first level has a high level of applicability to the concept of dominant maneuver. It also serves to validate and reinforce the concept of dominant maneuver. The first level provides the artist with the fundamental terms for the individual media that make up the individual dimensions of the operational environment in Joint Vision 2010. The first level clearly identifies the electromagnetic medium as the one that is capable of conveying the information that enables

exercising control in a multi-media (multi-dimensional) environment. Although the first level stops short of defining the multi-media environment, it provides the baseline for interactions rooted in the relationships of primary, secondary, and artificial media, describing how the transfer of effects from one to another medium can be conceptualized. Individual media characteristics help to flesh out an understanding of the relative capabilities and limitations of individual media to convey combat power.

The first level also has a high level of applicability to precision engagement, both validating and reinforcing this concept. First of all, an understanding of the individual media translates to an understanding of the behavior of individual sensor and weapons platforms on their respective media of operations. This understanding is the cognitive prerequisite for conducting the level of joint, capabilities-based mission analysis required by this concept. Finally, it begins a deeper understanding of how to retain the flexibility prescribed by precision engagement by providing an analytical framework to the artist - to view each of the media with their inherent opportunities.

The first level has moderate level of applicability to the concept of focused logistics. The construct at this level solidly validates focused logistics as a concept, and moderately reinforces it. Focused logistics, like dominant maneuver, is predicated on information to leverage and optimize the conveying qualities of the individual media, and specifically to fuse the logistics and transportation capabilities of a medium while providing constant command visibility of the status of all logistical movements. Of particular value is the comparison of the relative efficiencies available on each medium. Logistics, however, is the business of transferring (as opposed to applying) combat power from one medium to another. This problem requires another level of definition.

In summation, the first level of the construct is invaluable to the operational artist in that it defines terms for the singular dimensions - the individual media - in the multi-dimensional environment. This level of the construct is limited, however, due to its vertical, singular nature.

The concepts contained in Joint Venture 2010 remain valid according to this level of the theoretical construct.

The First Law

The first law has a high level of applicability to the concept of dominant maneuver. It also serves to validate and reinforce the concept of dominant maneuver. The first law enhances an understanding of multi-dimensional operations by outlining minimum requirements in the multi-dimensional (what the construct describes as multi-media) environment. The law equips the artist to visualize the succeeding levels of freedom of action within the battlespace based on the minimum thresholds for a multi-media environment. The combinations may be on one dimension spatially, but will involve more than one medium, given the requirement for the human medium. Hence, the term multi-media is more appropriate and precise than multi-dimensional when describing the operational environment. The first law begins to go beyond the limits of the first level of the construct of a singular approach on a singular medium, and posits minimum requirements for media if the complex operational machinery of Joint Vision 2010 is to be used at all. The law establishes the natural conditions required in order to exercise *succeeding levels of control of the battlespace* on a global level - starting with a minimum, prerequisite capability to leverage the human, electromagnetic, and space media. It identifies the naturally implicit need to protect these "lead-in" capabilities throughout the spectrum of conflict - from peace, through war, and post-conflict. It is also a useful tool to assess risks as you move through the succeeding levels from lodgment to decisive operations to post-conflict. Finally, it confirms the importance of the electromagnetic and space media to the force who would leverage a multi-media environment, one for its over-arching impact on control of all media, the other to provide or enhance this control with a degree of reach. Operations on these media, based on the first law, evolve from perceived "silver bullet" solutions to critical enablers if we are to do business in accordance with Joint Vision 2010.

The first law has a moderate level of applicability to the concept of precision engagement. It also serves to validate and reinforce the concept of precision engagement. The law applies well to generating desired effects by providing the cognitive tools to determine minimum thresholds for gaining desired effects given a "minimized" multi-media environment.

The first law has a high level of applicability to the concept of focused logistics. It also serves to validate and reinforce the concept of focused logistics. The analysis of minimum thresholds is crucial to logistics operations in particular, which is directly in the business of "getting the right stuff, to the right place, at the right time." Risk assessment in a "minimized" environment would be crucial to the ability to track and shift logistical support, as well as the ability to provide tailored logistics.

In summation, the first law serves to identify natural minimal thresholds, and the commonality of the "physics" of control (specifically in regard to the space and electromagnetic media) in a multi-media environment. The control of the complex machinery of warfare prescribed by Joint Vision 2010 means that these laws of nature validate what is in the concept as a matter of physical necessity, starting with the application of the minimum possible operational environments and the succeeding levels of complexity discussed in the second law. Finally, this law dictates that the artist must consider and assess risks based on minimum thresholds. These may assume the form of risk to succeeding levels of media in a given environment, or risk to any form of spatially non-linear, precision battle, where a force may be required to sacrifice some or all operations along a given medium or set of media in order to inflict dislocation on a potential adversary.

The Second Law

The second law has a high level of applicability to the concept of dominant maneuver. It brings out some questions, however, regarding the validity of the concept of dominant maneuver. The second law talks to the need for media to interact, and that in greater interaction, along multiple media (multiple dimensions), advantage is to be obtained - through asymmetric battle,

exchange of effects, resonance of effects, and mass/concentration in time and space. This second law, like the first law, goes beyond the limits of a singular approach on a singular medium, and posits a desire to operate on the maximum media available in order to optimize the complex operational machinery of Joint Vision 2010. This law at first blush confirms the validity of these concepts in toto by stating that nature favors the optimum circumstances of full dimensional/full spectrum dominance prescribed in Joint Vision 2010. The law also establishes, however, that this dominance has a price in the form of complexity. Joint Vision 2010 lacks a conceptual framework to address this complexity, and thus presents a degree of vulnerability. Finally, the ability to maintain the situational awareness that is key to control of the battlespace is singularly vulnerable, given the singular necessity of the electromagnetic medium to be the avenue to gain and share this awareness (feedback) so that we can exercise control of battlespace (feedforward).

