(2)

Operational Symbols: Can A Picture Be Worth A Thousand Words?

A Monograph
by

Major Frederick R. Kienle
Infantry

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

Second Term 90-91

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	APR 1991	MONOGRAPH

4. TITLE AND SUBTITLE
OPERATIONAL SYMBOLS: CAN A PICTURE BE WORTH A THOUSAND WORDS?

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJ FREDERICK R. KIENLE, USA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
SCHOOL OF ADVANCED MILITARY STUDIES
ATTN: ATZL-SWZ
FORT LEAVENWORTH, KANSAS 66027-6900
COMM (913) 684-3437 AUTOVON 552-3437

8. PERFORMING ORGANIZATION REPORT NUMBER

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

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED PUBLIC RELEASE; DISTRIBUTION UNLIMITED

12b. DISTRIBUTION CODE

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

14. SUBJECT TERMS
SYMBOLS
GRAPHICS
SEMIOTICS
OPERATIONAL ART
CAMPAIGN PLANNING
OPERATIONAL GRAPHICS

15. NUMBER OF PAGES
68

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

BLOCK 13. Abstract

This monograph determines if there is a potential to capture the essence of operational design through the use of graphic symbols. Although Army Field Manual 101-5-1, Operational Terms and Graphics is well suited for use at the tactical level of war, it is somewhat inadequate for the conduct of joint campaign planning and execution. There appears to be a need for clear, simple, and accurate graphics which are useful to the "operational artist."

The essential elements of operational design are derived through an examination of campaign planning, the process by which the operational artist translates strategic guidance into operational and tactical actions. The seven tenets of campaigning, as developed by COL William Mendel and LTC Floyd T. Banks, yield several key concepts which seem amenable to a useful portrayal with graphic symbols.

Criteria are derived from a basic study of semiotics (the science of symbols) and an understanding of the role of graphic symbols in portraying the relationship between time, space, and purpose pictorially. Additional direction for the formulation of operational graphics is obtained from reviewing the symbol applications of Napoleon, the Second World War era German Army, and the contemporary Soviet Army. Useful operational symbols should be able to portray useful concepts of operational design in a manner that is clear, simple, and accurate.

Over twenty-three different operational graphics are portrayed in accordance with the established criteria, providing the operational artist with a unique, and useful method of conceptualizing, designing, and communicating campaign design. When applied in the campaign planning process, the symbols presented in this monograph give the operational artist a new tool with which to envision, develop, communicate, and guide the synchronized application of joint forces in time, space, and purpose.

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Frederick R. Kienle

Title of Monograph: Operational Symbols: Can a Picture Be Worth a Thousand Words?

Approved by:

LTC(P) William J. Rice, MS — Monograph Director

COL James R. McDonough, MS — Director, School of Advanced Military Studies

Philip J. Brookes, PhD — Director, Graduate Degree Program

Accepted this 28th day of April 1991.

BLOCK 13. Abstract

This monograph determines if there is a potential to capture the essence of operational design through the use of graphic symbols. Although Army Field Manual 101-5-1, Operational Terms and Graphics is well suited for use at the tactical level of war, it is somewhat inadequate for the conduct of joint campaign planning and execution. There appears to be a need for clear, simple, and accurate graphics which are useful to the "operational artist."

The essential elements of operational design are derived through an examination of campaign planning, the process by which the operational artist translates strategic guidance into operational and tactical actions. The seven tenets of campaigning, as developed by COL William Mendel and LTC Floyd T. Banks, yield several key concepts which seem amenable to a useful portrayal with graphic symbols.

Criteria are derived from a basic study of semiotics (the science of symbols) and an understanding of the role of graphic symbols in portraying the relationship between time, space, and purpose pictorially. Additional direction for the formulation of operational graphics is obtained from reviewing the symbol applications of Napoleon, the Second World War era German Army, and the contemporary Soviet Army. Useful operational symbols should be able to portray useful concepts of operational design in a manner that is clear, simple, and accurate.

Over twenty-three different operational graphics are portrayed in accordance with the established criteria, providing the operational artist with a unique, and useful method of conceptualizing, designing, and communicating campaign design. When applied in the campaign planning process, the symbols presented in this monograph give the operational artist a new tool with which to envision, develop, communicate, and guide the synchronized application of joint forces in time, space, and purpose.

TABLE OF CONTENTS

INTRODUCTION

> One picture is worth more than ten thousand words.
>
> - Ancient Chinese Proverb[1]

Since the time that the earliest Neanderthal tribes conceived and communicated their ideas with cave-wall icons, man has relied on graphic symbols for conceptualization and expression. Man has used this ability to communicate abstract ideas in an ongoing effort to bring order out of chaos and to rationalize and understand the laws of nature.[2] Because war is a "part of man's social existence," special terminology and symbols have necessarily emerged to overcome the inherent ambiguities in communicating abstract military ideas and concepts.[3] Today, despite the development of modern military command, control, communications, and computer (C^4) technology, we continue to search for the most appropriate icons to rapidly organize and communicate our own conceptualization of the battlefield .

Our military profession of arms has its own distinguishable corpus of specific technical knowledge -- a knowledge which requires judgement in its application.[4] For this reason, the planning and prosecution of war is both a science and an art which demands not only its own grammar, but its own language of graphic signs and symbols as well.[5] Just as an architect creates a blueprint, combining art and science to guide construction, so must the military professional conceptualize and communicate his

plans with a "blueprint of the battlefield."[6] To do this, the military professional requires an abbreviated and standardized symbolic language to efficiently visualize and communicate relatively complex ideas and concepts.

With our military's increasing acceptance of the operational level of war and operational art, there emerges a need to expand our currently accepted suite of **"operational"** terms and graphic symbols.[7] Operational art, the essential link between tactics and strategy, is the medium by which we design and conduct campaigns and major operations to meet strategic ends. According to both Clausewitz and Jomini, operational art differs enough from tactics so as to merit separate consideration.[8] It therefore seems logical that the unique concepts employed by the operational artist should require equally unique graphic representations. Without these symbols, the operational artist may be subject to unnecessary misunderstanding, confusion, time delays, and errors.

Although Army Field Manual 101-5-1, Operational Terms and Symbols provides a substantial foundation for communication of military terms and symbols at the tactical level, it falls short in providing sufficient "tools" for the operational artist. This manual alleges to provide "graphic aids which accurately identify items of operational interest," but the term "operational" in this context broadly refers to "military actions, missions, or mancuvers" and **not** to the operational **level of war.**[9]

Although this doctrinal manual provides sufficient means for the tactician to develop and convey his intention, tasks, resources, and constraints, it is inadequate for the operational artist.[10] Rather than being forced to "ad hoc" symbols, the operational artist should possess a meaningful shorthand to assist in the full range of cybernetic functions; a shorthand of operational graphics which are clear, simple, accurate and tailored to meet the demands of operational art (campaign planning). And because in modern warfare the Army, Navy and Air Force are essentially interdependent for movement, protection, and firepower, the operational artist requires a standardized system of operational graphics which is joint in nature.[11]

But can graphic signs and symbols adequately capture and communicate the essential elements of operational design? By defining operational art and dissecting the tenets of campaign planning, we can identify these essential design elements. Then, through a short survey of semiotics, the science of signs and symbols, we can illuminate several requirements for producing clear, simple, and accurate symbols. We can also look for direction in past and present applications of operational symbols through a review of historical examples and procedures. Finally, we can attempt to carefully develop an inventory of proposed operational symbols. Only then can we determine if the proposed graphic symbols can adequately convey the essential elements of operational

design in a clear, simple, accurate, and useful manner.

OPERATIONAL ART AND CAMPAIGNING

Before we can begin to determine which essential elements of operational design lend themselves to graphic expression, we must first elucubrate those elements.[12] Operational art differs significantly from tactics in that it deals with much larger geographic areas and segments of time by employing theater forces in the conduct of campaigns. Joint Chiefs of Staff Publication 3-0 (Test) (JCS Pub 3-0[Test]) defines operational art as:

> The employment of military forces to attain strategic or operational objectives in a theater of war or in a theater of operations through the **design, organization,** and **conduct** of **campaigns** and major operations. Operational art translates theater strategy into operational and, ultimately tactical action. (Emphasis added)[13]

Clearly, the operational artist's modus operandi for translating theater strategy into operational and tactical action to attain strategic or operational goals is the campaign plan. Joint Chiefs of Staff Publication 1-02 (JCS Pub 1-02) defines a campaign plan as a "plan for a series of related military operations aimed to accomplish a common objective, normally within a given time and space."[14] In short, the campaign plan lays out a commander's vision of the sequential and simultaneous operations required to achieve the desired objective.[15]

Exploring the unique characteristics of a campaign plan provides a firm basis for discovery of the elements of

operational design. While there is a relative "paucity of authoritative information" amplifying the specifics of campaign plans, a U.S. Army War College report and JCS Pub 3-0, **Doctrine for Unified and Joint Operations (Test)** shed light on the subject with their similar fundamental characteristics of a campaign plan.[16] The characteristics, or "tenets," succinctly summarize what a campaign plan is and does. A campaign plan:

> **1. Provides broad concepts of operations and sustainment to achieve strategic military objectives in a theater of war or operations; serves as the basis for all other planning and clearly defines what constitutes success.**
> **2. Provides an orderly schedule of strategic military decisions; displays the commander's vision and intent.**
> **3. Orients on the enemy center of gravity.**
> **4. Phases a series of related major operations.**
> **5. Composes subordinate forces and designates command relationships.**
> **6. Provides operational direction and tasks to subordinates.**
> **7. Synchronizes air, land, and sea efforts and is joint in nature.**[17]

Each of these tenets now requires some examination to further expose the inherent elements of operational design.

The first tenet emphasizes Clausewitz' axiom of "considering the last step prior to the first."[18] For the operational artist, the strategic objectives (or end state) become evident from asking the question,"what military conditions must be produced to achieve the strategic goal?"[19] These conditions could include any of a multitude of possibilities, to include destruction, surrender, or evacuation of enemy forces and/or the control of geography or resources. In a low intensity conflict, conditions that

define success may be a weakening of enemy influence or even some other less specific condition.[20] In short, accomplishment of the desired military condition which achieves the enunciated strategic goal should unambiguously be defined and depicted as success.

The first tenet also includes the requirement to provide "broad concepts of operations and sustainment which may serve as the basis for all other planning." The operational artist must first decide, in general terms, how the campaign will be accomplished, to include anticipated logistics support. These "broad concepts" of operations can then be exemplified using lines of operations, pivots of maneuver, decisive points, and objective points. And for depicting sustainment concepts, through the use of forward and intermediate bases of operations, lines of communications, and culminating points. In this way the operational artist visually frames an overall scheme to achieve an end, a scheme upon which to later develop a functional and more detailed design.[21]

The second tenet describes the "operational commander's vision of how he will prosecute his portion of the war effort from the preparation phase through a series of military operations to the well defined conclusion."[22] In recognition of the fog, friction, chance and uncertainty of war, flexibility to accommodate change must be built into campaign plans. Some flexibility may be achieved through the designation of decision points oriented on information

regarding likely or actual battle outcome, which can then prompt implementation of branches or sequels.[23] Branches- options for changing intentions and accepting or declining battle, and sequels- changes to dispositions and objectives based on the outcome of battle, are vital to the provision of an orderly schedule of strategic military conditions.[24]

The third tenet, orientation on the enemy's center of gravity, is second only to the identification of a clear strategic objective. The careful consideration and identification of the enemy's center of gravity is a prerequisite for seizing the initiative and robbing the enemy of his will to fight. Clausewitz stated that the center of gravity, "the hub of all power and movement," could be found "where the mass is concentrated most densely."[25] He later sanctions several other possible centers of gravity, including a capital, an ally's army, the bonding interests of an alliance, leaders, or public opinion.[26] JCS Pub 3 (Test) defines a center of gravity as "that characteristic, capability, or locality from which a military force derives its freedom of action, physical strength, or will to fight."[27] Regardless of what the operational artist identifies as the enemy center of gravity, it remains a key design concept; the campaign must be designed around the disarticulation, destruction or shattering of the enemy center of gravity.[28]

The fourth tenet calls for phasing a series of related major operations. This requires a distinction be made for

each temporal, spatial, or event driven segment of the campaign which requires a reorganization of forces or resources before another action is initiated.[29] Phases, whether occurring sequentially or simultaneously, should each have intermediate goals which contribute to the overall accomplishment of the larger goal of the campaign.

