Systemic Operational Design: An Introduction

A Monograph
by
Lieutenant Colonel William T. Sorrells, US Army
Lieutenant Colonel Glen R. Downing, USAF
Major Paul J. Blakesley, British Army
Major David W. Pendall, US Army
Major Jason K. Walk, Australian Army
Major Richard D. Wallwork, British Army

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

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14. ABSTRACT

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_____ Mark S. Inch, COL, MP	Monograph Director, School of Advanced Military Studies
_____ Kevin C.M. Benson, COL, AR	Director, School of Advanced Military Studies
_____ Robert F. Baumann, Ph.D.	Director, Graduate Degree Programs

Abstract

Systemic Operation Design: An Introduction. 103 pages.

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Foreword - The School of Advanced Military Studies and Systemic Operational Design

In January 2005, six students of the U.S. Army's School of Advanced Military Studies (SAMS) began working with Brigadier General (Retired) Shimon Naveh of the Israel Defence Force (IDF) and members of the IDF's Operational Theory Research Institute (OTRI). This work was begun in order to facilitate an alternate planning process within Exercise Unified Quest (UQ '05), the U.S. Army's annual Title X war game at Carlisle Barracks, Pennsylvania in May 2005. Naveh taught the students Systemic Operational Design (SOD) methodologies and thought processes in a series of Training and Doctrine Command (TRADOC) sponsored workshops held at Fort Leavenworth, Kansas, between January and April 2005. From January through March 2005, the students studied SOD philosophy, methodologies and thought structures, completed an exercise to allow for practical applications of the concepts. In March, the team received UQ '05 exercise data and began to apply the SOD methodologies to design a campaign plan and operations, as the core element of a Standing Joint Force Headquarters' Staff within a Regional Combatant Command (RCC). Now knows as the "Case A" team (the group) began work to design a coherent campaign using the SOD methodologies under the tutelage of BG (R) Naveh. The students (and subsequently the authors of this monograph) continued to learn about SOD through focused readings and related independent study throughout the spring of 2005, integrating SOD thought into their broader study within the SAMS curriculum.

For UQ '05, the SAMS students produced an overall campaign design using SOD methodologies and then communicated this design to two separate planning teams for comparison. The goal was to view how the design would be interpreted by a group of planners with only limited exposure to SOD. These planning groups were composed of approximately 15 officers each, selected from student seminars at the U.S. Army Command and General Staff College (CGSC) and the U.S. Army War College (AWC).

The CGSC and AWC planners used doctrinal planning methodologies to refine and develop operational plans and courses of action based on the SOD team design. The approach used by Case A and the products produced did differ to that of Case B at UQ ‘05 which had used the Classical Elements of Operational Design and Effects Based Planning.

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Chapter 1 – Introduction

War is a complex phenomenon according to any practical definition of the term "complexity."[1] Historians argue about when warfare ceased being predominantly linear but, over the last century, the conduct of warfare has become more complex, driven by the combination of technology, the environment and the enemy.[2] The result of continued study into systems, chaos and complexity theory has changed our perception of the world from that of Newtonian reductionism to that of nonlinearity. Nonlinearity complicates issues because "the act of playing the game has a way of changing the rules."[3] Within this perceived turbulence, doctrine must evolve or risk becoming obsolete.[4] Intellectual debate has reflected this turbulence and concepts have been developed to advance our thought and planning processes. One of these concepts is Systemic Operational Design (SOD).

History of the Development of SOD

While systems theory was first promulgated by Ludwig Von Bertalanffy in the 1940's, the concept of Systemic Operational Design originated in the mid-1990's within Israel, and is ostensibly the brainchild of Brigadier General (Retired) Shimon Naveh and the Operational

[1] John F. Schmitt, "Command and (Out of) Control: The Military Implications of Complexity Theory," in *Complexity, Global Politics and National Security*. (Edited by David S. Alberts and Tom Czerwinski. Washington D.C.: National Defense University, 1997), 4. War is an exchange of matter, information and energy between at least two organizations, often occurring at many levels simultaneously. These engagements take place in a nonlinear environment. War cannot be captured in one place at one time, nor can its nature be summed up by one "snapshot" of a situation. These are some of the characteristics of complex systems.

[2] There is some debate over the issue of whether of not the world has become more complex, and the answer is, as always, a mixture of yes and no. The world is certainly more interconnected and the speed of the transport of information is near instantaneous. In the agrarian or pre-industrial age, information was passed at a slower rate. In the industrial age, information exchange has increased with the advent of the telegraph, print and visual media, radio, etc. Consumers of information are subdivided rather than aggregated, each forming a constituency of advocates or opponents for the views and insights offered. In short the answer may be that the world has always been complex. It maybe that we simply have more instruments capable of measuring and communicating this fact of complexity to us in the information age.

[3] James Gleick, *Chaos – Making a New Science* (New York: Penguin Books, 1997), 24.

[4] Colonel James K. Greer "Operational Art for The Objective Force." *Military Review* Vol. 82, Iss. 5 (September/October 2002): 23. Greer claims that the current operational design construct is incapable of providing planners the means of designing campaigns for full spectrum operations.