The second law has a high level of applicability to the concept of precision engagement. It brings out some questions, however, regarding the validity of the concept of precision engagement. The 3rd corollary concerning key points of media interaction is especially valuable to the target analysis process, but primarily at the operational level. The complexity issue addressed under dominant maneuver also affects the responsive command and control of precision fires. The larger number of media favored by the law contributes to prescribed flexibility. The law cuts both ways, though - operations on an optimum number of media also means greater vulnerability, since we will have more key points of media interaction for an adversary to identify and exploit.

The second law has a high level of applicability to the concept of focused logistics. It also serves to validate and reinforce the concept of focused logistics. The law is a good reference point for assessing multi-media bottle necks, and determining throughput estimates. The focus on patterns in this complex environment is especially useful, given that an understanding of the patterns gives us the ability to forecast trends and determine how to use the complex environment

to our advantage. A multitude of transportation options on multiple media is decidedly useful, confirming the basic premise of the law.

In summation, the second law posits that achievement of the optimal full-dimensional, multi-media environment prescribed by Joint Vision 2010 is not only desirable, but should be embraced. The concepts, however, must only be embraced after considering how to mitigate the inherent risks of complexity and singular forms of control. Understanding and embracing this complex environment will allow us to determine how best to leverage the multimedia operational environment to achieve the effect of "the rush of waters" noted by Sun Tzu.[90]

The Third Law

The third law has a high level of applicability to the concept of dominant maneuver. It brings out some questions, however, regarding the validity of the concept of dominant maneuver. The law dictates the need for nested concepts, even at the operational level, but assumes that the nesting of the efforts has to take place at the level where various individual media are put to use. This law requires a proof to determine if

a) the law is invalid by showing that technology and its effective use allows for "joint force" nesting vice "medium based" nesting;
b) the law is valid by showing that all efforts need to be nested by medium of conveyance. This assumes that, at a certain point in command and control, some level of specialization on a particular medium is required regardless of the technology available. This point usually exists under a joint force commander, who is the operational artist with his component chiefs.

The third law has a moderate level of applicability to the concept of precision engagement. It also brings out some questions, regarding the validity of the concept of precision engagement. Per the law, focus should clearly be placed at some point on decisive combat, and hence the application of force through destructive firepower. Like dominant maneuver, however, the level of simultaneity that can be achieved through technological means may render the law invalid. The potential for technology to impact precision engagement in this way is more

probable, given that ordinance, unlike maneuver forces, does not require command and control once it is fired, and the effects can easily be delivered from one medium to another. This also brings up a point of confusion regarding the third law with regard to generating desired effects: is the decisive medium the one conveying the effects, or the one receiving the effects? The context of the law is the conveyance of combat power, therefore the medium conveying decisive effects is the intended focus. The law as written, however, is open to the interpretation of the artist. Finally, the law mitigates the flexibility prescribed by precision engagement, since conditions must be established for the transition from one decisive medium to another.

The third law has a high level of applicability to the concept of focused logistics. It also serves to validate and reinforce the concept of focused logistics. The third law dictates that support must be focused and tailored to the main effort first, lending to a priority of logistics effort.

In summation, the third law posits a level of priority of effort that tends to attenuate the desire for simultaneity prescribed by Joint Vision 2010. The concept repeatedly refers to the ability of technology to enable the force to maintain positive control of simultaneous effects in a full-dimensional/full spectrum environment. The third law is rooted in two premises:

1. At a certain point in command and control of an operational force attempting to achieve full-dimensional/full spectrum dominance, some level of specialization on a particular medium is required regardless of the technology available.
2. All operations, regardless of the level of war, must be singular in purpose.

The third law will require a proof in the 2010 technological environment to determine if these premises, and therefore the law, are valid.

Components Requiring Conceptual Treatment

Treatment of humanity as a medium of operations is singularly missing from the entire fabric of Joint Vision 2010. The absence of this medium is historically endemic to our military concepts and doctrine.[91] This absence may be due to the natural tendency to avoid the vagaries of

the human "dimension" of warfare. The application of physical force, after all, is what characterizes military means from the other elements of national power available to a strategist. Physical force lends itself more readily to quantification and analysis. This quantification leads to an illusion of certainty, however, without an understanding of operations on the human medium.

The lack of treatment of the human medium makes Joint Vision 2010 unsuitable for achieving full-spectrum dominance in particular. Full-dimensional dominance in time and space can be theoretically achieved using physical means, but dominance on all points of the *spectrum* of conflict is a problem that requires dexterity on the human medium. This is true especially at the left and right extremes of the spectrum (during the buildup to potential armed conflict, and during post-armed conflict resolution), where our goals are not necessarily to fight and win, but to promote peace, deter armed conflict, and resolve armed conflict if it arises.[92] Both ends of this spectrum require the application of leadership, information, and protection, supported by maneuver and firepower. The center of the spectrum - the area of decisive armed conflict (and the focus of the technology-heavy concepts in Joint Vision 2010) requires the application of firepower, maneuver, and protection, guided by leadership and information.