Tenet number five, the composition of subordinate forces and designation of command relationships, provides organizational structure to the campaign. The operational artist structures subordinate forces based on several considerations:

> mission; objectives; tasks; nature and scope of operations; capabilities of, and doctrinal compatibility among allied and U.S. forces; strategic and operational force mobility; time and space available; logistic considerations; and area or functional organization factors.[30]

To direct the carefully composed subordinate forces in a theater, the operational artist designates command relationships. These relationships focus on fighting the forces (usually joint) to mission accomplishment, regardless of whether a "system" or "component" approach to organization is selected.[31] The product of the established relationships is a command system consisting of organizations, procedures and technical means; a system which makes use of information to coordinate people and things toward mission accomplishment.[32] This tenet takes on even greater operational significance with the 1986 Goldwater-Nichols Act's vesting of authority in the theater

commanders in chief to:

> ...prescribe the chain of command to the commands and forces within the command ...organizing (subordinate) commands and forces...and assigning command functions to subordinate commanders.[33]

The sixth tenet appears to be an obvious by-product of any plan, and is in some ways similar to the first tenet's guidance "to serve as the basis for all other planning." Providing "operational direction" orchestrates the fighting armies, corps, task forces, wings, or other combat groupings and their logistics toward the successful execution of campaigns.[34] By giving tasks to subordinates, the operational artist ensures a sense of connectivity between subordinate's actions while simultaneously providing subordinates with the necessary foundation upon which to build plans for the execution of tactical missions. Usually, this foundation of tasks will also be accompanied by control measures, restraints, and constraints to assist in the orchestration of forces.

The seventh, and last of the tenets, stresses the requirement for synchronization of air, land, and sea efforts to achieve synergistic results. It is here that the inherent joint aspect of modern campaign planning is clearly enunciated. Theater warfare, more often than not, will comprise air, AirLand, and naval warfare (each relying to some degree on space-based systems for communications and intelligence) with some mix of conventional and special operations forces.

This probe of the campaign tenets has exposed several essential concepts of operational design. Our distillation yields a list with such ideas as military conditions; lines of operation and communication; decisive and objective points; branches and sequels; centers of gravity; phasing; command relationships; tasks and control measures. Additionally, our review of the tenets specifically poses a requirement to synchronize joint forces. Our challenge remains to be able to portray these concepts, through the use of graphic symbols, in the operational environment.

GRAPHIC SYMBOLS

Before we attempt any graphic portrayal of the essential elements of operational design, it is prudent to establish standards for the engineering of our graphic symbols. The theory of signs and symbols that express concepts or ideas, or **semiotics**, resides in the fields of graphic arts, cartography, ergonomics, computer science, and psychology.[35] Although a comprehensive treatment of these fields far exceeds our scope, it remains useful to scientifically develop criteria to aid in selecting symbols which provide the desired picturing and imaging in command, control and communication processes. But first we should define the roles and capabilities of graphic symbols.

A graphic symbol may be defined as:

> ...a visual representation that suggests something else by reason of relationship, association, or convention.[36]

Often, graphic symbols visually communicate complex ideas or facts more rapidly and efficiently than can many lines of writing.[37] Symbols may be arranged to portray temporal and spatial relationships between the objects or events which they represent, or they may simply be used to enhance understanding. Symbols also arouse mental images which can be better remembered than words.[38] When used in conjunction with printed text, a symbolic representation significantly enhances both comprehension and memory. While the visual display of graphics can help define and exemplify words, the words can also delimit and interpret the graphics.[39]

But the utility of graphic symbols goes beyond that of communicating a message from a sender to a receiver. Graphic symbols assist in the process of internal visualization, because forms are to visual communication what words are to verbal communication. From a psychological point of view, the process of visualizing and the creative process are practically synonymous.[40] Although symbols themselves possess no meaning, they do evoke a manifest text, associations of things and events, and they create conscious responses. The utility of visualizing with symbols, for the operational artist, is summed up in the following:

> ...real thinking is better done without words than with them, and creative thinking **must** be done without words...when the mind is actively and vitally at work, for its own creative uses,

it has no time for word building.[41]

The engineering of effective symbols for both communication and visualization can be an exhaustive process. Semiotics borrows primarily from the field of psychophysics and Gestalt psychology to determine the usefulness of a given symbol.[42] The Army Research Institute has conducted several studies related to the selection of tactical military symbols and has developed several methods for engineering symbols. Among these methods are conducting field surveys of Army officers, development of an algorithm which allows discrimination between two or more symbols portraying the same concept, and development of a step-wise procedure for designing new symbols.[43] This last method, which aids in defining our criteria of symbol clarity, simplicity, and accuracy, is applied in this study.

The principles of closure, continuity, and figural unity all contribute to clarity.[44] Closure is exhibited when a symbol is a closed form, such as a complete triangle. a symbol without closure causes the viewer, in perception, to mentally provide the missing part and thereby distorts clarity. Continuity is achieved when symbols are constructed as to make the fewest changes or interruptions in straight or smoothly curving lines. Because of continuity, two crossing lines are perceived as two crossing lines rather than four lines intersecting at a point. Figural unity is best displayed when the symbol

boundaries are evident and the symbol is clearly defined as a physical whole.

Simplicity is achieved by using a minimum number of symbol elements such as lines, arcs, angles, ovals, and other "primitive" parts.[45] The Gestalt law of "pragnanz" indicates that people prefer the simplest or most efficient interpretation of a symbolic representation.[46] Overly complex symbols should be avoided and the visual clarity of the symbol must be retained when delivered and received by digital means. The symbol must be equally capable of production by hand for a map overlay (easy to draw) or by a computer driven software package for screen display.

Accuracy is a blend of distinctiveness and association with the portrayed concept. Distinctiveness can be easily defined as uniqueness of configural attributes, or a minimum of commonly held elements of two or more symbols.[47] To be distinctive, a symbol must be readily discernible from all other existing symbols in use. Association with the portrayed concept relies on taking advantage of inherent associations with existing symbols and the background of the user. For example, the association of the color red with danger opts for depiction of enemy forces in this color.[48] In short, accuracy should allow little or no ambiguity about which symbol and concept belong together.

Other contributors to symbol effectiveness which may affect clarity, simplicity, or accuracy are color,

integration of alphanumerics, and metaphors. Color coding provides enhanced symbol effectiveness, but the color itself may convey information that is inappropriate to the object of the display.[49] Additionally, color differentiation may not be within the capability of selected information processing devices. Alphanumeric integration can also enhance the accuracy in symbol identification, but it increases the complexity of the symbol and results in a decrement to both memory and the time it takes the user to perceive and process the information.[50] Metaphor-based symbols rely on the attributes of an external environment which is familiar to the user, and can positively affect accuracy.

This basic understanding of semiotics is essential to our ability to create and select graphic symbols which meet the needs of the operational artist; graphic symbols which are useful because they depict elements of operational design in a clear, simple, and accurate manner.

MILITARY SYMBOLS; TIME, SPACE, AND PURPOSE

Clear, simple, and accurate military symbols which are useful at the tactical level are contained in Army Field Manual 101-5-1, Operational Terms and Symbols.[51] As a dictionary of term definitions and symbols applicable to the AirLand battlefield, it is an indispensable tool to the ground tactician striving for synchronization in time, space, and purpose.[52] The concepts symbolically presented

in the manual include units, weapons, installations, and activities (or restrictions on activities). These standardized symbols help the tactical planner "visualize the consequences to be produced and how activities must be sequenced to produce them."[53] Army Field Manual 100-5, Operations (FM 100-5) further emphasizes that "synchronization takes place first in the mind of the commander, and then in the actual planning and coordination."[54] Knowledge and familiarity of the tactical military symbols in FM 101-5-1 significantly enhance the commander's mental imagery and provide him with a capability to then communicate that image to achieve synchronization on the battlefield.

FM 101-5-1 first appeared on the tactician's bookshelf in 1980, with a revision published in 1985. Previous editions of other "military symbol" manuals predate the Second World War and continued to evolve to their present form. From the 1939 U.S. War Department edition of Field Manual 21-30, Conventional Signs, Military Symbols, and Abbreviations to the present FM 101-5-1, we can trace the evolution in the application of military symbols. Changes to organizations and doctrinal concepts brought about corresponding changes to the symbolic representation of those concepts. Increased operations with air forces prompted the inclusion of conventional aeronautical chart symbols in 1943, while increased operations with naval and marine forces created a similar need to include

hydrographic chart symbols in that same 1943 revision. As organizations and doctrinal concepts further evolved, new revisions of FM 21-30 included symbols related to nuclear weapon employment and the command of large combined forces in a NATO environment.[55] It becomes evident that military graphic symbols, like organization and doctrine, evolve over a period of time and require periodic updating to remain practicable to the user.

As he does with organization and doctrine, the tactician employs the available suite of graphic military symbols within the framework of the battlefield operating systems (BOS). Symbols are used in the command and control BOS for course of action visualization, both mentally and on paper.[56] Symbols are also an instrument to assist in the clear and rapid transmission of information such as in the graphic portrayal of developing situations on maps. The tactical plans and orders that accurately portray the commander's decision, concept, and intent often rely heavily on the symbols in FM 101-5-1.

Likewise, the intelligence BOS relies on symbols to represent enemy units, weapons, installations, and activities in time and space. This permits a more ordered and rapid processing of combat information and subsequent communication of intelligence. The fire support, air defense and mobility/survivability BOS's rely on symbols for communication of target data, understanding imposed restrictions and coordination measures, and integration

with other systems.[57] The combat service support BOS relies on symbols to conceptualize and plan locations and relationships for elements providing logistics, personnel services, or health services. And the maneuver BOS depends heavily on symbols to position forces, control movements, designate terrain associated responsibilities, and control fires. At the tactical level, common military symbols are integral to each of the operating systems themselves and the subsequent coordination between them.

What becomes most apparent in reviewing the relationship between the BOS and military symbols is that while graphic symbols seem to fulfill a cybernetic function, they become most useful when linked to the time and space of the physical domain. Symbols assist the military planner in achieving purpose within temporal and spatial confines. The symbol may represent "who, what, or how" to the user, but it is only though interaction with space that it can represent "where." To represent "when" the symbol must be placed in the context of time, either with an accompanying alpha-numeric time designator or through the relative portrayal to the symbol's status at other moments in time. In this way, the tactical planner can portray images of his intended purpose by answering the question of "who, what, when, where, and how"; when viewed as a whole the "why" of the visual plan will often become apparent.

The "where" of a symbol is best expressed by its

position on a map. A map is not an environment in itself, but is instead a display designed to present an environment in its absence.[58] In effect, a map is a symbol designed to convey enough information about an environment to a user that he can effectively plan actions within that environment.[59] To the tactician, a map is a detailed playing field upon which he can arrange and order standardized symbols representing the tactical "players." To the operational artist, the map becomes a large canvas, with much less detail than found at the tactical level, upon which he could arrange symbols representing operational elements and functions.

Time, like space, is symbolically represented. Our precise measurement of time is merely a modern invention designed to provide order to life. Chronometers are merely calibrated symbolic representations of a naturally recurring phenomena, derived specifically from the rotation of the earth around the sun.[60] Through convention, we use a twenty-four hour day with each hour, minute, or second, symbolically representing a commonly held, yet abstract concept of a duration of time. By combining the symbolic representation of time with a map and a military graphic, we can more easily imagine and communicate innumerable concepts for organization of the battlefield.