Theory Research Institute (OTRI).[5] Naveh's interest in this field began with his belief that there was a problem with the manner that the concept of campaign analysis and planning was understood, explained, and applied. His examination of the role cognition plays with the conceptualizing of operational art led both him and the Israeli Defense Force (IDF) to realize in 1992 that they had let their knowledge of the concept of operational art drift.[6] This conceptual crisis had manifested itself in several areas; frequent operational failures since 1973; growing irrelevance of their current operational doctrine; and a perceived delta in communication between the military and political echelons. Furthermore, Naveh's investigation led to the rediscovery that operational art is more than just a process; it is all-encompassing from design context, through mental rationalization, and is reliant on creative tension to create discourse.[7]

With the development of this new paradigm, Naveh and his team took their ideas on the road to test their theory.[8] The focus of their efforts were groups of ten to fourteen general officers, who partook in an eight-day seminar (split evenly between theoretical sessions and practical exercises). The aim of the successive seminars was to promote conditions for a cultural change in the IDF's modes of functioning and thinking as well as mobilizing the critical mass of generals to ensure the integration of SOD into the IDF. At the end of the first year of these "road-shows" an institute for the research and development into operational art was institutionalized into the IDF. At the end of the second year, the IDF Chief of the Defense Staff (CDS) decided to institute a school to continue the investigation into operational art. OTRI was born, and with it,

[5] Ludwig von Bertalanffy, "General Systems Theory – Foundations, Development, Applications." New York: George Braziller, 1993.

[6] Naveh at National Security Strategy Meeting (Nov 2004) for UQ '05. Despite the outcome of the 1973 war there was a dawning realization that what had saved them was tactical excellence, not anything at the operational level. This led the realization of a conceptual crisis within the IDF. Their strategy was responsive, and as such was an oxymoron, as strategy should be something used to create opportunities.

[7] Shimon Naveh, "In Pursuit of Military Excellence: The Evolution of Operational Theory." London: Frank Cass, 1997.

[8] Naveh refers to this period as the "conceptual wandering circus," something that shows that all military institutions require buy in at the higher level to instigate change.

the creation of the School of Operational Command (SOC).[9] To aid speedy integration, the IDF initiated a top down cascade approach, with the senior leadership being taught SOD during a six month course, although a recent change has seen the introduction of the teaching of SOD within their Command and General Staff College.

OTRI consists of four sub elements; the school for Generalship; a school for operational research; an institutional learning apparatus; and an interfacing laboratory.[10] The aim of OTRI is through the integration of research, learning and testing, to equip its students with the tools required to deal at the operational level in the modern environment. OTRI continues to explore the concepts of operational art, while maintaining a multi-disciplinary organization (employing architects to sociologists, economists to cognitive scientists) to ensure rich discourse.

Why do we need to consider another concept?

Within war, a theory rarely rises to the level of a law.[11] A theory is at best what is believed by the majority of professionals within a given discipline at that moment of time. New theories, emerging from believed or apparent discrepancies within the current theory stand or fall by the support they gain from members of the community where the ideas are discussed. Thus doctrine (nothing more than a synthesis of history and theory) is by very definition in a state of

[9] The School for Operational Command (SOC) is billed as an institutionalized learning experience that provides students with generic tools and concepts for systemic-individual learning within the future strategic-operational environments they will encounter. The SOC equips the students with three packages of systemic knowledge; the contents (operational concepts); a cognitive method (SOD); and cultural perceptions about the dynamics they will confront in the environment and constitutes a framework for a constantly-evolving discoursive community for the development of strategic-operational knowledge in the system. Worthy of note is that the structure, contents, and methodology change from course to course.

[10] In detail, the School for Generalship serves as a framework for schooling the senior command echelons in Operational Art, as well as enabling operational learning which further develops joint knowledge. The Operational Research Institute exists to facilitate operational knowledge development; structures IDF's learning environment; and broadens and deepens IDF operational knowledge through research partnership with external agents.

[11] For a clear exposition of why this cannot occur see Paul Reynolds, A Primer in Theory Construction. (Boston: Allyn and Bacon, 1971), 10-14. It is important here to differentiate between war and warfare.

flux, although the rate of change is dependent on the level of the doctrine.[12] Concepts can serve as a source of doctrine.[13] They are put out as immature theories for people to debate over, in the hope that the concept will become more robust and eventually find its way into doctrine if it is worthy, or fall by the way side if it is not. If doctrine and concepts are not open to debate or challenged by other concepts or ideas they may become dogma. Thus one should never ignore competing concepts within the study of war. SOD fits into this category of competing concepts.

Paraphrasing current campaign planning, the cognitive process starts with receiving strategic guidance (complete with constraints) and establishing an end state, and then backward planning to ensure that this goal can be reached. Planning and executing campaigns in the current and future operational environment is significantly more challenging.[14] The Classic Elements of Operational Design (CEOD), which the US Army paid an immense intellectual price to instigate in the early 1980's, are based on history, theory, and practice from a different context. Current US planning processes have grown from a synthesis of the works of Clausewitz and Jomini, having been modified for AirLand battle concepts and technology. It was based on a mixture of Agrarian and Industrial age warfare (where mass, time, space, and linear warfare were prime, all derived from Napoleonic Warfare and theory), German Blitzkrieg (which enshrined combined arms warfare), and Soviet Deep Operation Theory (which stressed depth and simultaneity).

Despite recognizing the importance of adopting a systemic outlook in the 1982 and 1986 versions of Field Manual (FM) 100-5; FM 3-0 (released in 2001) made no reference to systemic thought or logic. Thus at the heart of the processes there is a belief in the benefit of linear

[12] United Kingdom doctrine writers consider classifying doctrine according to four levels; philosophy; principles; practices; and tactics, techniques and procedures (TTP). Although the US does not categorize its doctrine in this manner, the procedure provides an example of this hierarchy.