The human medium with its properties of heart, mind, and will - emotion, intellect, and volition - must be understood as it pertains to the particular "human" terrain (to use Cable's terms from Chapter II) of friendly and adversary forces. This understanding is essential if the artist is to have *all* the stuff required to deal with the Clausewitzian "chance and probability" of war.[93] Sun Tzu's immortal dictum, "one who knows the enemy and knows himself will not be endangered in a hundred engagements," is delivered in the context of achieving the "true pinnacle of excellence", or "acme of skill:" *the ability to subjugate an enemy's will* (a wholly human outcome) *without the application of physical force.*[94]

V. Conclusions and Implications for Future Operations

> We will need to wring every ounce of capability from every available source. That outcome can only be accomplished through a more seamless integration of service capabilities. To achieve this integration while conducting military operations we must be fully joint: institutionally, organizationally, intellectually, and technically. *Future commanders must be able to visualize and create the best of favorable forces needed to produce the immediate effects and achieve the desired results.*
>
> Joint Vision 2010,[95]
> concerning the imperative
> of jointness

This monograph has established and evaluated a singular environmental theoretical construct - the multimedia operational environment. This construct is built at two levels, the description of individual media of operations, and the laws of multi-media interaction. As such, the construct provides a set of terms for defining the nature of any given operational environment. The construct also breaks with the constraints of current IPB doctrine and campaign planning models by defining terms for the conveyance of combat power throughout the fabric of the battlespace, to include the human medium.

The construct is designed to provide the fundamental terms for the physics of warfare in the context of the conveyance of combat power on multiple media. It is intended to be a scientific primer for the operational artist to maximize the various instruments in the symphony described as the multi-media operational environment.

When compared to the concepts of future operations contained in Joint Vision 2010, the first level of the construct provides the necessary terms and relative ordering of the media to allow for the second level of the construct. The first level also provides the artist with a relative understanding of the conveyance capabilities and efficiencies of the individual media. The development of the second level of the construct, with its laws of interaction, serves to flesh out the nature of the environment conceptualized in Joint Vision 2010, and calls some aspects of its concepts into question:

- It serves to identify natural minimal thresholds and associated risks. It also defines the commonality of the "physics" of control, using the minimum human, electromagnetic, and space media, as a necessity in any multimedia environment using today's complex war machinery.
- It serves to validate the potential of full-dimensional, full-spectrum dominance as a concept to be embraced, provided that we are prepared to deal with the complexity of this environment.
- It calls into question the ability of technology to enable a force to maintain positive control of simultaneous operations without the express designation of main and supporting efforts based on media of operations.
- It calls into question the lack of treatment of the human medium (the first order primary medium, and the medium of decision at the beginning and ending of any campaign) in Joint Vision 2010

The first implication of the conclusions is that the American warfighter must reconcile himself to the fact that electronic battle is neither a luxury nor an albatross in a joint, complex, global environment, but a physical necessity. This necessity must be woven into the entire fabric of the force - individual, leader, and collective. The laws of multi-media interaction provide for the intellectual fortitude to overcome our Luddite tendencies toward the exponential growth of information technologies, and the associated growth of the information society.[96]

The second implication is directly related to the first. It concerns the need to adapt to the spiraling complexity of the machinery described in Joint Venture 2010. We must transform our views of battle command to allow for the existence of true learning organizations that can become, in effect, extensions of the mind of the operational artist.[97] These learning organizations must consider and understand the vast system of systems that naturally constitutes the multi-media operational environment. Management theorist Peter Senge provides this prescription:

> "The increasing complexity of today's world leads many managers to assume they lack the information they need to act effectively. I would suggest that the information problem faced by them is one of too much rather than too little. We need to know ways to distinguish what is most important, what variables to focus on and which to pay less attention to - and we need ways to do this which can help groups or teams develop shared understanding."[98]

There is a paradox between the first and second implication: the need to accept the control of the complex machinery using information, and the need to not be overwhelmed with irrelevant information. The two keys to understanding this paradox are the operational artist, who provides the vision of what he wants to create, and the ability of technology to bridge this vision with the seemingly overwhelming amount of information that results from the multi-media operational environment. The bottom line is also twofold:

- A commander's critical information requirements - driven by intent and endstate - remain necessary for focusing his creation.
- The tools of information technology are just that; they must be used only in the context of the commander's - the artist's - vision, and cannot become an end unto themselves. They must, however, be used if the artist is to thrive in this complex environment.

The final implication is that we must develop and emplace some acceptable means of defining the human medium. Joint Vision 2010 does not acknowledge the medium, much less understand how combat power is conveyed it. The construct attempts to begin this dialogue by providing a simple definition of the human medium and human terrain that allows for varying degrees of rigorous, quantifiable application.

Historically, the operational artist who has accurately understood the nature of a given operational environment (and translated that understanding into the best combination of means in order to gain a decided advantage over a potential adversary) has won the day.[99] This monograph has attempted to provide one environmental context for evolving the first two steps of the "intelligence preparation of the battlefield" process (define the battlefield environment, describe the battlefield's effects) to meet the needs of "intelligence preparation of the battlespace" for

operational planning. Although threat evaluation and determining threat courses of action exceed the scope of this particular work, these steps can be evolved to help the operational artist fully translate his vision into reality in the multi-media operational environment.