The operational artist requires a symbol set which fits emerging doctrine and organizations, in addition to those available to the tactician in FM 101-5-1. Symbols

for the operational artist should support the operational operating systems (OOS) in a vein similar to the way that symbols in FM 101-5 support the BOS.[61] Because the operational artist designs campaigns within greater magnitudes of time and space than the tactician is accustomed to, his needs are different. Although the map scale is larger, and the time periods much greater, the operational artist uses graphic symbols for the same basic purposes as the tactician.

THEORY, HISTORY, AND PRACTICE OF OPERATIONAL SYMBOLS

Napoleon stated that strategy ("operational art" in contemporary parlance) is "the art of making use of time and space."[62] He was, in fact, the consummate operational artist endowed with an almost supernatural ability to synchronize time, space, and purpose in a campaign. Although Napoleon decentralized the organization of his Grande Armee, his command system remained an extremely centralized affair.[63] And despite a large general staff, "Napoleon's brain served as the Grande Armee's central information processing machine." It was in his mind that Napoleon visualized and combined ideas almost instantly to develop broad concepts, phase events, and synchronize efforts.

This idea of a "rapid and accurate decision based on the evaluation of time and space" was addressed by Clausewitz and termed "coup d'oeil."[64] Described as the

inner eye, "coup d'oeil" is further characterized by Clausewitz as "the quick recognition of truth that the mind would ordinarily miss or would perceive only after long study and reflection."[65] This ability to mentally imagine order and cohesion through the rapid intellectual processing of information was somewhat of a Napoleonic trait.

Perhaps one secret of Napoleon's "coup d'oeil" and ability to synchronize time, space and purpose was his topographer's use of maps and symbolic representations. We catch a glimpse of Napoleon's "innermost sanctuary of genius" in this passage:

> d'Albe was entrusted with the task of amending maps and the maintenance of a large daily situation chart, on which every formation was marked by pins of different colors...Bacler d'Albe undoubtedly helped the emperor in his planning to a very real degree. Together they would crawl over the surface of the map, pressing in more pins, and cursing or grunting when their hindquarters came into collision.[66]

The vital role and duties of Napoleon's Topographical Office chief, Bacler d'Albe, is surely attested to:

> ...the Emperor's first and last command on every day spent on campaign was "send for d'Albe."[67]

Napoleon's pins on maps and charts were, to him, visual tools representing things and concepts. d'Albe highlighted positions of rivers, maps, and frontiers with various colors to create Napoleon's operational canvas.[68] With creative imagination, Napoleon selected his line of operations, designated the enemy objective, and developed

broad concepts of operations and sustainment. Napoleon's "symbolic" pins, with their colored heads representing his army corps and those of the enemy, enabled him to plan on the operational canvas. Based on his visualization of the campaign through symbols of space and concepts, Napoleon then issued orders to his marshals.

A most celebrated and influential student of Napoleon's campaigns was Antoine Henri Jomini. He sought to uncover the underlying truths of operational art through the study of Napoleon's campaigns, but instead endowed us with a catalogue of the basic concepts of campaign design. Although often criticized for being excessively scientific or prescriptive, Jomini made a valuable contribution to the theory of war through his attempt to "establish the way men think about war."[69]

Jomini's Summary of the Art of War provides us with with numerous theoretical concepts which remain relevant to today's operational artist. These concepts are often expressed in geometrical terms - such as lines, points, or zones. These concepts allow the operational artist to visualize spatial relationships and should not be construed as being nothing but prescriptions for a rigid battlefield geometry. Jomini said that:

> A general who would expect to arrange his line of battle as regularly as upon paper or on the drill-ground would be greatly mistaken...[70]

Jomini's principle of the decisive point demonstrates the utility of his writings. His principle asserts that it

is imperative to maneuver the mass of an army so as to threaten the decisive points in a theater and then to hurl all available forces against a fraction of the enemy force defending those points.[71] While the principle may be subject to dispute, the concept of a decisive point that will provide a force with marked advantage over his opponent is priceless. This, in effect, translates to the mental image of some point which can be fixed spatially and temporally, with some associated purpose. Even though Jomini's actual **graphic** symbols may be limited to depictions of order of battle formations, his contribution to our attempt to portray elements of operational design is immense. We'll discuss more of Jomini's contributions later.

Clausewitz said,"historical examples clarify everything...and this is particularly true of the art of war."[72] But a difficulty arises when a dearth of information exists about some "minute" aspect of war. Attempting to find concrete, historical examples of graphic symbols used specifically at the operational level is akin to searching for the fountain of youth. Nevertheless, we can find some pertinent lessons in the historical practice of operational art.

The German army of the Second World War, well steeped in the traditions of Clausewitz, Moltke, and von Schlichting, developed a theory of operational art based on two elements: "blitzkrieg" and operational exploitation.[73]

This German theory of operational art was put to the test in Operations Yellow (France, 1940), Barbarossa (Russia, 1941), and Autumn Mist (Ardennes Offensive, 1944). The situation maps maintained by the operational level headquarters' (army high headquarters; OKH or OKW) provide us with useful insights. While a study of the actual planning maps would probably prove more beneficial, we are not fortunate enough to have them available.

The actual German General Staff situation maps from these campaigns are noticeably devoid of symbols which depict any conceptual matters. Units are depicted, sometimes down to the separate battalion level, with alpha-numeric designations and without any unit symbols attached. Army and division sectors are barely evident, and where marked seem to show specific delineation along the immediate fronts of the units only. Reserve unit and resupply area symbols are clearly posted as are rear area security responsibilities. Distinctively highlighted on these small-scale maps are main roads, railways, and occasionally the weather (written on the map). These maps do clearly and accurately present a "big picture" without becoming muddled in details extraneous to the planner.[74]

The reason for the Spartan appearance of the German maps is not for the lack of graphic symbols. The German repertoire of tactical military symbols was elaborate, and contained in excess of two thousand individual symbols. This number is not so astonishing, however, when we take

into account that this included army, air force and navy symbology; it was a "joint" symbols doctrine. Amazingly, there were no symbols which portrayed such concepts as "attack" or "screen." Perhaps this lack of conceptual or purpose-related symbology helps explain a corresponding lack of conceptual symbols applicable to the operational level.[75]

Like the Germans, the Soviets have long understood operational art. As a product of Marxist-Leninism, Soviet operational art presumes a scientific approach to war.[76] The Soviet laws of armed conflict are primarily concerned with materiel and force correlation, further attesting to their scientific approach to war. This scientific approach is also evident in the Soviet approach to operational graphic symbols.

Soviet operational level graphics take on the form of an engineering blueprint superimposed on a map. In contrast to the German maps, the Soviet maps appear extremely detailed and cluttered. The intent behind these comprehensive graphic plans is the "elimination of an accompanying written plan which takes on the dimensions of a telephone book."[77] Soviet operational graphic symbols maintain several commonalties with their tactical symbols; on a front level map, the tactical symbol for a tank (diamond) represents a tank division, and airfield symbols are "grouped" to form operational air defense zones in much the same way that artillery battalions are "grouped" to

form regimental artillery groups at the tactical level. Like the Germans, the Soviets also employ a joint graphics system, with the tactical symbol for a single fighter representing an air wing when placed on a front level map.[78]

Unlike the German examples though, the Soviets graphically portray several concepts on their operational maps. Soviet operational objectives ("zadacha" or missions) are portrayed as lines which indicate a depth to be achieved in the enemy rear, or they may be indicated by a "slashed goose egg" around the enemy force to be destroyed. Soviet graphics also depict attack axis' to be used in different phases of a major operation, and often relate time and space by including projected timelines (and phasing) along the top of a map. In most cases, the Soviets plan several variants, or branches of the operation to permit reaction to unexpected enemy response.[79]

From German simplicity to Soviet complexity, modern operational artists depend on maps and symbols to visualize the conduct of a campaign in much the same way as did Napoleon. Today's operational artist applies concepts similar to those defined by Jomini, to produce and communicate a plan in many of the same ways as did Napoleon. There is much to be garnered from these examples: the ability to symbolically represent the theater; the integration of principles or concepts with symbols on the map; the need to plan campaigns on a large

scale and not "down in the weeds"; the suggestion of joint graphics; and a technique to portray time, space, and purpose relationships on a map.

EXISTING DOCTRINE RELATED TO OPERATIONAL GRAPHICS

For graphic operational symbols to be of any utility, they must be able to portray synchronization of time, space, and purpose across the campaign's entire theater; this will include activities on land and in the air, and most likely at sea. And since one of the tenets of a campaign is that it is "joint in nature," the accompanying graphics should be further applicable to all services.[80] This opens the door (and perhaps Pandora's box) for the creation of a joint graphics system similar to those, previously mentioned, of the Germans and Soviets.

While a level of divergence exists between the services about operational art and its constituent elements, the fielding of JCS Pub 3-0 (Test), Doctrine for Unified and Joint Operations indicates a trend toward some agreement.[81] This publication provides guidelines for planning and executing theater strategy, campaigns, and unified and joint operations. JCS Pub 3-0 even provides specific guidance to the Unified Command Commanders in Chief (CINCs) to organize for war by:

> consider(ing) **time and space available**, logistics considerations, and geographic, environmental, political, and economic...diversity of their theaters...to facilitate the efficient integration of the components while optimizing

> the capabilities of each service. (Emphasis added)[82]

As the keystone doctrine for directing, planning, and executing joint military operations, this manual breaks new ground for campaign planning. It specifically states that:

> campaign plans embody CINC visions of the series of operations necessary to attain strategic objectives...they do not supplant the established JOPES (Joint Operation Planning and Execution System). Rather they define the framework in which Operation Plans fit.[83]

In addition, JCS Pub 3-0 (Test) contains a campaign plan format which addresses a need for accompanying maps, charts, or other relevant documents. By including the definition of such concepts as operational art, center of gravity, and line(s) of operation, JCS Pub 3-0 (Test) seems to commend to CINCs the value in applying these concepts toward the synchronization of time, space, and purpose in developing campaign plans. It is difficult to envision doing this effectively without using graphics and a map.

The Army and the Marine Corps, wholeheartedly embracing the three levels of war and operational art, have doctrines which parallel the emphasis on operational art in JCS Pub 3-0(Test). The Army's manual, FM 100-5, Operations, provides useful guidance for theater commander's use in conducting campaigns. Likewise, FM 100-6, Large Unit Operations (Draft), provides yet more details and guidance for the development of theater campaign plans.[84] The Marine Corps' FMFM 1-1, Campaigning, also addresses several elements of campaign design and considerations for

conducting campaigns.[85] But no existing campaign doctrine goes beyond stylized graphics in pictorially conceptualizing these verbalized aspects of campaigning. Nowhere do we find any suggestion of graphic symbols which can assist the operational artist as they do the tactician.

At the service level, the Army and Marine Corps both make extensive use of a common tactical graphic symbol system, while the Air Force and Navy do not.[86] The graphic symbols used by the Air Force and Navy are relatively specialized to portray positional location for tactical air control systems or geographically restricted areas at sea or in the air.[87] A few graphics, such as air corridors, air axis, and selected unit symbols are shared in Army and Air Force multiservice publications.[88] But for the most part there is no existing system of comprehensive joint graphics at any level.

This lack of commonly understood graphic symbols becomes an even more significant liability to the operational artist when modern technology enters the C^4 equation. The World Wide Military Command and Control System (WWMCCS) Intercomputer Network (WIN) is a fast and secure message traffic system capable of transmitting orders and campaign plans anywhere in the world. Yet there is no standard system of graphics, despite comments by the former Joint Chiefs of Staff Director, J-6:

> Voice and text communications are too slow for many if not all C3I applications...automatic generated graphics and symbols will provide the

> capability to display information in meaningful and readily understandable presentations.[89]

In short, doctrine offers us no suite of graphic symbols for the operational artist, yet doctrine and technology are creating a greater need for them now than ever before. Not only must our graphics be clear, simple, and accurate, but to be truly useful they must be adaptable to the vast array of C^4 systems in existence.