[13] Dictionary.com defines a concept as "a general idea derived or inferred from specific instances or occurrences or something formed in the mind; a thought or notion."

[14] This has been brought about by the impact of asymmetries (means, motivation, focus, organization, morality), and the new strategic context, which challenges campaign planning that integrates all elements of US and multinational action. Also with the change in the operating environment there is difficulty in understanding the enemy comprehensively; unconventional warfare frustrates conventional thinking and makes it difficult to recognize patterns in an unconventional adversary's actions.

reductionism, something that assumes problems can be broken down into constituent parts, solved, and then reintegrated to allow a solution to be imposed. The Military Decision Making Process (MDMP) is a process that has become somewhat lockstep in its teaching, and is now constrained by a series of checklists, which are to be followed religiously. The MDMP is effectively a tactical problem solving process, which as part of its first steps seeks to distill from a higher order the mission, tasks and purpose of what is required of the sub unit. This assumes the mission has already been formulated and the tactical problem has already been adequately framed.

There is an inherent danger in adopting a process that started off as a tactical problem solving tool and via an induction has been imposed on the operational level. A danger is that in ignoring the distinction of the operational level of war, strategy can become tactics writ large. Finally there is a degree of hubris within current campaign planning which implicitly assumes an ability on behalf of the US to "freeze the system" in its current state long enough to allow the operators to initiate a series of tactical actions to reach the end state.[15] Campaigns are defined as "a series of related military operations aimed at accomplishing a strategic or operational objective within a given time and space."[16] By its definition campaigns are considered to be longer, rather than shorter, affairs. If one subscribes to complexity theory and adaptive enemies, the assumption that the system can be frozen for any length of time is incorrect.

When all of these factors are taken into account, it seems only useful that new ideas are welcomed into the debate on future warfighting and campaign planning. As Plato stated "if there is no contradictory impression there is nothing to awaken reflection."[17] In short, a need exists to rethink current understanding of the operational art and the characterization of its unique cognitive traits and redefine the cognitive as well as the functional challenges confronting

[15] The term 'end state' is conceptualized as a static condition which fails to appreciate that an end state is an impossibility within dynamic systems.

[16] This definition of campaign is from Joint Publication 1-02.

[17] Plato, The Republic, trans. Cornford (New York: Oxford University Press, 1941), 240.

commanders in the operating environment; develop a language and method of thought that facilitates both tactical planning and strategic assessment; and design a system of institutional training and education that will equip operational commanders and staffs with the appropriate tools and faculties to practice the operational art.

A Brief Discussion of the Theoretical Roots of SOD

On a philosophical level, SOD accepts that one can never understand the whole system within which one operates, and even if it that were possible, it would be impossible to know that this had been achieved. Furthermore, it accepts that even if mapping of the whole system were possible (in its infinite interactive outcomes), it is questionable if any one part of the system can have the ability to influence the entire system in the manner required. To that end it does not matter if the world is determinant or indeterminant in the concept of SOD.[18] By realizing that the key to any operational level of war is the treating of each engagement as an opportunity to learn, ongoing combat and clashes with the enemy allow a detailed picture to be built up.

Theoretically the roots for SOD originate from General Systems Theory.[19] The use of biological analogies (and complex adaptive systems), stress the concepts of co-evolution and competition between existing systems in a search for relative and comparative dominance. At the human interactive level, SOD does not rely on classical behavior theory, where inputs can be used to create a planned output (i.e. a direct linkage between cause and effect) but concentrates on action theory where beliefs and desires as well as intentions better represent the real world. In

[18] In terms of outcomes however, it is mechanistic which sees all outcomes as efficient, as opposed to teleological, which sees some outcomes as final. Either way, it is not possible to engineer a series of military actions to achieve an end state. This does not however negate the need for a clearly articulate aim and purpose. Furthermore, SOD adopts a Kantian approach, preferring the practitioner to choose a method that differentiates between right and wrong (delayed ethics) as opposed to concentrating on outcomes of absolute good and bad (immediate and consequential ethics).

[19] An in depth introduction to Systems Theory is at Appendix II.

short people act for reasons, they are not caused to behave. Militarily the concepts incorporated into SOD are those developed first by the Russians and then later by the US.[20]

So Where Do We Go From Here?

To ensure the relevance of doctrine, dialogue between and among concepts must occur in an open and honest forum. The aim is not to find a winner and a loser, but to ensure that our future thought processes are based on sound first principles that are useful in explaining the real world for the purpose of acting within it (or as close as an approximation as is possible). Colonel James K. Greer identified a need for a new operational design construct for effective planning and execution of future campaigns and operations, and presents one possible concept using General Systems Theory.[21] The concept of SOD fits within this.

Scope, Limitations and Assumptions

The monograph will provide a primer in SOD. It will not compare SOD to other planning processes, nor should it be considered a definitive piece of work. It is assumed that the reader has an understanding of systems theory. An overview of systems theory is at Appendix II.

Research Question and Methodology

The research question is: What is Systemic Operational Design and how can SOD be employed as a campaign design tool for full range operations? The secondary research questions include how can campaign planning (which includes both design and planning) be executed utilizing SOD within the current JOPES framework; and what would need to change in order to utilize SOD at the RCC. How SOD could be implemented in the US military is beyond the scope of this paper but warrants further research.