ENDNOTES

[1] Carl von Clausewitz, On War (Princeton, NJ: Princeton University Press, 1984), pp. 88-89.
[2] Martin Van Creveld, Command in War (Cambridge, MS: Harvard University Press, 1985), p. 264. Van Creveld describes the "history of command in war" as "an endless quest for certainty."
[3] TRADOC Pamphlet 525-5, Force XXI Operations (Ft. Monroe, VA: U.S. Army TRADOC, 1 August 1994), p. 3-3; and Sun Tzu., Art of War, Translated by Ralph D. Sawyer (Boulder, CO: Westview Press, Inc., 1994), p. 177. Sun Tzu refers to this ability to subjugate the enemy's army without fighting as the "true pinnacle of excellence" (the "acme of skill" in some translations).
[4] Clausewitz, p. 77; Consider chess, a game played on two dimensions with perfect situational awareness, as an example of this complexity inherent in the clash of opposing wills. As Clausewitz notes, In pure theory, "war is an act of force, and there is no logical limit to the application of that force. Each side, therefore compels its opponent to follow suit...To overcome the enemy, or disarm him — call it what you will — must always be the aim of war....The ultimate aim of waging war, as formulated here, must be taken as applying to both sides....*Thus I am not in control*: he dictates to me as much as I dictate to him....If you want to overcome your enemy you must match your effort against his power of resistance....Assuming you arrive...at a reasonably accurate estimate of the enemy's power of resistance, you can adjust your own efforts accordingly....But the enemy will do the same; competition will again result and, in pure theory, it must again force you to extremes."
[5] JP 1-02m, DoD Dictionary of Military and Associated Terms (Washington, DC: The Joint Chiefs of Staff, 23 March 1994) defines operational environment as "a composite of the conditions, circumstances, and influences which affect the employment of military forces and bear on the decisions of the unit commander." Examples include permissive, uncertain, hostile environments. This definition is far too constrained. Operational environment, by the nature of the words used, is the all-inclusive term for where the operation will take place; specifically, it includes the availability of individual and multiple operational media, and the potential for exploitation of these media, both singularly and in combination, by all potential adversaries.
[6] Joint Tactics, Techniques, and Procedures (JTTP) for Joint Intelligence Preparation of the Battlespace (JP 2-01.3) is currently under development. See website www.dtic.mil/doctrine/pubstat/stat2013.htm for more details.
[7] By constraining the discussion to an environmental context, this monograph will primarily focus on evolving the first two steps of the IPB process (define the battlefield environment, describe the battlefield's effects) to meet the needs of operational planning. Threat evaluation and determining threat courses of action exceed the scope of this particular work.
[8] Joint Vision 2010 (Washington, DC: The Joint Chiefs of Staff, 1996), p 25. JV 2010 defines full spectrum dominance as "the ability to dominate the full range of military operations from humanitarian assistance, through peace operations, up to and into the highest intensity conflict." It describes full dimensional dominance as "active and passive measures to guarantee the air, sea, space, and information superiority that is needed to gain the degree of control to accomplish assigned tasks....built upon information superiority which will provide multidimensional awareness and assessment, as well as identification of all forces in the battlespace."
[9] Joint Vision 2010, p. 19. Dominant maneuver, precision engagement, full-dimensional protection, and focused logistics are the "new conceptual framework" for future forces, defining how they will accomplish full spectrum, full dimensional dominance. See Chapter IV for more details on this conceptual framework and future operations in general.
[10] J.F.C. Fuller, Lectures on F.S.R. III (London: Sifton Praed and Co., LTD, 1932), p. ix.
[11] Jess Stein (ed.), The Random House College Dictionary, (New York, NY: Random House, 1980); Huba Wass de Czege, "Understanding and Developing Combat Power" (Unpublished Paper, Ft. Leavenworth, KS: School of Advanced Military Studies, 1984); and George J. Franz, "Information--The Fifth Element of Combat Power," Student Monograph (Ft. Leavenworth, KS: School of Advanced Military Studies, 1996), p. 40; Random House specifically defines medium as "an agency, means, or instrument, usually of something specified. For our purposes, the operational media provide "agency, means, or instrument," and power in its various forms provides the "something specified." Also, power in this study refers to the

elements of combat power identified by Wass de Czege and Franz (leadership, information, maneuver, firepower, and survivability), and the elements of national power (diplomatic, information, military, and economic). A survey of joint and Army doctrine shows that no definition exists for operational media. In the author's experience (tactical and strategic intelligence operations, BCTPs, and JAAT live fire exercises), discussions involving the understanding of the various operational media and their properties occur regularly in both joint operational and exercise environments, where the players must understand capabilities and limitations of various weapons systems operating on a variety of individual and combined media. These discussions invariably begin with the words "you have to understand the nature of operations on the (you fill in the blank - land, sea, air, etc.) medium....."

[12] Per JP 1-02m lines of communications are all the routes, land, water, and air, which connect an operating military force with a base of operations and along which supplies and military forces move.

[13] Per The Random House College Dictionary, science is the branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws (scientism - advocacy of the application of principles derived from the natural sciences to other disciplines, including the humanities and social sciences); from Latin scientia, knowledge; includes mathematics and logic, the physical sciences, life sciences, and social sciences

[14] Quoted from an instructional briefing provided by LTC Tom Glennon, U.S. Army Command and General Staff College, During Course C310 (Tactics), October 1996. This unofficial definition of operations is conventional wisdom among CGSC instructors and Battle Command Training Program cadre, and is a derivation of a statement made by Clausewitz concerning purpose and means in war (Chapter 2, book 1): "The end for which a soldier is recruited, clothed, armed, and trained, the whole object of his sleeping, eating, drinking, and marching, *is simply that he should fight at the right place at the right time*." (Clausewitz, p. 95) It's tactical equivalent is "fight the fight right;" it's strategic equivalent is "fight the right fight."

[15] Per JP 1-02m, p 387, "the operational level of war (is that level at which) campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations.....These activities imply a broader dimension of time and space than do tactics: they ensure the logistic and administrative support of tactical forces, and provide the means by which tactical successes are exploited to achieve strategic objectives."