OPERATIONAL GRAPHIC SYMBOLS

Semiotics, theory, and history indicate that it may be quite possible to portray the essential elements of operational design in a visual format. The best available precedent for the depiction of the graphic symbols is the array of symbols used at the tactical level. By taking all of our previous considerations and analysis into account, we can attempt to develop graphics and symbols which benefit the operational artist.

The first tenet of a campaign follows Napoleon's first principle of campaigning that "the ultimate objective must be clear from the start."[90] The operational artist determines the "ultimate objective" of the campaign through an analysis of the strategic aim and determination of the military conditions which will lead to attainment of the strategic aim. Realization of the military conditions is expected to lead to the established strategic military aim, and therefore becomes the campaign (operational) objective.

Visual depiction of the campaign objective is difficult because of the many forms that the military conditions may take. While in a conventional conflict the strategic aims will likely translate into the military condition of defeating an enemy force, there are cases where the military conditions may be defined as control of geography, protection of specified facilities, curbing enemy influence and aggression, or diverting enemy resources from other areas.[91] Because of the disparate conditions that may be required, we must develop several symbolic representations.

The military conditions, or objective of the campaign can normally be portrayed on the map, as it will be achieved at or near some geographic location within the theater. Destruction of enemy forces is most easily depicted in a somewhat analogous manner to the tactical graphic symbol for an objective: a bold irregular line ("goose-egg") enclosing the symbol of the enemy force(s) to be destroyed. Destruction is then symbolized by drawing an "X" through the "goose-egg," therefore highlighting the requirement to destroy the enemy force.[92](Appendix A, figure 1) Some military conditions may not call for destruction of enemy forces and can be depicted by drawing a dashed "X" through the "objective" symbol.(App.A, fig.2) Control of terrain or facilities can be similarly depicted with the "goose-egg" around the principle area.(App.A, fig.3)

Limiting influence or aggression, maintenance of

borders, or providing deterrence may be best visualized with a bold line and an alpha-numeric indication of the objective to be achieved. (App. A, fig. 4) These may be statements such as "**prevent incursion** below this line; **limit** red **influence** east of this line; or **restore** this border." In any case, the campaign objective(s) or military conditions should be clearly indicated as a primary component of any graphic depiction.

Closely related to achievement of military conditions is "orientation on the center of gravity," as described in the third tenet. As seen earlier, the center of gravity may be an elusive concept to precisely define; nonetheless, the analysis which leads to its identification is critical to mission accomplishment.[33] For purposes of our graphic visualization of a campaign, we will apply the following definition:

> ...at the strategic level, the enemy center of gravity [may be seen] in complex and abstract forms, such as alliance solidarity or national will. At the operational level of war...likely focus is upon a concrete center of gravity-main enemy forces.[34]

FM 100-5 specifically cites the center of gravity as the "key to all operational design."[35] It further states that concentrating superior strength against the center of gravity is essential. For this reason, the center of gravity must be located in space, and relocated in both time and space if it should change. Represented as a circular shape "balanced on its center of gravity," and

metaphorically alluding to a "key-hole," our center of gravity symbol is also darkened in to emphasize its critical role in campaign design. (App. A, fig. 5) It may or may not be co-located with the campaign objective, and in the case of a "soft" non-spatial center of gravity, such as popular-will, it would be graphically portrayed as near as possible to the suspected source of psychological strength and then alpha-numerically annotated. (App. A, fig. 6)

Broad concepts require lines of operation and lines of sustainment. Jomini defined lines of operations as "those of an army acting from the frontier when it is not subdivided into large independent bodies...and includes all armies not widely separated in space and for long intervals of time."[36] In effect lines of operations are broad axes along which armies maneuver and fight, and are likely to contain multiple tactical thrusts. JCS Pub 3-0 (Test) defines lines of operations as:

> The directional orientation of a force in relation to the enemy. Line(s) of operation connect the force with its base(s) of operation and its objective.[37]

Lines of communication are defined in FM 101-5-1 as:

> All the routes (land, water, and air) that connect an operating force with one or more bases of operations and along which supplies and military forces move.[38]

Both lines of operations and lines of communication, which may overlap or be one in the same, will be relatively broad expanses on the operational artist's canvas. Taking a cue from the Soviets and using tactical symbols on a

grander scale, lines of operation and communication can be depicted similarly to tactical "axis of advance" arrows, and alpha-numerically labeled as "LOPNS" or "LOC". (App. A, fig. 7) Because these concepts are presented on a theater-level map (or sketch), there should be no confusion with similar tactical graphics. Tactical axis, if depicted on the same graphic, are labelled "AXIS ___" with an appropriate name or unit designation; and, of course, the thrusts of tactical axis will be narrower and reside within the line of operations.

Broad campaign concepts and ensuing tasks are further conceived and communicated using bases of operations. The base of operations, as defined by Jomini, is:

> the portion of the country form which the army obtains its reinforcements and resources, from which it starts when it takes the offensive, to which it retreats when necessary, and by which it is supported when it takes position to cover the country defensively."[99]

In effect, the base of operations is equivalent to the theater of operations communications zone and is therefore designated alpha-numerically as "COMMZ" within its linear geographic limits. (App. A, fig. 8)

Also applicable to the broad sustainment concept and development of phases is the culminating point. Clausewitz stated that it is "important to calculate the culminating point" to avoid overextension and defeat.[100] The culminating point is some abstract locus in time and space, beyond which a force cannot physically or morally sustain

itself to maintain the initiative. It is an admittedly difficult task for the operational artist to anticipate the time and place where the culminating point will occur. This may be done through complex battle calculus or merely by intuition, but however formulated it remains key to operations, sustainment, and phasing.

As culminating points (friendly or enemy) will likely be conceptually predicted within the constraints of time and space, they can therefore be indicated on the map (though not with exacting certitude). A culminating point can be depicted as a circle containing a "squiggly" vertical line which represents the break in initiative. If depicted in a linear fashion, it can merely be a "squiggly" line. Alpha-numeric labeling can remain optional, as it closely resembles no other tactical symbol. (App. A, fig. 9)

To avoid reaching a culminating point, the operational artist may elect to plan an operational pause. In essence, an operational pause is a deliberate cessation of actions without losing the initiative, to preempt possible culmination or to allow for generation of additional combat power. A pause may be graphically depicted as a point in time and space on a map or timeline. Our symbol can be a square with an "X" inside, the top triangle darkened in so that it symbolically resembles an hour glass with all of the sand held in its top compartment- a symbollic cessation of the passage of time. (App. A, fig. 10)

Concepts are refined, synchronized, and broken into

tasks for subordinates through use of decisive points, objective points, and pivots of maneuver. Decisive points are any objectives that provide a force with marked advantage over the enemy, whether physical, cybernetic, or moral.[191] Physical decisive points may be operationally key terrain, urban-industrial areas, or military units. Cybernetic decisive points are key C^3 nodes and moral decisive points refer to anything that may sustain morale-which can be physical points such as religious or cultural shrines. Because the vast majority of these points can be geographically located, and are closely related with the center of gravity concept, they may be graphically located with a rectangle containing our center of gravity symbol. To further differentiate from the center of gravity symbol, the figure should not be darkened in. (App. A, fig. 11)

Objective points are merely decisive points which the operational artist deems must be seized or retained.[192] They may simply be indicated with the addition of the letters "OBJ" placed at the base of the triangle in the decisive point symbol. (App. A, fig. 12)

Pivots of maneuver are essentially decisive points which contribute to sustainment of the initiative. The operational artist identifies these for seizure to ensure maintenance of momentum.[193] Related to decisive points, it is logical to use the decisive point symbol with the letters "MVR" placed below the base of the triangle. (App. A, fig. 13)

The fourth tenet, phasing, requires organization of the campaign into manageable parts which are distinguishable from each other, like guideposts.[104] Following the Soviet example, graphic depiction of phases on a map can be accomplished by superimposing a timeline parallel to the primary line of operations. This serves to establish a temporal-spatial relationship in much the same way as drawing a high school time-distance algebra problem. Phases are indicated on the timeline with their starting and ending points alpha-numerically indicated, whether the phase transitions are marked by time, space, activity, or goal achievement. (App. A, fig. 14) Additionally, each phase should be labeled with a "title" that specifically characterizes that segment of time or space. We must recognize that occasionally creativity will be needed to relate timelines and phasing to the map-based environmental representation.

Branches and sequels, like phasing, enable the operational artist to create flexibility while establishing an "orderly schedule of military decisions."[105] Helmut von Moltke described branches as variations on the main theme of the concept which allow for freedom of action to be maintained. Branches are simply options (contingency or outline plans) for shifting lines of operation and accepting or declining tactical battle while retaining the same objective. Implementation of a branch is obviously tied to a decision made by the operational artist.

The decision to execute a branch is based on indications of an event occurring at some point in time and space, therefore permitting that point to be graphically depicted on a map or related timeline. This decision point is linked to intelligence collection activities and assists the commander in executing decisions early enough to have the desired effect on the campaign. The decision point should be represented by a "star" symbol containing an alpha-numeric designator, which is the conventional graphic used convention at the tactical level. This decision point graphic is then related to a separate matrix which spells out which events cue specific branches.[106] (App. A, fig. 15) The branch, whether graphically depicted with dotted lines, on a separate map or chart, or with another color, should be clearly labeled with the corresponding alpha-numeric designator of the decision point which prompts its initiation. (App. A, fig. 16)

Sequels are general ideas of what the operational artist "might do next," given a certain outcome.[107] Like branches, sequels are conceived and planned in advance, but they require somewhat more anticipation and conjecture on the part of the planner. Sequels are prompted by battle outcome and spell-out how success may be exploited or setbacks minimized. As with branches, they require decisions and can be similarly depicted through linkage between the map, timeline, and decision point "star" symbols. (App. A, fig. 17) Because a sequel is prompted by

battle outcome and will likely be based on revised or new campaign objectives, the decision point "star" for the sequel will probably be positioned contiguous to the initial campaign objective graphic. The sequel is then best expressed as a separate graphic; a follow-on to the initial campaign representation.

Constraints- actions that must be done, and restraints- actions that cannot be done, may exist which inhibit the operational artist's freedom of action. These must be portrayed in time and space, as applicable, and communicated as restrictions in tasks to subordinates. Constraints usually refer to actions related to elements such as objective points, pivots of maneuver, or graphic control measures. But restraints may refer to such items as "nuclear-free zones," fire control measures, or boundaries which may not be violated. In these cases, restraints may be simply depicted as lines (boundaries) or areas consisting of cross-hatched diagonals in a periphery represented on a map or chart. (App. A, fig. 18) Alpha-numerics must be added concisely defining the restriction and delineating any pertinent temporal period. When controlling operational fires, the existing "tactical" restrictive measure symbols seem adequate.[108]

Occasionally the operational artist may want to graphically depict limitations imposed on the campaign by logistics. This is easily accomplished through the use of decision or "effectiveness" graphics similar to those in FM

101-5-1 or through the creation of "gumball" situation reports as employed with the Army Maneuver Control System software. These symbolic representations need not be spatially associated on the map, but do provide effective visual displays of logistic constraints.(App.A, fig.19)

Other graphic control measures should be limited to those essential to the campaign. Several graphic control measures now used by the services apply to the operational level, and they express appropriate concepts with clarity, simplicity, and accuracy. But a significant shortcoming exists in the graphic boundary differentiation between a theater of war- typically a unified command directed toward attainment of a major political goal, and a theater of operations- typically a geographical division of a theater of war directed toward attainment of a major portion of the war plan.[108] This can easily be overcome by drawing boundaries around each theater, using the four circles which depict theater army level to also represent the boundary of the theater of operation; the theater of war, commanded by a CINC, may then be represented by five circles denoting this "highest-level" boundary.[109] (App.A, fig.20) In contingency operations which do not employ a theater army organization, the theater of war boundary symbol would not change, but the theater of operations boundary designator may become that of the command echelon of the Joint Task Force (JTF) or other headquarters' commander.(App.A, fig. 21)

The fifth tenet is composition of subordinate forces and designation of command relationships. This graphic requires minimal attention, as the standard line-diagram is sufficient, and absolutely necessary, at the operational level. Assorted matrices and alpha-numeric symbols are already available to assist in this endeavor. (App. A, fig. 22)

The seventh tenet is synchronization of joint forces. Of over eighty existing or developing joint doctrine publications, none specifically addresses a system of joint operational graphics. The operational artist currently lacks doctrine with sufficient standardized symbols to represent all forces in his time, space, and purpose picture.[11]

FM 100-5-1 and Appendix C to FMFM 3-1 present a rudimentary beginning for graphic depiction of joint elements. Tactical symbols in both manuals represent selected Air Force and Marine aircraft and their associated units. Combined with the existing guidelines for tactical graphic symbols these can easily be developed into meaningful symbols for all Air Force elements. It follows that naval aviation could then be similarly represented. The geometric symbol for a "unit," the rectangle, could be applied to every type service element; a filled-in "round-tipped airplane propeller" in the rectangle could always denote Air Force (to distinguish from the Marine Corps "propeller" which is not filled-in) with an alpha-

numeric system depicting the identification and primary function of air forces, aircraft divisions, wings, or squadrons. (Appendix A, figure 23) Navy units could be represented with an "anchor" symbol in the rectangle or close beside. Like the alpha-numeric system of the aviation units, naval fleets, task forces, task groups, units, or elements would be readily identified as to type element and composition. (App. A, fig. 24) For all units, the size indicator would equate to those now used by the Army and Marine Corps; for example, a double "X" would represent an Army or Air Force division, a Marine Expeditionary Force, or a naval task group. This standardization would significantly enhance symbol interoperability and usefulness.