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[20] Naveh posits that despite finding the Russians elegant in theory, the Israelis found that their execution was often clumsy. Thus they concentrated more on building upon the US concepts of the early 80s.

[21] Greer, 26. In the article Greer lists the five options as being current doctrine; systems approach; effects based; destroy-dislocate-disintegrate; and center of gravity to critical variables.

Chapter 1 explains the need for an investigation of SOD, briefly examining the theoretical and philosophical underpinnings of SOD. Chapter 2 explains SOD, while Chapter 3 recommends a way to conduct SOD within a RCC, considering the implications of using SOD as well as offering a way of utilizing SOD within JOPES. Chapter 4 offers concluding observations.

Common Terms

The plethora of terms that exist within SOD are described in Appendix I.

Chapter 2 – What is Systemic Operational Design?

> Simplicity achieved by idealized isolation of systems and of variables within systems, deterministic laws, clearly delineated boundaries, linear causal chains, and other tools with which to forge analytical prediction have become the hallmarks of a good theory. By using such techniques, rooted in the parsimonious and deductive power of logic, we have searched for – and therefore overwhelmingly found – static equilibria, constant explanations, periodic regularities, and the beauty of symmetry.
>
> Alan Beyerchen [22]

SOD is an application of systems theory to operational art. It is an attempt to rationalize complexity through systemic logic. SOD is a holistic approach that translates strategic direction and policy into operational level designs. SOD focuses upon the relationships between entities within a system to develop rationale for systemic behaviors that accounts for the logic of the system. SOD facilitates a cycle of design, plan, act, and learn. This is accomplished through seven discourses, leading to a holistic design of an operation that will facilitate planning.

Problem-Setting, Not Problem-Solving

The first unique aspect of SOD is it does not assume any strategic directive is final or complete. Unlike the traditional approach which accepts that the full scope of the problem is understood and that strategic directives are derived from this understanding, SOD makes no such assumption. SOD commences with the premise that operational design requires 'problem setting' instead of 'problem solving'. It is prompted more by the inquiry of 'how should I think about the problem' rather than 'what is the problem'. It entails an inherent recognition that operational art includes a need to place the problem in the broader (geo-political) context before developing campaign design and subsequently informing the planning process.

The SOD approach requires a much more discoursive relationship between those who provide strategic guidance and those organizations that reside at the operational level. The nature of this relationship is demonstrated in the metaphor of a city council and an urban designer. The

[22] Alan Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War." *International Security* Vol. 17, No. 3 (Winter 1992/93): 86.

city council is the sponsor and financier of a suburban housing project. It has broad objectives it wishes to achieve and a general vision in mind. These include abstract notions such as the desire to minimize the environmental impact and create a parkland atmosphere within the suburban development. It may also entail concrete ideas such as the need to construct a school at a specific location. It is the urban designer's role to transform these ideas and concepts into an actual design for the suburban development, utilizing his specialized skills within his area of expertise to do so. This process requires the urban designer to consider the existing environment for the intended project and how the project will relate to the surrounding use of the land, whether it be industrial, rural or existing urban development. Furthermore, the transformation of the abstract into the concrete may require compromises. For example, to achieve the vision of minimal environmental impact may require changing the location or the design of the school because that location is vital to the local eco-system. Consequently, the urban designer can only fulfill their role through a consideration of the problem within the wider context of the environment upon which he is going to impose change. This requires a revelation of the broader vision for city development in respect to how it relates to this project, and this can only be provided by the town council. Secondly, it requires discourse between the urban designer and his sponsor as issues emerge that require clarification, prioritization and modification of both the objectives and the vision. The end result is that the urban design for the project emerges through constant interaction between the urban designer and the town council, necessitated by the need to apply an abstract concept to the physical environment through a creative medium. To complicate the design process, the city continues to change, as people move in or move out, or visitors impact the local population and economy (i.e. a dynamic, open system).

Application of Systems Theory

Problem-Bounding

As highlighted by the approach to 'problem setting', SOD avoids templating or a dogmatic methodology in its application of systems theory. Acknowledging that the boundaries of an open system are contrived by an observer for a specific purpose, SOD requires the campaign designer to first define the system. This is very much a creative process and involves a consideration of those elements that relate to the purpose. This consideration goes to the required span and depth that is deemed necessary in terms of its relevance to the problem. For example, while the global market system may be influential upon the problem under consideration, it is only those aspects of it that are of direct relevance that are developed. This may entail focusing on the regional economy and the influence of key economic partners outside the region. Similarly, consideration of a nation as a system may go to great depths in terms of its population, its government and its geography, all representing systems unto themselves requiring understanding, but may neglect the education system given its relevance to the issue. This form of problem bounding is an artificial construction that allows freedom for the designer to consider all those elements of a system deemed pertinent to the issue under consideration. It is limited by the designer's ability to cognitively map a dynamic and complex system, and recognition through understanding that not all elements of a system have equal bearing on those characteristics desirous of change.