[16] Ibid., p. 385; and James J. Schneider, "The Theory of Operational Art." Theoretical Paper No. 3 (Ft. Leavenworth, KS: School of Advanced Military Studies, 1988), p. 3; JP 1-02m defines operational art as "the employment of military forces to attain strategic and/or operational objectives through the design, organization, integration and conduct of strategies, campaigns, major operations, and battles. Operational art translates the joint force commander's strategy into operational design, and ultimately, tactical action, by integrating the key activities at all levels of war." Schneider talks to warfare as a "creative activity" distinguished by "the use of weapons and armies." He also refers to operational science aimed at analysis vice creation. "The scientist is servant to the will of the artist. He makes the artist's work easier to perform.....With respect to operational art and science...the burden of scientific analysis falls largely on the staff officers and logisticians. This group ultimately forms the lubricant and fuel for the grand design of the operational artist." The author borrows Schnieder's "tools of the artist" analogy when comparing an operational medium to a painter's canvas.

[17] John A. Warden, III, The Air Campaign: Planning for Combat (Washington, DC: National Defense University Press, 1988) Chapter 9 of Warden's work is entitled "The Orchestration of War." Warden does not make the connection with the creative aspects of operational art. He also focuses more on the parts that go into the creation, as opposed to the holistic creation itself.

[18] Sun Tzu, p. 187; and Clausewitz, p. 86; Clausewitz, when discussing the element of chance in war, stated that "From the very start there is an interplay of possibilities, probabilities, good luck and bad that weaves its way throughout the length and breadth of the tapestry. In the whole range of human activities, war most closely resembles a game of cards."

[19] James J. Schneider, "The Theory of Operational Art," p. 3-4. Schneider notes that the root of teleology is the Greek word telos – or end. He ties this with man's Promethean (forethought) nature when describing man as a goal oriented creature.

[20] John Keegan, A History of Warfare (New York, NY: Alfred E. Knopf, Inc., 1993) and Geoffrey Blainey, The Causes of War, Third Edition (New York, NY: The Free Press, 1988)

[21] Clausewitz, p. 87.

[22] Larry Cable, lecture presented to CGSC, March 1997.
[23] Michael Howard, Clausewitz (Oxford: Oxford University Press, 1983), p. 48.
[24] Cable lecture.
[25] Larry Cable, Small Wars and Insurgencies (New York, NY: Frank Cass and Co., 1996), pp. 97-111.
[26] Clausewitz, p. 89, and Jerry White, The Power of Commitment (Colorado Springs, CO: Navpress, 1985), p. 25. Clausewitz' prescriptive qualities of military genius – courage, intellect (*coup d'oeil*), and determination – clearly parallel the dominant tendencies noted in the paradoxical trinity. White uses the terms heart, mind, and will, and expands their definitions specifically to emotion, intellect, and volition, in a Christian context of spiritual "self."
[27]Wass de Czege, p. 9; and James R. Beniger, The Control Revolution: Technological and Economic Origins of the Information Society (Cambridge, MS: Harvard University Press, 1986). Wass de Czege describes leadership as the element of combat power upon which all others depend, functioning through personal interaction and command and control to provide purpose, direction, and motivation in combat. Beniger solidifies an understanding of information with a description of the role of information in the information society relative to matter and energy (the other raw components of industrial production; and for our purposes, the raw components of combat power): "Information processing may be more difficult to appreciate than matter or energy processing because information is *epiphenomenal*: it derives from the organization of the material world on which it is wholly dependent on for its existence. Despite being in this way a higher order or derivative of all matter and energy, information is no less critical to society. All living systems must process matter and energy to maintain themselves counter to entropy, the universal tendency of organization toward breakdown and randomization. Because control is necessary for such processing, and information, as we have seen, is essential to control, both information processing and communications, insofar as they distinguish living systems from the inorganic universe, might be said to define life itself." Wass de Czege describes protection in the same terms, noting that the second component of protection includes actions to maintain fighting morale; hence, protection derives from both leadership and physical well-being. Protection, however, can also be manifested physically (as "matter or energy," if you will) in the form of cover, concealment, dispersion, and electronic surveillance; it is the one form of combat power that can be both physical and incorporeal.
[28] Per The Random House College Dictionary, space is the three-dimensional expanse in which all material objects are located. The term "space" in this monograph is separate and distinct from "space medium," as described in Chapter II of this monograph.
[29] Manuel De Landa, Lecture entitled "Singularities, Mathematical Models, and Combat Simulations," presented to the School of Advanced Military Studies, 2 Apr 98. De Landa notes that, in the context of leadership and decision making, "math proves that uncertainty is unavoidable, and the only way to deal with it is to lower decision making thresholds; in the military, the best command system is one that can deal with this uncertainty, not wish it away." De Landa's comments serve to validate the limited goal of this monograph - to provide, as De Landa describes, "a means to enhance the intuition of the potential combat leader" - in this case the operational artist - by providing him with a set of parameters and patterns for the behavior of combat power on the various media that it can be conveyed.
[30] See note 10 for a definition of scientism.
[31]Per The Random House College Dictionary, a substratum is the base or material on which an organism lives.
[32] Sustained in this case is relative. Sustained in space may be a couple of hours in a space suit; sustained at sea may mean months on a ship.
[33]Clausewitz, p. 354. In Book Five, Military Forces, Clausewitz discusses the influence of terrain, and specifically "the command of heights" in relation to the army. He notes that the character of the ground bears a close and ever-present relation to warfare - specifically, in form of obstacles to movement, cover, concealment, and observation from particular vantage points. Although he regularly uses the term "advantage" when discussing terrain throughout On War, his last word on the subject (in Book five) tends to convey his overall attitude: "If the decision depends only on the number and scale of victories, it becomes obvious that the first consideration is the relative quality of the two armies and their commanders. Terrain can only play a minor role." The author's interpretation of this parting thought is that Clausewitz is advising the reader to beware of simple, pedantic answers to the question of relative advantages (vis a vis terrain) when discussing the overall correlation of combat power - taking into account all physical, moral, and cybernetic effects. The scope of this work falls short of taking into account the overall correlation of

combat power, and is primarily concerned with the combat potential for each of the elements of combat power on a given medium or set of media (see note 6).