CONCLUSIONS

Clausewitz proclaimed that "the equation of time and space does underlie everything else and is, so to speak, the daily bread of strategy."[12] To help "solve" the equation of time and space, the operational artist can turn to symbols. The availability of the map and the timepiece provide two-thirds of this equation, while graphic symbols of unique operational elements involved can provide the third.

Through the preceding application of theory, semiotics, and examples we were able to develop an initial suite of graphic symbols which meet our tests for clarity,

simplicity, and accuracy. Each graphic visualization is based on the semiotic principles we established and withstood rigorous testing. (Appendix B) Symbol development further capitalized on lessons garnered from the practice of other operational artists. And each symbol was based on a perceived requirement stemming from the seven tenets of campaigning, therefore demonstrating that there is significant usefulness to the operational artist.

Although we can depict the essential elements of operational art clearly, simply, and accurately with symbols, their true universal applicability remains to be tested. These symbols are only as useful as the concepts they invoke, and a guaranteed utility across the entire spectrum of conflict may be a bit presumptuous. They will prove their worth only if they can help the operational commander "see the battlefield, communicate intent, and synchronize the campaign."[13] But the true determination will result from practical application in exercises, planning, and war. Nonetheless, this study is only a beginning and work in this direction should continue because:

> A **visual display** is by far the quickest and most effective way of presenting information. A **symbol** can tell more in a moment than many lines of writing...the near ideal is a digital symbol display superimposed on a survey map. It is well within the state-of-the-art technology today.[14]

We can eventually develop and agree on those symbols for the operational artist, but it is up to the operational

artist to employ the symbols with imagination and creativity to envision, develop, and communicate successful campaign plans.

APPENDIX A
Operational Graphics Figures

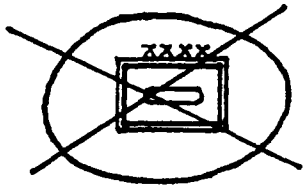


Figure 1. Military condition or objective. Destruction of enemy force(s).

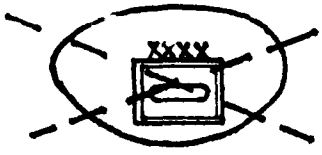


Figure 2. Military condition or objective. Action on enemy forces not requiring destruction as in diversion of resources from another theater or "tying-up" enemy forces to preclude use elsewhere.

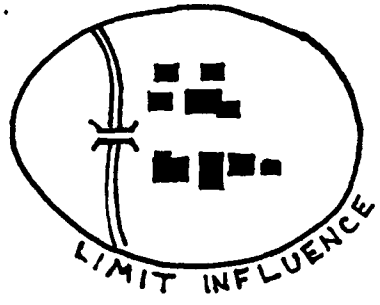


Figure 3. Military conditions or objective. Control of terrain or facilities. (with alphanumerics)

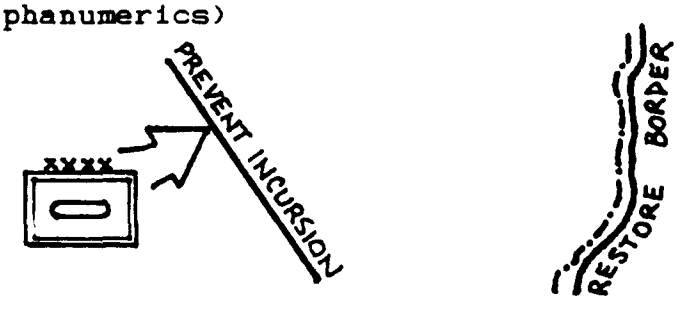


Figure 4. Military conditions or objective. Maintenance of borders, limiting aggression, or providing deterrence. (with alphanumerics)

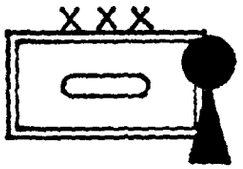


Figure 5. The center of gravity. The "key" to operational design.

Figure 6. Center of gravity depiction for "soft" centers of gravity. (with alphanumerics)

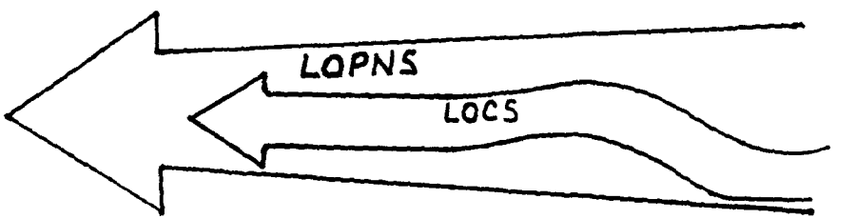


Figure 7. Line of operations, "LOPNS" and lines of communications/sustainment, "LOCS." Similar to tactical axis symbol.

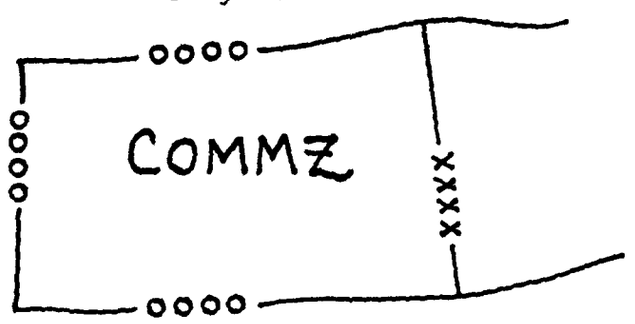


Figure 8. Base of operations, "COMMZ."

Figure 9. Culmination point(s). Similar to "electrical resistance" or tactical "bypass difficult" symbols.

Figure 10. Operational pause. Metaphorical "hourglass" with a "cessation of time."

Figure 11. Decisive points. Ways to get to the center of gravity. Short line may be added to indicate specific point.

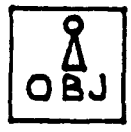


Figure 12. Objective points. A subset of Decisive point.

Figure 13. Pivots of maneuver. A subset of decisive point.

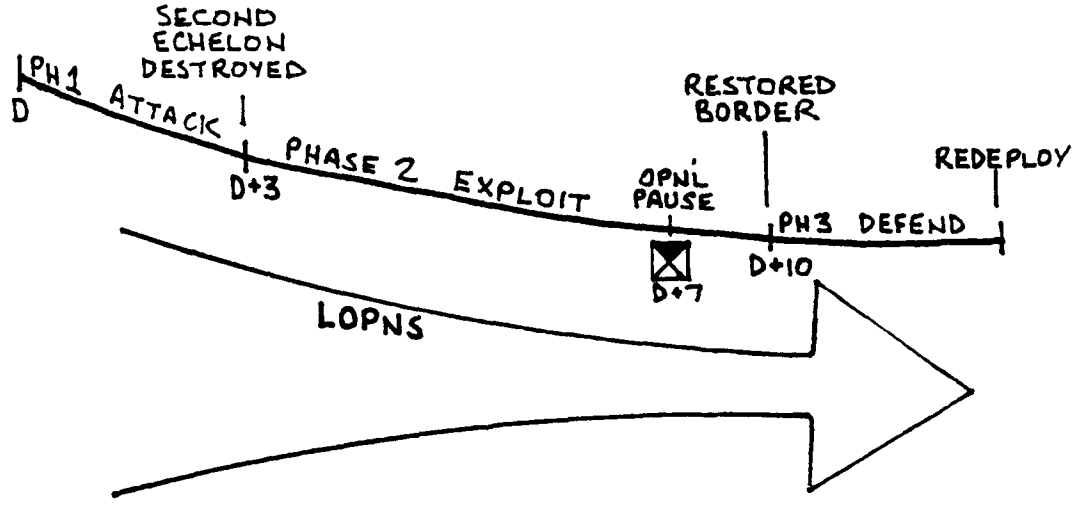


Figure 14. Phasing by use of a timeline parallel to the line of operations.

DECISION SPT MATRIX

DP	BRANCH
1	
2	
3	
4	

Figure 15. Decision points for branches and sequels. Linked to a decision support matrix.

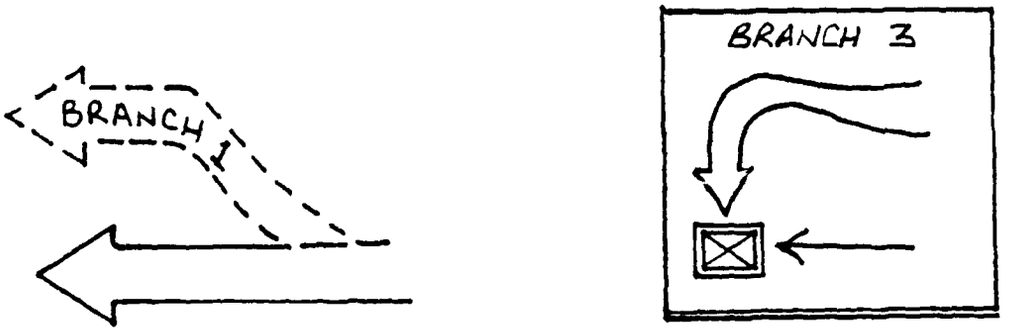


Figure 16. Depiction of a branch by dotted lines or on a separate map or chart.

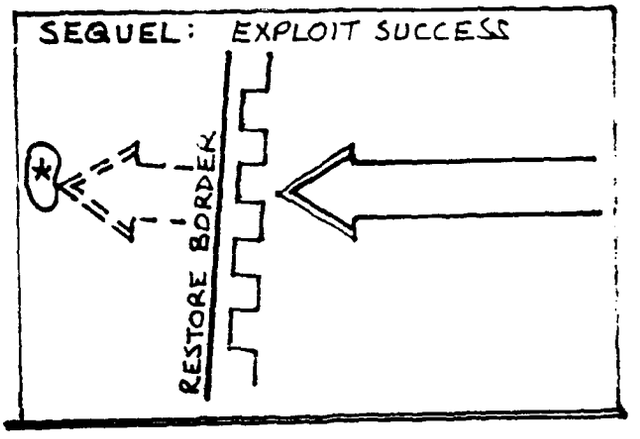


Figure 17. Depiction of a sequel on a separate map or chart.