Tensions

SOD proceeds to develop an understanding of the behavior or actions exhibited by a system. This is conducted through an exploration of relationships between the various entities within a system. It is based upon the concept of open systems that are dynamic in character and complex in nature, based upon the interaction and interdependence between the various elements of the system, and that these elements conceivably comprise of their own system or multiple inter-related systems. Given this conceptual backdrop, SOD attempts to do more than just map a

network of relationships between various entities. It is an exploration of the range of behavior or actions demonstrated by an entity, whether that be a singular actor or a system itself. It is derived from an understanding that there are multiple influences upon an element of a system. Dependant upon the context of the situation, a certain element will act in a certain manner and it will not necessarily repeat those behaviors should the context change. Subsequently, SOD does not attempt to be predictive, but attempts to develop an understanding of what factors or characteristics of a system influence the actions of the entities within the system.

The SOD approach aims at recognizing a range of actions and expresses tensions within or between entities. SOD methodology is an attempt to recognize the dominant features of an entity and explore the differences or friction it creates. These tensions may evolve from opposing or conflicting aims. An example would be a terrorist group's desire to commit terrorist acts in order to promote its cause, in contrast with its desire to maintain a minimal profile to ensure the groups survival and longevity. Alternately, tensions may evolve from features or characteristics that are not in direct opposition to each other, simply different. An example of this is an insurgent movement that employs both guerilla warfare and conventional tactics in the pursuit of its cause, as was evident within Mao's Chinese Communist movement in that it forced a prioritization of scarce resources between the two forms of war he employed. The tensions explored are not limited in number and can exist between elements of a system and within elements of a system. Similarly to the method applied to problem bounding, there is a recognition that there are multiple tensions within a system, but only those that relate to the issue under consideration are expressed and explored.

The purpose of this exploration of tensions is to establish an understanding of the logic of a system. In other words, it is designed to identify the association between entities within a system, the various ensembles of power within an emerging system, what causes certain ensembles to take precedent over others, and in what circumstances this occurs. Ultimately, this exploration is intended to develop a base-line of understanding of the system in order to allow

opportunities for further learning. It also allows exploitation of the differences or tensions within a system, and allows manipulation of the system logic. From this understanding, the operational commander attempts to prompt change to the character of the system in a manner more favorable to strategic objectives and the national interest.

Learning

An important facet of SOD is the concept of continual learning. Given the theoretical foundation of SOD, it is understood that the system that is developed as a cognitive framework is artificial. As such, the logic that is associated with it needs to be tested, and validated or reassessed. In this respect it is not dissimilar to the traditional approach to operational level planning. An intelligence picture is developed and efforts are made to verify the accuracy of the picture, both preceding and during an operation. Where SOD differs from traditional approaches is its harnessing of the concept of emergence in that it uses it to inform the learning process.[23] As systems theory portrays systems as dynamic and either undergoing change or possessing the potential for change, SOD acknowledges that the logic developed to understand a system is also subject to change. Changes to the system, potentially caused by one's own involvement, can fundamentally alter a system's character, or at least the character of certain relationships as the system evolves. SOD therefore requires continual verification of the logic through action learning and reframing, and if the logic is found inconsistent with the emergent behavior that is being witnessed, then SOD calls for a reassessment or reframing of that logic. In this respect it is contended that SOD differs from the traditional approach. Although there is an intent within the traditional approach to seek ongoing verification of facts and assumptions, there is no compelling mechanism within the process that enforces it. In comparison, the theoretical foundation of SOD inculcates continual learning. It is observed that SOD requires a paradigm shift in the way intelligence is collected, analyzed and presented. The way in which operational level headquarters

[23] Emergence in the context of SOD is a new characteristic in the environment produced by interactions within the system.

interact with the tactical level will also have to be addressed as SOD requires tactical commanders to have an understanding of systems theory.

While SOD is a process that can be applied at the operational and strategic level, it is also more fundamental. It requires the application of a different mindset, or epistemological approach within the military as an institution. This does not need to permeate the entire organization with equal inculcation, but it does require varying degrees of awareness beyond the operational level for SOD to realize its potential.

The Strategic Raid

The concept of emergence and need to conduct continuous learning also leads to a different approach to the execution of a campaign through SOD. As previously highlighted, SOD is imbued with a recognition that complex systems adapt in response to changes within the system or surrounding environment. Given the complexity of systems and the range of permutations in scope and number that may occur, SOD refutes the ability to plan a campaign from beginning through to a specified 'end state'. Once again, this places SOD in contrast to the traditional approach of campaign planning. Instead, SOD encourages a more iterative approach.

In keeping with its theoretical foundation, SOD recognizes that any application of energy into a system can initiate change, possibly dramatic change. This change needs to be accounted for in order to understand the appropriate context within which to plan subsequent operations. Otherwise, there is the potential that the intended 'end state' no longer becomes relevant or can no longer be achieved as intended because changes to the operating environment have been ignored.

Napoleon's invasion of Russia in 1812 represents a historical example of this phenomenon. Napoleon massed an enormous army with the intent of bringing the Russian Army to a decisive battle in response to his invasion of Russian soil. This intent could well have proven successful had he been able to execute it at the commencement of the campaign. However, the Russians employed a scorched earth policy, trading ground for time, thus extending the French

line of supply. In doing so, they dramatically altered the nature of the relationships between the entities within the system. As a result, by the time Napoleon was able to fulfill his intent at Borodino, the character of the system had changed so that even though he was victorious, he was no longer able to achieve his end state of forcing Russia to submit to his vision of the Continental System. Instead his tactical victory was the harbinger of a strategic defeat. Therefore, even though Napoleon executed his operational concept, the changed nature of the system was such that it invalidated the original logic.