[34] Antoine Henri Jomini, The Art of War. Edited by BG J.D. Hittle. Reprinted in Roots of Strategy, Book 2 (Harrisburg, PA: Stackpole Books, 1987), pp. 392; 461; 543-552.

[35] Julian S. Corbett, Some Principles of Maritime Strategy (Annapolis, MA: Naval Institute Press, 1911), p. 94. Corbett notes that "the object of naval warfare is the control of communications, and not, as in land warfare, the conquest of territory." Corbett's strong views on control of the sea as an operational medium provided the primary inspiration for this study.

[36] Alfred Thayer Mahon, The Influence of Sea Power Upon History, 1660-1783 (Boston, MS: Little, Brown and Company, 1918), p. 25.

[37] Corbett, p. 91. Corbett also states that command of the sea refers to control of all maritime communications, both commercial and military.

[38] Giulio Douhet, Command of the Air (New York, NY: Coward-McCann, Inc., 1942), p 15.

[39] Ibid., p. 19. Per Douhet, "the surface of the earth is the coastline of the air."

[40] Ibid., p. 21. Douhet talks extensively of air power relative to the WW1 paradigm of static defenses and parity in firepower and maneuver. He describes air power as the emerging capability to break this gridlock and establish a positional advantage relative to surface forces, bases, capitols, and commercial/population centers.

[41] Ibid., p. 24, and Warden, p. 168. Per Douhet, "To have command of the air means to be in a position to prevent the enemy from flying while retaining the ability to fly oneself." Per Warden, "attaining air superiority means eliminating by one means or another enemy forces that can interfere with air operations."

[42] Warden, p. 169.

[43] Ibid., pp. 19-22. Warden's five cases of war is a comparative analysis of the air situation used to "establish a framework for planning." The five cases compare, in relative terms, the positions of friendly airfields and rear areas, battle lines (ground/sea forces), and adversary air fields and rear areas. His air superiority variables likewise provide a comparative analysis tool for personnel and material capability.

[44] Michael R. Mantz, The New Sword: A Theory of Space Combat Power (Maxwell Air Force Base, AL: Air University Press, 1995), p. 2.

[45] David E. Lupton, On Space Warfare: A Space Power Doctrine (Maxwell Air Force Base, AL: Air University Press, 1988), p. 23. Lupton describes the infinite arena of space: "We can get some sense of the expanse of the medium by realizing that the distance from the earth to geostationary altitude is almost the same as a trip around the earth. In addition, when satellites in geostationary orbits are positioned one degree apart to preclude radio interference, they are actually 400 nautical miles apart."

[46] Ibid., p. 23.

[47] Ibid., p. 20. According to Lupton, "unpowered space forces have more of the attributes of fixed fortifications whose position is known than of maneuvering forces whose future position is in the mind of the commander. This is not to say that space vehicles cannot maneuver but that their maneuver is limited by the logistical problems involved in supplying them with fuel."

[48] Ibid., p. 24.

[49] Mantz, p. 80. Per Mantz, "the candidate theory declares the independence of space combat power from combat air power. Whether or not space can be decisive will depend on combat experience. The amount of space control needed is still uncertain due to the vastness of space and the nature of orbital mechanics. Independent control is essentially current doctrine since separate service and unified commands handle space operations today."

[50] Michael W. Schneider, "Electromagnetic Spectrum Domination. 21st Century Center of Gravity or Achilles Heel?" Student Monograph (Ft. Leavenworth, KS: School of Advanced Military Studies, 1994), p. 23; and Neil Munro, The Quick and the Dead: Electronic Combat and Modern Warfare (New York, NY: St. Martin's Press, 1991), p. 2.

[51] Munro, p. ix; Munro states that "because information is so central in modern warfare, every little technological or tactical issue that affects the speedy gathering, sharing, and exploitation of information is of great importance." Munro also notes the efforts toward directed energy capabilities have not reached a widely exploitable level at this point, but show great promise in the areas of laser and radio frequency weapons.

[52] Michael W. Schneider, "Electromagnetic Spectrum Domination," pp. 23-25.

[53] The human medium can also operate outside the bioshere, but only by establishing artificial land

conditions as discussed in the section on the land medium.

[54] James J. Schneider, "Black Lights: Chaos, Complexity, and the Promise of Information Warfare." Joint Force Quarterly no. 15 (Spring 97), p. 22. See also Beniger's discussion on information and control in note 25.

[55] Ibid., pp. 22-23; Schneider notes three previous control crises/revolutions:

a) Control of organic organization and reproduction, answered by the formation of DNA to organize matter and energy at the most fundamental level of control; resulting in simple organic life forms.
b) mobility and survivability of complex living organisms, answered by the formation of a central nervous system, the first electronic system that provided sensory feedback and executive feedforward of information in a dynamic, lethal environment; resulting in complex lifeforms.
c) The introduction of simple mechanical and cultural tools bringing about societies, answered by the control mechanisms of civilization (central government, security, economic systems, and science); resulting in nations.