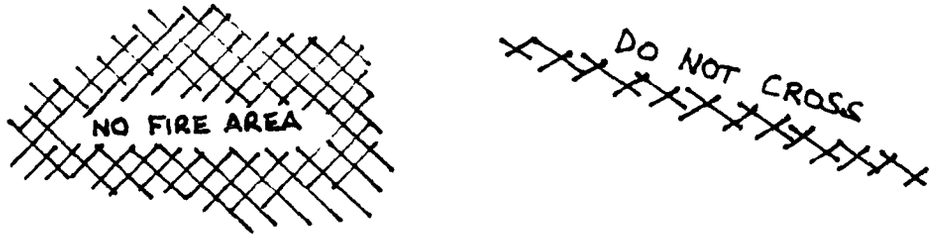


Figure 18. Restraints.

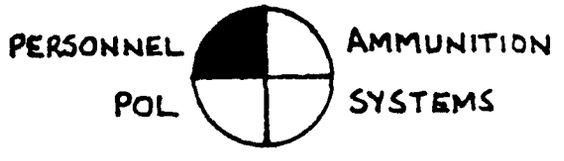


Figure 19. Limitations. Effectiveness, or decision graphics.

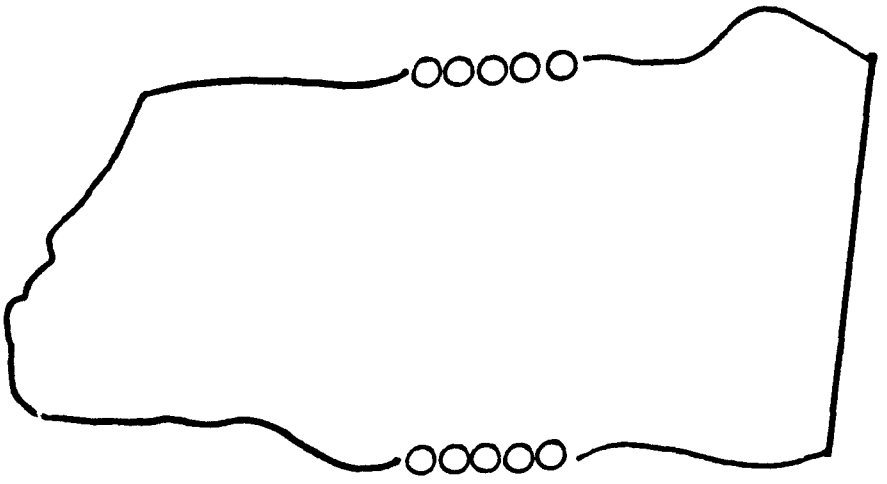


Figure 20. Theater of war.

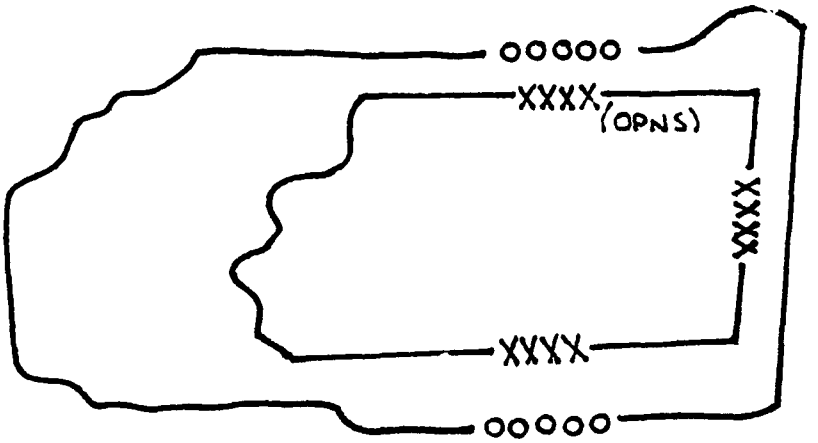


Figure 21. Theater of operations.

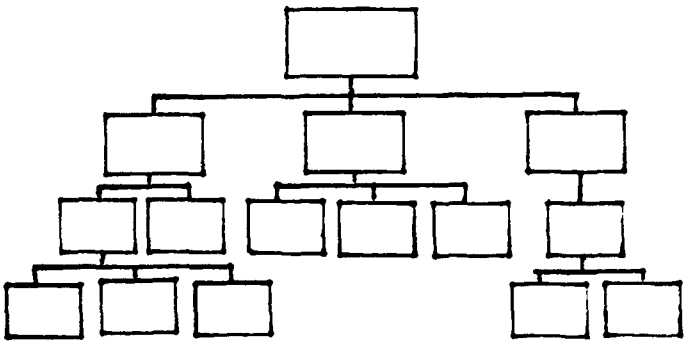
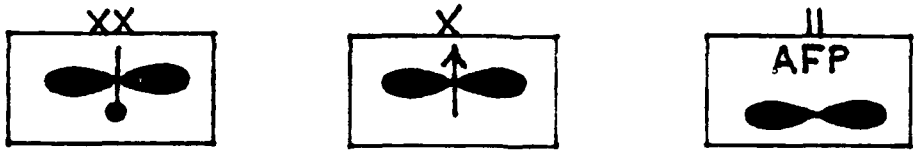


Figure 22. Standard organizational line diagram for designation of command relationships.



Bomber Division | Fighter Wing | Attack/Fighter Recon SQDN

Figure 23. Air force "type" symbols.

Carrier Task Group | Amphibious Element

Figure 24. Navy "type" symbols.

Appendix B. Operational Graphics Criteria Review.

ELEMENTS OF OPN' L DESIGN	CLARITY Closure	CLARITY Continuity	CLARITY Unity	SIMPLICITY Min. Primitives	ACCURACY Distinct	ALPHANUMERIC ENHANCED	METAPHOR ASSIST	USEFUL Element?
1. Military Condition	Note 1	Yes	Yes	Yes	Note 1	Note 1	Yes	Yes
2. Military Condition (Not destr. of enemy)	Note 2	Yes	Yes	Yes	Note 2	Note 2	Yes	Yes
3. Military Condition (Terrain control)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Military Condition (Limit or deter)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Center of Gravity	Yes	Yes	Yes	Yes	Yes	Yes As Required	Yes	Yes
6. Center of Gravity ("Soft")	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Line of Opns Line of Comm	Yes	Yes	Yes	Yes	Note 3	Yes	Yes	Yes
8. Base of Opns	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Culmination Point/Line	Yes	Yes	Yes	Note 4	Yes	As Required	Yes	Yes
10. Operational Pause	Yes	Yes	Yes	Yes	Yes	As Required	Yes	Yes
11. Decisive Point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix B. Operational Graphics Criteria Review (continued)

ELEMENTS OF OPN' L DESIGN	CLARITY Closure	CLARITY Continuity	CLARITY Unity	SIMPLICITY Min. Primitives	ACCURACY Distinct	ALPHANUMERIC Enhanced	METAPHOR Assist	USEFUL Element
12. Objective Point	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13. Pivot of Maneuver	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14. Phasing by Timeline	N/A	Yes	Yes	Yes	Common Use Graphic	Yes	N/A	Yes
15. Decision Pt.	Yes	Yes	Yes	Yes	Yes	Yes	Note 5	Yes
16. Branch	N/A - Several Figures Used			Yes	Yes	Yes	N/A	Yes
17. Sequel	N/A - Several Figures Used			Yes	Yes	Yes	N/A	Yes
18. Restraints	Yes	Yes	Yes	Yes	Yes	Yes	Note 6	Yes
19. Limitations	Yes	Yes	Yes	Yes	Common Use Graphic	Yes	Note 7	Yes
20. Theater of War	Yes	Yes	Yes	Yes	Yes	Yes	Note 8	Yes
21. Theater of Operations	Yes	Yes	Yes	Yes	Yes	Yes	Note 9	Yes
22. Organization Diagram	Yes	Yes	Yes	Yes	Common Use Graphic	Yes	N/A	Yes
23. Air Force Symbols	Yes	Yes	Yes	Yes	Yes FM 101-5-1	Yes	Yes Propeller	Yes
24. Naval Symbol	Yes	Yes	Yes	Yes	Yes FM 101-5-1	Yes	Yes Anchor	Yes

NOTES: See next page

Note 1. Military condition which requires destruction of enemy force(s) or facility. Symbol closure is not fully achieved due to the "ends" of the "X" overlapping the perimeter of the shape enclosing enemy force(s) or facility symbol. This does, however, draw attention to the "X" due to symbol continuity. This attention highlights the destruction requirement. Accuracy may be slightly diminished because this resembles a tactical objective to some degree, but this is compensated for by the same resemblance (i.e. the campaign "objective"). Alphanumerics can be used to enhance this graphic, but should be kept to a minimum.

Note 2. See note 1, above. Alphanumeric enhancement may be more necessary in this symbol to indicate the effect desired, but should also be kept to a minimum so as not to forfeit simplicity.

Note 3. Line of Operations and Line of Communications/Sustainment resemble the tactical "axis" symbol. Accuracy should not be a problem because of the relative size of the operational symbols versus those that would be used at the tactical level. In addition, tactical symbols applied would reside within the operational symbols. Alphanumeric enhancement of these operational symbols is a requirement.

Note 4. The "squiggly" line of the culmination symbol should be considered as a single primitive shape; a randomly drawn line metaphorically invoking an image of interruption.

Note 5. The decision point, represented by a "star" shape, is identical to that used tactically in accordance with FM 34-130. In addition, a "star" shape alludes to the importance of the decision point in the overall plan. This is related to a matrix and alphanumerically enhanced

Note 6. The restraint symbol is similar to that used at the tactical level, but requires alphanumeric enhancement. Cross-hatching invokes an image of an area which should be avoided.

Note 7. The limitation symbols are identical to those used for tactical planning and execution.

Note 8. The theater of war symbol is developed with existing symbology as its basis. This symbol builds on those available in FM 101-5-1. It can be alphanumerically enhanced for clarity.

Note 9. The theater of operations symbol is directly related to existing symbols in FM 101-5-1. It may be alphanumerically enhanced with the letters "JTF" or other organization as appropriate.

ENDNOTES

1. This ancient Chinese proverb is essentially the foundation of the thesis tested by this research effort. The Russian writer Ivan Turgenev wrote, in Fathers and Sons: "A picture shows me at a glance what it takes dozens of pages of a book to expound." James Rogers, Dictionary of Cliches (New York, NY: Facts on File Publishing, 1985), 196.

2. A.M. Zarem, Dictionary of Electronic Abbreviations, Signs, and Symbols (New York, NY: Western, 1965), ix.

3. Carl von Clausewitz, On War, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton Univ. Press, 1984), 149. Clausewitz endeavors to prove that war is more than an art or a science, and he categorizes war as an act of human intercourse...a clash between wills. He does state, however, that war is more an art than a science because art requires creative ability while science is merely knowledge.

4. John Winthrop Hackett, The Profession of Arms (Washington, DC: Center of Military History Reprint, 1990), 3. Hackett states that in some respects, the military profession resembles medicine or law.

5. Clausewitz, On War, 149. Clausewitz affirmed that war has "its grammar indeed...but not its own logic."

6. Department of the Army, TRADOC Pam 11-9, Blueprint of the Battlefield (Fort Monroe, VA: Army Training and Doctrine Command, 1990). The "Blueprint" is actually a tool that provides a basis for describing Army requirements, capabilities, and combat activities at the three levels of war. The selection of the term "Blueprint" is an excellent metaphor.

7. The term "operational" in this usage, refers to a level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operation. Activities at this level link strategy and tactics by establishing operational objectives needed to accomplish the strategic objectives, initiating actions, and applying resources to bring about and sustain these events. Joint Chiefs of Staff, JCS Pub 3-0 (Test), Doctrine for Unified and Joint Operations (Washington, DC: Joint Doctrine and Allied Interoperability Division, 1990) xiii. This is cited later in the text.

8. L.D. Holder, "A New Day for Operational Art," Army (March, 1985): 22. Holder presents a concise evolution of

operational art.