SOD attempts to account for this change and one method of realizing this intent is through the concept of the strategic raid. A strategic raid does not necessarily fall within the doctrinal definition of the term 'raid'.[24] Essentially a strategic raid has the intention of injecting energy into the system with the purpose of affecting change within the system and providing an opportunity to learn more about the system. To that end it may have the purpose of simply causing the rival to further reveal their form.[25] An associated concept of the strategic raid is that the presence of one's own forces sees them increasingly form part of the system. Subsequently the term invokes non-permanence. Consequently, a strategic raid may vary in duration and intensity providing it meets this intent. Two examples of strategic raids are the British intervention in the civil unrest in Sierra Leone in 2000, which was over a month in duration and involved a minimal use of force, and the Israeli Air Force bombing of the Iraqi nuclear reactor at Osirak in June 1981, which was executed quickly, but violently.

[24] JP 1-02 defines a Raid as "an operation, usually small scale, involving a swift penetration of hostile territory to secure information, confuse the enemy, or to destroy installations. It ends with a planned withdrawal upon completion of the assigned mission."

[25] Revealing form means the rival has been caused to act in a way that unmasks his intent and tactical form to achieve the intent. This fuels the learning that SOD relies on (e.g., forcing defensive units to unmask or move, or insurgent groups to mass to conduct operations).

The strategic raid is by no means the only method of executing a campaign design that has been developed using SOD.[26] The point of incorporating the concept of the strategic raid when implementing SOD is to engage the notion that at the operational level, when applying a systemic approach, controlled operational tempo rather than an emphasis on tactical speed is critical. Furthermore, rather than a pre-determined campaign path (akin to an engineering project), each operation plays a critical role in informing the conduct of future operations after an opportunity to conduct learning has occurred.

Having outlined the role and intent of SOD, it is now necessary to describe the structure of the process. In proceeding to this step, an observation that is offered is that the intent and theoretical background of SOD influences the manner in which the process is conducted. The use of egalitarian discourse rather than directive interaction, and the provision of a narrative rather than an emphasis on visual products, is a natural medium of communication given the form of SOD. This will also be explained further in Chapter 3.

So How Is SOD Accomplished?

The process of systemic operational design is composed of seven sets of structured discourse broken into two major components, each with interrelated subcomponents (see fig. 1). These components work from the broad to the narrow, the abstract to the concrete, leading the designer toward a final design. Each discourse informs the next, yet the process is not lockstep. Moving from discourse to discourse is fluid, iterative, and recursive. The sections below explain each discourse.

[26] Should the decision be made that a military response that is violent in nature is preferred, it is recognized that the tactical battle is conducted and for its duration the system essentially becomes closed. The risk of driving the system into chaos also increases.

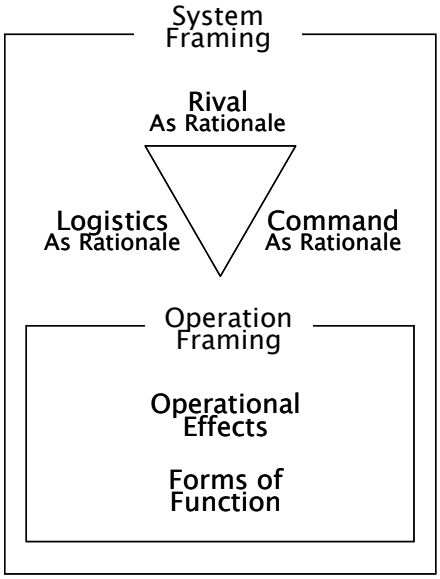

Figure 1: Overview of SOD

System Framing

The goal of system framing is to rationalize the strategic directives in broad context and relate them to the specific context of the issue under study. Part of this rationalization is a conceptualization of the tension between the system as it previously existed and the system as it exists within the specific context under study. In other words, something has changed that leads to a strategic directive to take action within a system. What has changed and how does it affect the system? Answering these questions rationalizes the context of the problem. The designer must also make cognitive connections and define relationships of parts, nodes, or actors through their interrelated actions.

System framing defines the system for study and action. SOD acknowledges the world is truly a system of systems, however the ability for any given group to understand the diverse and complex interactions of a truly global system is limited. In order to take meaningful action, the

designer must define a smaller system, a subset of the global system. System framing accomplishes this by grouping independent but interrelated elements to define the smaller system. This smaller system, or system frame, becomes the backdrop and boundary for further consideration.

Further informing the development of the frame is the identification of the relevant, distinctive sources of the circumstances bearing upon the investigation. Those sources can be of a physical nature or relate to the rival's way of thinking or worldview. The designer formulates ideas to explain known phenomena and to project logical trends. Ultimately, the designer conceptually links these insights along with multiple events, ingredients, or approaches into a singular logically framed text. In this context, a key element is developing an understanding of the inherent logic of the strategic sponsor (e.g. President, Secretary of Defense, policy makers etc.).

Rival as Rationale

The first of the three major subcomponents of system framing is rival as rationale. The function of rival as rationale is to describe the rival as a system. The designer describes the rival's logic and behavior and considers the rival as a reflection or complement to the designer's own system. The aim is to logically determine the form of the enemy through critical discussion. Rival as rationale examines the rival's logic, motives, and behavior as to why he has taken a particular form and investigates the interrelationship of his system components with other entities within the system, including the designers' system. In other words, the rival system is examined both endogenously (internally) and exogenously (externally).