[56] Ibid., p. 24; and Beniger, pp. 1-27. Schneider borrows some of the terms for his discussion in "Black Lights" from Beniger, who states that, in response to the control crisis presented by the machines of the industrial revolution, we are now continuing to undergo a control revolution toward the end state of an "information society." This information society has manifested itself in the geometric growth of information-based vocations in the U.S. (from 0.2% in 1800 to nearly 50% in 1980).

[57] Ibid., p. 25.

[58] Munro, p. ix.

[59] Ibid., pp. 35-55.

[60] Clausewitz, p. 92. Clausewitz, in his discussion of purpose and means in war, asks hypothetically how to make success more likely in an armed conflict. "one way, of course, is to choose objectives that will incidentally bring about the enemy's collapse – the destruction of his armed forces and the conquest of his territory; but neither is quite what it would be if our real object were the total defeat of the enemy. When we attack the enemy, it is one thing if we mean our first operation to be followed by others until all resistance has been broken; it is quite another if our aim is only to obtain a single victory, in order to make our enemy insecure, to impress our greater strength upon him, and to give him doubts about his future. If that is the extent of our aim, we will employ no more strength than is absolutely necessary. In the same way, conquest of territory is a different matter if the enemy's collapse is not the object. If we wish to gain total victory, then the destruction of his armed forces is the most appropriate action and the occupation of his territory only a consequence. To occupy land before his armies are defeated should be considered at best a necessary evil."

[61] Sun Tzu., p. 187.

[62] The Random House College Dictionary house defines physics as the science that deals with matter, energy, motion, and force; this being the raw stuff of combat power as described in note 25.

[63] Wass de Czege, pp. 1-2.

[64] FM 100-5, Operations (Washington, DC: Department of the Army, 1993), p. 2-5.

[65] Wass de Czege., p. 9.

[66] A solid extension of Wass de Czege's logic regarding relative combat power; hence relative media advantage is a logical goal of the operational artist - and is at the core of the "full-dimensional, full spectrum dominance" described in the introduction.

[67] The Random House College Dictionary defines asymmetric as not identical on both sides of a central line. Although this term appears in a number of concepts, no clear definition exists in doctrine. Joint Vision 2010 defines asymmetric advantage as the ability to apply force "in sustained and synchronized operations from dispersed locations...applying overwhelming force on the same medium and creating asymmetric advantages by attacking cross-dimensionally, such as air or sea against ground and sea against air defenses....having the ability to outpace and outmaneuver the enemy."

[68] That level of war concerned with "fighting the right fight, with the right stuff, at the right place and time." See Clausewitz, p. 95.

[69] The Random House College Dictionary defines resonance (relative to physics) as the state of a system in which an abnormally large vibration is produced in response to an external stimulus.

[70] The Random House College Dictionary defines complexity as the state of being complex...composed of interconnected parts; compound; composite.

[71] Peter M. Senge, The Fifth Discipline: The Art and Practice of the Learning Organization, (New York,

NY: Doubleday, 1990), pp. 71-73. Senge describes two forms of complexity. Detail complexity is the complexity of simple variables used against given norms. Dynamic complexity involves subtlety in cause and effect...where effects over the time of interventions and interactions is not obvious. He notes that conventional forecasting, planning, and analysis models are not equipped to deal with dynamic complexity; where "the same action has dramatically different effects in the short and the long run;" or "where an action has one set of consequences locally, and a very different set of consequences in another part of the system.....where obvious interventions produce nonobvious consequences." He goes on to state that "the real leverage in most management situations lies in understanding dynamic complexity, not detail complexity...seeing the interrelationships rather than the linear cause and effect chains, and seeing processes of change rather than snapshots."

[72] Ibid., p. 73.

[73] Authors note - this is a distinctly American character attribute and strength - what we normally describe as "intrepreneurialship" in capitalistic parlance.

[74] The Random House College Dictionary defines decisive as having the power or quality of determining....characterized by or displaying decision or resolution. Per JP 3-0, Doctrine for Joint Operations (Washington, DC: The Joint Chiefs of Staff, 1 February 1995), pp. II-4 to II-7, "A campaign plan is a series of major operations that arrange tactical, operational, and strategic actions to accomplish strategic and operational objectives. A campaign plan describes how these operations are connected in *time, space, and purpose*. Within a campaign, major operations consist of coordinated actions in a single phase of a campaign and usually *decide* the course of a campaign." In this context, the idea of decisive medium in a particular phase specifically refers to the ability of operations on that medium to set the conditions for the succeeding operations, or phases, of the campaign.

[75] FM 100-5, Operations, p. 2-5, contains the currently accepted principles of war. This particular use of the term decisive medium was built into the 100-5 description of economy of force.

[76]Clausewitz, p. 75, notes that "war is an act of force to compel our enemy to do our will." This punctuates the idea of human origination...toward a human end as noted by Schneider in Chapter II.

[77] Ibid., p. 99, Clausewitz states that "Everything is governed by a supreme law, the decision by force of arms."

[78] Wass de Czege, pp. 10-14, uses levels of abstraction relative to the elements of combat power to illustrate the application of an analytical framework for conducting combat power assessments that allows for a "clear and rigorous understanding of combat power in a modern context..."

[79] Alvin and Heidi Toffler, War and Anti-War: Survival at the Dawn of the 21st Century, (New York, NY: Little and Brown Company, 1993), pp. 18-25; 64-85; the Tofflers discuss in detail the clash of civilizations and their basis of power - agrarian (land), industrial (mass), information (knowledge and innovation); they extend their argument to forms of conflict inherent in each civilization.