9. Department of the Army, Field Manual 101-5-1, Operational Terms and Graphics (Washington, DC: US Army). In this title, the term "operational" is better defined as that definition found in a standard dictionary, and does not refer to a level of war. Webster's New Collegiate Dictionary (Springfield, MA: Merriam Webster, 1979).

10. Richard E. Simpkin, Race to the Swift: Thoughts on Twenty-First Century Warfare (McLean, VA: Pergamon-Brassey's International, 1985), 240. Simpkin highlights these four elements as the items to be controlled by operation orders.

11. Holder, 24. Holder asserts that when dealing with land warfare, the operational level of war is "inescapably a joint activity."

12. To "elucubrate" is exactly the correct term. It means to work out or express by studious effort. Webster's New Collegiate Dictionary, p.366.

13. JCS Pub (Test) 3-0, xiii.

14. Joint Chiefs of Staff, JCS Pub 1-02, Department of Defense Dictionary of Military and Associated Terms (Washington, DC: US Government Printing Office, 1989), 60.

15. William W. Mendel and Floyd T. Banks, "Campaign Planning: Getting It Straight," Parameters, vol.XVIII, no. 3 (September, 1988), 45. William R. Williamson, "Campaign Planning," Parameters, vol. XIV, no. 4 (Winter 1984),25.

16. William W. Mendel and Floyd T. Banks, Campaign Planning (Carlisle Barracks, PA: USAWC Strategic Studies Institute, 1988) and JCS Pub 3-0 (Test), op cit.

17. Mendel and Banks, "Campaign Planning: Getting It Straight," 46. These same tenets appear with minor, if any modifications, in JCS Pub 3-0 (Test) and Mendel and Banks Campaign Planning. In addition, they appear in a preliminary draft of Department of the Army, FM 100-7, The Army in Theater Operations (Fort Monroe, VA: TRADOC, August, 1990).

18. Clausewitz, On War, 584. "Theory demands that at the outset of a war its character and scope should be determined on the basis of the political probabilities."

19. Department of the Army, Field Manual 100-5, Operations (Washington, DC: US Army, 1986), 10.

20. US Army Command and General Staff College, Field Manual 100-6, Large Unit Operations (Coordinating Draft) (Fort Leavenworth, KS: US Army C&SC, 1987), 3-1.

21. US Marine Corps, FMFM 1-1, Campaigning (Washington, DC: Department of the Navy, 1990), 40-41. This manual quotes Eisenhower,"These phases of a plan do not comprise rigid instructions, they are merely guideposts."

22. Mendel and Banks, "Campaign Planning: Getting It Straight," 45.

23. Ibid, 45-46.

24. FM 100-5, Operations, 30-31.

25. Clausewitz, On War, pp. 248, 260, 285-286. Clausewitz treats the concept of a center of gravity several times. He also infers that the cohesion of a force produces a center of gravity, and describes a "great battle" as the provisional center of gravity." He further states that all effort should be focused on the center of gravity, leading to its occasional reference as "schwerpunkt."

26. Ibid, 595-596.

27. JCS Pub 3-0 (Test), ix. This definition is slated for inclusion in JCS Pub 1-02. This general definition, like that in FM 100-5, is widely open to interpretation.

28. James J. Schneider, "The Theory of Operational Art," Theoretical Paper No. 3 (Fort Leavenworth, KS: School of Advanced Military Studies, 1990), 27.

29. Mendel and Banks, Campaign Planning, 7.

30. JCS Pub 3-0 (Test). Several factors for force structuring are addressed throughout the publication.

31. John H. Cushman, Sr., Command and Control of Theater Forces (Cambridge, MA: Program on Information Resources Policy, 1990), 57. The two ways of establishing theater command and control relationships may also be combined in some manner.

32. Martin Van Creveld, Command In War (Cambridge, MA: Harvard Press, 1985), 262. This is Van Creveld's definition of a command and control system.

33. US House of Representatives , Goldwater-Nichols Department of Defense Reorganization Act of 1986, Report 99-824 (Washington, DC: 99th Congress USGPO), Sec 164(c).

34. Cushman, Command and Control of Theater Forces, 29.

35. Henry Dreyfuss, Symbol Sourcebook (New York, NY: McGraw-Hill, 1972) 18-22.

36. Webster's New Collegiate Dictionary, 1172. J. Cumming, Sign and Symbol (New York, NY: Herder and Herder, 1972), 217.

37. Zarem, DEASS.

38. Robert M. Gagne ed., Instructional Technology: Foundations (Hillsdale, NJ: Lawrence Erlbaum Associates, 1987), 242. Several studies have proven that pictures can significantly increase learning over what is learned from a verbal display alone.

39. Ibid, 242. Pictures and words can be reciprocally beneficial, captions guide what is learned from a picture or graphic.

40. John C. Ball and Francis C. Byrnes, ed., Research, Principles, and Practices in Visual Communication (Washington, DC: National Education Association, 1960), 19.

41. Ibid, 119.

42. Beverly G. Knapp, "Symbology Sourcebook for Military Applications" (Alexandria, VA: Army Research Institute, 1986), 7. This research note provides an up-to-date reference for all available U.S. military symbols at the time of its publication. It included all symbols in the database of TACSYM and provided synopsis of several methods used to determine symbol preference and effectiveness. No symbols expressed the elements of operational art.

43. Ralph E. Geiselman, Betty M. Landee, and Francois G. Christen, "Perceptual Discriminability as a Basis for Selecting Military Symbols" (Woodland Hills, CA: Perceptronics, 1985), 3-4.

44. Ibid, 7.

45. Jon J. Fallesen and Helen V. Lewis, "Human Factors Guidelines for Command and Control Systems: Battlefield and Decision Graphics Guidelines" (Fort Leavenworth, KS: Army Research Institute, 1989), 86.

46. Ibid, 86.

47. Geiselman, Landee, and Christen, "Perceptual Discriminability...," 14.

48. Michael N. Hawrylak and Jeffrey W. Miller, "Enhanced Tactical Symbology for Command and Control of Ground Forces," Thesis, Naval Postgraduate School, Monterey,CA, (1985), 29.

49. Fallesen and Lewis, "Human Factors Guidelines for Command and Control Systems...," 24.

50. John K. Schmidt," An Annotated Bibliography on Tactical Map Display Symbology" (Aberdeen, MD: US Army Human Engineering Laboratory, 1989),76. and Hawrylak and Miller, "Enhanced Tactical Symbology for Command and Control of Ground Forces," 22.

51. FM 101-5-1, Operational Terms and Graphics. The guidelines for symbols are stated as clear, simple, and uniformity in FM 101-5-1, 2-1.

52. FM 100-5, Operations, states "synchronization is the arrangement of time, space, and purpose to produce maximum relative combat power at the decisive point, p. 17.

53. Ibid, 17.

54. Ibid, 17.

55. Department of the Army, FM 21-30, Conventional Signs, Military Symbols, and Abbreviations (Washington, DC: Department of the Army, 1961) and Department of the Army, FM 21-30, Conventional Signs, Military Symbols, and Abbreviations (Washington, DC: Department of the Army, 1965). FM 21-30 went through no less than seven updates between 1939 and 1970. While the 1961 version contained symbols for vessels and was stated to apply to the Air Force and Navy Civil Engineer Corps, these features are dropped from the 1965 update. North Atlantic Treaty Organization (NATO), STANAG 2019, Military Symbols (October, 1962) established a standard military symbology to be applied within the NATO coalition thereby improving interoperability of multi-national army organizations.

56. US Army Command and General Staff College, Student Text 100-9, The Command Estimate (Fort Leavenworth, KS: USA C&GSC, 1989). A procedure is spelled out to properly depict courses of action in pictorial form.

57. TRADOC Pam 11-9, Blueprint of the Battlefield.

58. Gershon Weltman, Maps: A Guide to Innovative Design (Woodland Hills, CA: Perceptronics, 1979), 8. and R. Down and D. Stea, eds., Image and Environment (Chicago, IL: Aldine, 1973). There also exists different abilities between different people to obtain information from these

representations we call maps. This is because maps are not "true to life," but are selective representations that actually can distort reality.

59. Daniel J. Boorstin, The Discoverers (New York, NY: Random House, 1983) 219. The introduction of the magnetic compass in the twelfth century had profound influence on man's ability to match his crude map to the environment. It was not until triangulation was learned in the eighteenth century that man could refine his mapmaking skills and derive great benefits. Weltman, Maps, 9.

60. Boorstin, 4.

61. TRADOC Pam 11-9, Blueprint of the Battlefield, 12. The Operational Operating Systems (OOS) are somewhat different from the BOS and require different graphics to portray different concepts. The OOS are operational movement and maneuver; operational fires; operational protection; operational command and control; operational intelligence; operational support. An example of an operational operating system that requires special graphic portrayal is the subfunction of operational movement and maneuver, "transition to and from tactical battle formations." This is best exemplified through the portrayal of pivots of maneuver and lines of operation to enable the transition to be depicted. Peter E. Haglin, "Contingency Exercise Observation, Graphics and the Operational Level of War," unpublished student paper, School for Advanced Military Studies, January 1991.

62. David G. Chandler, The Campaigns of Napoleon (New York, NY: MacMillan Co., 1966), 161. Strategy is the "planning and execution of the moves from the outset of a war or campaign until its culmination."

63. Van Creveld, Command In War, 98. Despite a sizeable staff, Napoleon was his own planner and often didn't expose his intentions to anyone.

64. Clausewitz, On War, 102.

65. Ibid.

66. Chandler, The Campaigns of Napoleon, 371.

67. Ibid.

68. d'Albe prepared Napoleon's study upon arrival at each cantonment. This included carefully setting up maps with positions of friendly and enemy units represented. This work of d'Albe "singularly facilitated the arrival at a decision of the commander, resulting in a great economy of

time, and contributing more than one thinks to the success of operations. No other officer was so closely associated with Napoleon's intellectual work." Colonel Vachee, Napoleon at Work (London, England: Adam and Charles Black, 1914), 97-98.

69. John Shy, "Jomini," in Makers of Modern Strategy, Peter Paret, ed. (Princeton, NJ: Princeton Univ. Press, 1986), 163.

70. Antoine Henri Jomini, Summary of the Art of War, in Roots of Strategy, Book 2 (Harrisburg, PA: Stackpole, 1987), 506.

71. Ibid, 467.

72. Clausewitz, On War, 170.

73. James J. Schneider, "Theoretical Implications of Operational Art," Military Review (September 1990), 25.

74. Observations from actual German maps currently in the US National Archives, Washington, DC. Dr. Samuel J. Lewis, US Army Command and General Staff College Combat Studies Institute provided 35mm photographic slides for study of these documents.

75. United States War Department, German Military Symbols (Washington, DC: War Department Military Intelligence Division, 1944) and German General Staff, Handbuch den Generalabsdienst im Krieg [Handbook for the General Staff in War] (Berlin, Germany: Reich Printing Office, 1939).

76. Department of the Army, Field Manual 100-2-1, The Soviet Army (Final Draft) (Fort Leavenworth, KS: Combined Arms Threats Directorate, 1990), 1-23.

77. Interview with LTC Lester Grau, Soviet Area Studies Office, Fort Leavenworth, KS, 13 February 1991. LTC Grau provided actual Soviet overlays for Front level operations, and other topical information.

78. Soviet Military Encyclopedia (Moscow, USSR: Voyenizdat, 1983). The encyclopedia, printed in Russian, contains four pages detailing the wide variety of available Soviet joint graphics.

79. Grau interview, 13 February 1991.

80. Mendel and Banks, "Campaign Planning: Getting It Straight," 46.

81. JCS Pub 3-0 (Test), 1.

82. Ibid, II-1.

83. Ibid, III-8.

84. FM 100-6 (Draft), appendix A.

85. FMFM 1-1, Campaigning.

86. US Marine Corps, FMFM 3-1, Command and Staff Procedures (Washington, DC: Department of the Navy, 1987), appendix C.

87. Beverly G. Knapp, "Symbology Sourcebook for Military Applications" (Alexandria, VA: US Army Research Institute, 1986).