Rival as rationale informs subsequent parts of the SOD process by constructing a tension generating framework for the examination of command and logistics rationale. In addition, the construction of the rival's operational form provides a reference in the logical construction of the operational frame. This examination allows the designer to understand logically the implications

of the rival's strategic and operational orientation. A later section will discuss command and logistics as rationale, as well as operational framing.

The rationalization of the rival has three primary efforts. The first is gaining an understanding of the orientation of the rival by determining patterns that may give a logical form or reason for his actions. Secondly is a rigorous investigation of the significance of different values, goals, and practices between the rival and other elements of the system to identify connections and logical relationships. Lastly, through artistic interpretation, designers characterize the elements that comprise the rival as a system within the logical boundaries of the problem as determined in system framing.

Command as Rationale

Command as rationale serves to examine the tension between existing command structures and that of potential command combinations for the design. It is a consideration of current command structures and a determination of whether or not they suit the logic of the system frame. If current command structures are unsuitable, command as rationale attempts to determine how they must adapt in order to support operations within the system frame. For example, the discourse may simply examine the need for the formation of a Joint Task Force (JTF) or should the Regional Combatant Commander (RCC) assume theatre command outside its established area of responsibility.

Designers must describe the difficulties and challenge the assumptions or objectives established by the national command authorities or strategic level policy makers, which affect the system. Designers examine existing command structures and combinations from an external perspective to determine their impacts upon the design. Additionally, designed command combinations must allow for the use of existing structures and formations while providing for the uniqueness of the operational design.

Logistics as Rationale

Designers rationalize friendly logistics in a similar fashion to command as rationale. This requires an examination of the tensions that exist between existing logistical structures and those structures and materiel challenges of the design. The goal is the construction of a logistics system that enables the implementation of the design and the reasoning embodied in it.

Logistics as rationale examines the potential of available logistics and logistics infrastructure to meet the challenges arising from the unique requirements of the design. The logistics system, once conceptualized, provides a framework that shapes and bounds the operational design. This is reflected in the operational framing. The resulting logistical combinations enable the sustainment of maneuver using existing organizations.

Operation Framing

Operation framing conceptualizes an operation that exploits the differences and tensions within the system in an attempt to shape the system toward conditions more in the designers' favor. It accomplishes this by positioning forces in space and time and by providing a frame for key ideas on how the operation will unfold. This frame translates the strategic logic determined in system framing into an operation within the context established by rival, command, and logistics as rationale. It establishes the specific form of operational maneuver. Lastly, it sets conditions for learning within the natural tensions between the 'end state' desired by national command authorities and the realm of what is achievable through the application of force.

Similar to the way system framing draws the boundaries of a smaller subsystem upon which to act, operation framing orders that system into an operation by establishing a singular logical frame. The ending conditions, in the context of operation framing, become a systemic guideline that provides order to operational learning.[27] It orders staging of forces and sequencing of operations by relating space and time. Designers must also take into account political

[27] This is recognition that a specific end state with detailed characteristics is deterministic. Rather, 'end-conditions' recognize an attempt to achieve generic interests.

constraints and strategic limitations. Finally, the operational frame sets the cognitive conditions for designing the operational logic and operational form to compliment the rationalization of the rival. The following sections address these last two issues.

Operational Effects

Operational effects exist to enable the achievement of the end conditions. This dialogue identifies the interrelated elements of the rival and the system as a whole, determining the point of initiation for learning through military action. By understanding the components of the rival, the designer can ascertain the form and procedures necessary to exploit the tensions identified in rival as rationale. All this combines to create a system allowing learning within the natural tension between terminating conditions established by national command authorities and the designed application of force. The result of this learning is new ideas and thought translated into future action through the process of reframing. Reframing is a reconsideration of the dialogue that led to the final operational forms and effects. If necessary, it demands the current design is re-examined through SOD and a new operation developed.

Learning is necessary in order to recognize new possibilities, events, or logic, which do not meet established design or terminating conditions and therefore mandate a new design or structure. Learning takes place inside boundaries established within time and space as it relates to the rival. These boundaries have the purpose of validating reasoning of the design structure or form. Failure to validate the reasoning leads to reframing. Standard patterns or templates may be adapted to fit within the operational frame providing form to the operational system.

Each effect encompasses a logical interface, a time-space interface, and a learning interface. The logical interface dictates the portion of the enemies system or rationale acted on. The time-space interface acknowledges the required staging or phasing required to accomplish the effect. The learning interface allows for learning through military action.

Forms of Function

The form of function provides substance to the operational design. It establishes the shape and structure of each action. Forms of function bring the planner into the design through discourse and establishes a form for each effect. It combines the elements of the design into a central idea or framework that enables the planning of the operation. Specifically Forms of Function dictates to the planner the form of action required. This stage of the discourse is when the established conceptual logic is translated into physical activity in the form of tasks.

The result of this dialogue must stress the reasoning and logic of the design to bind the thoughts for the structure of the design. It promotes the adaptation of existing structures into readily adaptable packages, which can achieve the desired results of the design. Existing patterns become tools or starting points to create new forms or structures for the design. Additionally, the methodology engenders more agile problem-setting which then bridges strategic-level intentions and tactical-level actions. The result of SOD is a family of products that conceptualizes the systems involved in the problem, their relevant interrelations, and provides a direction for action so as to shape a plan whose intended result is disruption of the adversary-as-system (this is opposed to planning for discreet, or even grouped/categorized, kinetic and non-kinetic effects).