[80] Joint Vision 2010, p. 8.

[81] Ibid., p. 18, Toffler, pp. 64-85; and briefing entitled "Force XXI How-To-Fight" (Joint Venture Office, TRADOC, January 1998, pp. 27-43. Both the Tofflers and the Joint Venture briefing describe an operational environment where higher lethality of weapons = concurrent attack; precision + range = effects with fewer systems and reduction of massed people and equipment; improved C4I = massed maneuver at right time and place and not assembled earlier than necessary; and improved targeting information = reduction of traditional force requirements.

[82] Ibid., p. 18-19.

[83] Ibid., p. 20-21. Altogether, the organizational concept of dominant maneuver is a prescription for more agile, faster moving joint operations, which will combine air, land, and maritime forces more effectively to deliver decisive combat power.

[84] Ibid., p. 21. Per JV 2010, even from extended ranges, precision engagement will allow us to shape battlespace, enhancing the protection of our forces.

[85] Ibid., p. 22-24. Per JV 2010, we must also protect our own forces from the very technologies that we are exploiting. Unless we provide an adequate measure of protection for our forces, these new operational concepts will be highly vulnerable to disruption. We will achieve his required level of protection through the concept called full-dimensional protection..... Full dimensional protection will be built upon information superiority which will provide multidimensional awareness and assessment, as well as identification of all forces in the battlespace....providing a more seamless joint architecture for force protection, which will leverage the contributions of individual services, systems, and echelons. The result

will be improved freedom of action for friendly forces, and better protection at all echelons against precision attack, weapons of mass destruction, and other conventional or non-conventional systems.
[86] Ibid., pp. 24-25.
[87] Ibid., pp. 25-27. JV 2010 comes with the following caveats. We must ensure that capturing technologies doesn't over-specialize the force; regardless of how sophisticated technology becomes. Also, JV 2010 emphasizes that the individual warfighter's judgment, creativity, and adaptability in the face of highly dynamic situations will be essential to the success of future joint operations..."our success will depend, as it has historically, upon the physical, intellectual, and moral strengths of the individual soldier, sailor, airmen, and marines, especially their adaptability in the face of the unexpected. Only a force that has courage, stamina, and intellectualability to cope with the complexity and rapid pace of future joint operations will have the capability to achieve full spectrum, full dimensional dominance."
[88] Toffler, pp. 22-25; Samuel P. Huntington, "the Clash of Civilizations?" Foreign Affairs, Summer 1993, p. 22-49; Robert Kaplan, "The Coming Anarchy," The Atlantic Monthly, February 1994, pp. 44-58; and Robert D. Walz, "Describing the International Security Environment; The Clash of Ideas," Department of Joint and Combined Operations Selected Readings Book (U.S. Army Command and General Staff College, 1996), pp. B-1 - B-12.
[89] Joint Vision 2010, p. 10-11. Per JV 2010, application of technologies by this adversary can prove surprising - the idea of resonance used against us. An adversary will have an independent will and some knowledge of our capabilities, and will desire to avoid strengths and exploit vulnerabilities. This translates into a probability of technological, operational surprise.
[90] Sun Tzu, p. 184. Sun Tzu specifically states "Terrain gives birth to measurement, measurement produces the estimation (of forces). Estimation (of forces) gives rise to calculating (the number of men). Calculating (the number of men) gives rise to weighing (strength). Weighing (strength) gives birth to victory. Thus the victorious army is like a ton compared with an ounce, while the defeated army is like an ounce weighed against a ton! The combat of the victorious is like the sudden release of a pent-up torrent down a thousand-fathom gorge."
[91] Peter J. Schifferle, "Incorporating Enemy Psychological Vulnerability into US Heavy Division IPB Doctrine," Student Monograph (Ft. Leavenworth, KS: School of Advanced Military Studies, 1993). Schifferle discusses the lack of attention paid to the estimation of enemy psychological vulnerabilities, which resulted in a gross over-estimation of Iraqi capabilities during the Gulf War. In his estimation, this overestimation resulted in unnecessary tentativeness and lack of initiative in exploiting the grave psychological state of the Iraqi high command and the army in general. His discussion centers primarily on Army doctrine and concepts.
[92] JP 3-0, p. I-2.
[93] Clausewitz, p. 87.
[94] Sun Tzu, p. 177-179. See also note 3 and its associated text in the introduction.
[95] Joint Vision 2010, p. 9.
[96] The Random House College Dictionary defines Luddite as a member of any of various bands of English workmen (1811-1816) who destroyed industrial machinery in the belief that its use diminished employment. The term is commonly used to describe an individual who shuns or rejects technological innovations. The information society is discussed in note 55.
[97] Senge, pp. 236-307. Senge describes team learning as one of the five disciplines of a successful organization. Team learning has three elements: to think insightfully about complex issues as a team; the need for innovative, coordinated action; and interact teams with other teams. In team learning, the goal is to reach the dialogue stage (the free-flowing, two-way exchange of information and ideas) rather than just discussion (the presentation of ideas and information for the purpose of gaining a decision). In dialogue, people become observers of their own thinking. There are three conditions required for dialogue: people must suspend their assumptions; they must regard each other as colleagues, and there must be a facilitator who holds the context of the dialogue. Contrary to popular belief, great teams are not characterized by an absence of conflict.
[98] Ibid., pp. 12-128. Senge describes systems thinking - the fifth discipline that integrates the others, fusing them into a coherent body of theory and practice - as the art of seeing systems as a whole.
[99] See note 1.

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