88. Department of the Army, FM 100-103, Army Airspace Control (Washington, DC: Department of the Army, October 1987); Department of the Army/ Department of the Air Force, FM 100-42/AFM 2-14, Airspace Management (Washington, DC: Department of the Army, November, 1976); Department of the Army, Department of the Air Force, FM 100-27/AFM 2-50, Doctrine for Joint Airborne and Airlift Operations (Washington, DC: Department of the Army). Each of these multi-service manuals manuals share common symbols with FM 101-5-1.

89. VAdm. Jerry O. Tuttle, "Command is the Name of the Game," Signal, vol 43, no. 10 (June 1989), 121.

90. Chandler, The Campaigns of Napoleon, 161.

91. "Campaign, The Main Weapon of War," Marine (September, 1990), 23.

92. This is a technique used by the Soviets to portray destruction of a target or objective. Grau interview, 13 February, 1991.

93. John F. Meehan III, "The Operational Trilogy," Parameters, vol. 16, no. 3 (August, 1986), 14.

94. Mendel and Banks, "Campaign Planning: Getting It Straight," 46.

95. FM 100-5, Operations, 179.

96. Jomini, Summary of the Art of War, 473.

97. JCS Pub (Test) 3-0, xii,

98. FM 101-5-1, Operational Terms and Symbols, 1-42. FM

101-5-1 does not present a symbol to portray a LOC, although it erroneously directs the readers attention to a page which depicts routes. See also Clausewitz, On War, 345.

99. Jomini. Summary of the Art of War, 465 and Clausewitz, On War, 341.

100. Clausewitz, On War, 572 and FM 100-5, Operations, 181.

101. Schneider, "The Theory of Operational Art," 28 and Jomini, Summary of the Art of War, 466-7.

102. Schneider, "The Theory of Operational Art," 29.

103. Ibid, 22. This is somewhat different from the original definition posed by Jomini.

104. FMFM 1-1, Campaigning, 41. "Guidepost" was a term first used by Eisenhower to describe phases in a campaign.

105. Mendel and Banks, "Campaign Planning: Getting It Straight," 46 and FM 100-5, Operations, 30.

106. Department of the Army, Field Manual 34-130, Intelligence Preparation of the Battlefield (Washington, DC: Department of the Army, 1989), 4-42. This manual states that decision points are an integral part of a decision support template (DST), which is **"essentially a combined intelligence estimate and OPORD in graphic form."** p.F-11.

107. Holder,"A New Day for Operational Art," 27 and FM 100-5, Operations, 31.

108. Department of the Army, Field Manual 6-20-30, Tactics, Techniques, and Procedures for Fire Support for Corps and Division Operations (Draft) (Fort Sill, OK: US Army Artillery School, 1987).

109. Schneider, "Theory of Operational Art," 32.

110. FM 100-5-1, Operational Terms and Graphics.

111. LTC Herrly lecture handout, School for Advanced Military Studies, 6 November, 1990 and JCS Pub 1.01, Joint Doctrine System, (Change 1) (Washington, DC: Joint Chiefs of Staff, 15 September 1989.

112. Clausewitz, On War, 196.

113. These are listed as the primary requirements for command and control. LTG Leonard P. Wishart III, "Leader

Development and Command and Control," Military Review (July, 1990), 17.

114. Anthony G. Bohannan, "C3I In Support of the Land Commander," in Principles in Command and Control, Jon L. Boyes and Stephen J. Andriole, ed. (Washington, DC: AFCEA/Signal Press, 1987) 189.

BIBLIOGRAPHY

Ball, John C. and Francis C. Byrnes, ed. Research, Principles and Practices in Visual Communication. Washington, DC: National Education Association, 1960.

Bohannan, Anthony G. "C3I In Support of the Land Commander," in Principles in Command and Control, Jon L. Boyes and Stephen J. Andriole, ed. Washington, DC: AFCEA/Signal Press, 1987.

Boorstin, Daniel J. The Discoverers. New York, NY: Random House, 1983.

"Campaign, The Main Weapon of War," Marine. September, 1990.

Chandler, David G. The Campaigns of Napoleon. New York, NY: MacMillan Co., 1966.

Clausewitz, Carl von. On War, ed. Michael Howard and Peter Paret. Princeton, NJ: Princeton Univ. Press, 1984.

Cooper, Matthew. The German Army, 1933-1945. Chelsea, MI: Scarborough House, 1978.

Cumming, J. Sign and Symbol. New York, NY: Herder and Herder, 1972.

Cushman, John H., Sr. Command and Control of Theater Forces. Cambridge, MA: Program on Information Resources Policy, 1990.

Department of the Army. Field Manual 6-20-30, Tactics, Techniques, and Procedures for Fire Support for Corps and Division Operations, (Draft). Fort Sill, OK: US Army Artillery School, 1987.

_____. Field Manual 21-30, Conventional Signs, Military Symbols and Abbreviations. Washington, DC: Department of the Army, 1961.

_____. Field Manual 21-30, Conventional Signs, Military Symbols and Abbreviations. Washington, DC: Department of the Army, 1965.

_____. Field Manual 34-130, Intelligence Preparation of the Battlefield. Washington, DC: Department of the Army, 1989.

_____. Field Manual 100-5, Operations. Washington, DC: US Army, 1986.

_____. Field Manual 100-2-1, The Soviet Army. (Final Draft) Fort Leavenworth, KS: Combined Arms Threats Directorate, 1990.

_____. Field Manual 100-7, The Army in Theater Operations, (Draft). Fort Monroe, VA: TRADOC, August, 1990.

_____. Field Manual 101-5-1, Operational Terms and Graphics. Washington, DC: US Army.

_____. Field Manual 100-103, Army Airspace Control. Washington, DC: Department of the Army, October 1987.

_____. TRADOC Pamphlet 11-9, Blueprint of the Battlefield. Fort Monroe, VA: Army Training and Doctrine Command, 1990.

Department of the Army/Department of the Air Force. Field Manual 100-27/Air Force Manual 2-50. Doctrine for Joint Airborne and Airlift Operations. Washington, DC: Department of the Army.

_____. Field Manual 100-42/Air Force Manual 2-14. Airspace Management. Washington, DC: Department of the Army, November, 1976.

Donnelly, Christopher. Red Banner. Alexandria, VA: Janes' Publishing, 1988.

Down, R. and D. Stea, eds. Image and Environment. Chicago, IL: Aldine, 1973.

Dreyfuss, Henry. Symbol Sourcebook. New York, NY: McGraw-Hill, 1972.

Fallesen, Jon J. and Helen V. Lewis. "Human Factors Guidelines for Command and Control Systems: Battlefield and Decision Graphics Guidelines." Fort Leavenworth, KS: Army Research Institute, 1989.

Gagne, Robert M. ed. Instructional Technology: Foundations. Hillsdale, NJ: Lawrence Erlbaum Associates, 1987.

Geiselman, Ralph E., Betty M. Landee, and Francois G. Christen. "Perceptual Discriminability as a Basis for Selecting Military Symbols." Woodland Hills, CA: Perceptronics, 1985.

German General Staff. Handbuch den Generalabsdienst im Krieg. [Handbook for the General Staff in War]. Berlin, Germany: Reich Printing Office, 1939.

Hackett, John Winthrop. The Profession of Arms. Washington, DC: Center of Military History Reprint, 1990.

Haglin, Peter E. "Contingency Exercise Observation, Graphics and the Operational Level of War," unpublished student paper. School for Advanced Military Studies, January 1991.

Hanger, Eva. Symbols. Witchita, KS: McCormick Armstrong, 1962.

Hawrylak, Michael N. and Jeffrey W. Miller. "Enhanced Tactical Symbology for Command and Control of Ground Forces," Thesis. Naval Postgraduate School, Monterey, CA, 1985.

Holder, L.D. "A New Day for Operational Art." Army. March, 1985.

Joint Chiefs of Staff. JCS Pub 1-02. Department of Defense Dictionary of Military and Associated Terms. Washington, DC: US Government Printing Office, 1989.

_____. JCS Pub 1.01, Joint Doctrine System, (Change 1). Washington, DC: Joint Chiefs of Staff, 15 September 1989.

_____. JCS Pub 3-0 (Test), Doctrine for Unified and Joint Operations. Washington, DC: Joint Doctrine and Allied Interoperability Division, 1990.

Jomini, Antoine Henri. Summary of the Art of War, in Roots of Strategy, Book 2. Harrisburg, PA: Stackpole, 1987.

Knapp, Beverly G. "Symbology Sourcebook for Military Applications." Alexandria, VA: US Army Research Institute, 1986.

Meehan, John F., III. "The Operational Trilogy." Parameters, vol. 16, no. 3. August, 1986.

Mendel, William W. and Floyd T. Banks. Campaign Planning. Carlisle Barracks, PA: USAWC Strategic Studies Institute, 1988.

_____. "Campaign Planning: Getting It Straight," Parameters, vol.XVIII, no. 3. September, 1988.

Rogers, James. Dictionary of Cliches. New York, NY: Facts on File Publishing, 1985.

Schmidt, John K. "An Annotated Bibliography on Tactical Map Display Symbology." Aberdeen, MD: US Army Human Engineering Laboratory, 1980.

Schneider, James J. "The Theory of Operational Art," Theoretical Paper No. 3. Fort Leavenworth, KS: School of Advanced Military Studies, 1990.

_____. "Theoretical Implications of Operational Art," Military Review. September 1990.

Shy, John. "Jomini," in Makers of Modern Strategy, Peter Paret, ed. Princeton, NJ: Princeton Univ. Press, 1986.

Simpkin, Richard E. Race to the Swift: Thoughts on Twenty-First Century Warfare. McLean, VA: Pergamon-Brassey's International, 1985.

Soviet Military Encyclopedia. Moscow, USSR: Voyenizdat, 1983.

Tufte, Edward R. The Visual Display of Quantitative Information. Cheshire, CN: Graphics Press, 1983.

Tuttle, VAdm. Jerry O. "Command is the Name of the Game," Signal, *vol* 43, *no.* 10. June 1989.

United States Army Command and General Staff College. Field Manual 100-6, Large Unit Operations (Coordinating Draft). Fort Leavenworth, KS: US Army C&SC, 1987.

_____. Student Text 100-9, The Command Estimate. Fort Leavenworth, KS: USA C&GSC, 1989.

United States House of Representatives. Goldwater-Nichols Department of Defense Reorganization Act of 1986, Report 99-824. Washington, DC: 99th Congress USGPO.

United States Marine Corps. FMFM 1-1, Campaigning. Washington, DC: Department of the Navy, 1990.

_____. FMFM 3-1, Command and Staff Procedures. Washington, DC: Department of the Navy, 1981 (with 1987 changes).

United States War Department. German Military Symbols. Washington, DC: War Department Military Intelligence Division, 1944.

Vachee, Colonel. Napoleon at Work. London, England: Adam and Charles Black, 1914.

Van Creveld, Martin. Command In War. Cambridge, MA:

Harvard Press, 1985.

Weltman, Gershon. Maps: A Guide to Innovative Design. Woodland Hills, CA: Perceptronics, 1979.

Webster's New Collegiate Dictionary. Springfield, MA: Merriam Webster, 1979.

Wishart, LTG Leonard P., III. "Leader Development and Command and Control," Military Review. July, 1990.

Zarem, A. M., ed. Dictionary of Electronic Abbreviations, Signs and Symbols. New York, NY: Western, 1965.

INTERVIEWS

Personal interview conducted with Dr. Samuel J. Lewis, February 6, 1991, at the US Army Command and General Staff College Combat Studies Institute, Fort Leavenworth, KS. Interview included review of 35mm photographic slides of actual German maps held in the United States National Archives, as photographed by Dr. Lewis.

Personal interview with LTC Lester Grau, February, 13, 1991, at the Soviet Area Studies Office, Fort Leavenworth, KS. Interview included review of actual Soviet map overlays.