Chapter 3 – Utilization of Systemic Operational Design

The metaphor of the urban planner symbolizes well who should use SOD. The operational 'architect' exists at a level between the strategic sponsor (a.k.a. the National Command Authority or Government) and the artisan (a.k.a. the tactical commander). As such, the users of SOD could operate at the Joint Chiefs of Staff (JCS level), the RCC/Functional Combatant Commander (FCC) level, and possibly at the JTF level, but probably no lower. The Case A team for UQ '05 used SOD at the RCC level. This chapter is a reflection of their experience of using SOD.

How SOD was Used

SOD attempts to engage the following:

- Discourse as a mode of learning and engaging subjective interpretations
- Context dependant rationalization
- Identifying the unique logic and the unique forms within the system
- Identifying: Patterns of events – Patterns of Space – Patterns of Language
- Engaging (deconstructing) existing paradigms within emerging trends

Learning about SOD creates some preconceptions and discomfort, due to its seemingly complex nature and dramatically different form compared to current military planning systems. The language in which SOD is conveyed is detailed, descriptive, and not conducive to quick understanding. Using SOD also presupposes a certain amount of knowledge of General Systems Theory and some basic understanding of philosophy. The key to understanding the utility of SOD is to be involved in its use as a tool, or that not being possible, observe the process in operation. Greater use of SOD has proven to increase understanding and confidence in its ability as a tool. The following sections discuss the implementation of SOD by examining in detail the areas of structured storming, capturing insights, communicating the design, and organizational learning will be examined.

Structured Storming

SOD is practiced via the medium of discourse. This serves as the method for obtaining insights, observations and producing ideas, vice the traditional mechanistic approach currently used. Rather than being overly procedural, SOD is not enslaved by process. Instead it is designed to prevent constraints to the discourse to ensure a holistic approach. The lack of fixed procedure requires a certain amount of discipline and understanding of the process vice traditional planning methods. Having only used the process three times, it is apparent to the design team that this method produces a very rich level of understanding of the situation amongst the designers, whilst it avoids producing lock-step, numerous courses of action. SOD moves outside the level at which it is initially being employed and insists on discourse with the next higher level in order to establish exactly what they want and in what form. Experience has shown they may not know up-front, and the discourse will help the next higher level improve their understanding.

Inherent to the SOD process, is the notion of an egalitarian discourse where rank and position do not overshadow, nor stifle the process. This produces a system that is more staff driven and command led. SOD moves away from a traditional hierarchic structure of planning and decision making that is command driven and staff led. SOD integrates the commander within the design process and fully involves him in the discourse. The involvement of the commander is critical to achieving success with the design.[28] The apparently oxymoronic title of "structured storming" gives some indication of the idea behind the method – free thinking, yet within a certain framework. Whereas traditional planning relies on a lead planner and someone to drive the process, SOD relies on discourse between the members of the design team and discipline from within the team to keep it on track. For UQ '05, a team consisting of six members was found to be an acceptable and workable number of participants. Clearly, too many members would be unwieldy, and too few would not create the diversity of skills and opinions necessary to foster

[28] Normal US military planning methods require briefing the Commander to allow him to make decisions. Embedding the Commander in the process removes the need for this time consuming and often disruptive activity.

meaningful discourse. SOD is not as product focused as traditional planning methods -- SOD is essentially about creating understanding and conceptualizing the problem in hand. Culturally and professionally the team had no issues with entering into and using discourse to produce a design. However, for this to work on an RCC staff or elsewhere, the participants will likely require some adjustment to standard working practices and preconceptions.

The SOD process consists of an integrated logic structure that follows seven discourses; these then contribute to the production of an operational design.[29] The design team wrestled with the issue of the separation of 'design' from 'planning'. The delineation between design and planning is still not clear in terms of where one ends and the other begins, and thus the ability to separate responsibilities will be a challenge. At some point, the staff will have to establish clear procedures and detail the differences.

SOD discourse is not totally free, but should initially fall within the recommended structuring questions. A suggested list of structuring questions is at Appendix IV. The questions assist in guiding the discourse but in no way served as a check list for the design team to follow methodically. The team found that there were other lines of enquiry unique to the situation that fell outside of the suggested structuring questions. Embedded in the discourse is the absolute need to capture insights from the discourse in a timely and accurate fashion. Visualization aids provide a powerful tool to assist in the discourse and to create the logic frame of the operation. Also creating a conceptual map helped the understanding the rival and communicating the insights gained in the discourse. Following the steps of SOD initially proved to be stymied and difficult. The process is somewhat alien to conventional practice and as such a mental change is necessary with corresponding tools; some find this easier than others.

[29] As listed in the previous chapter, the seven discourses are: System Framing, Rival as Rationale, Command as Rationale, Logistics as Rationale, Operational Framing, Operational Effects, Forms of Function.

Time remains an important issue when using SOD. The seven discourses can roll on ad-infinitum and at some point, regardless of the level of clarity and understanding achieved in the particular discourse, a move to the next step must occur. The progress must be carefully monitored by the participants. As with normal planning, practice in this and adherence to a time-line will allow this to become a smoother process. It is important to acknowledge that complete understanding from a particular discourse will not occur, however it is necessary to generate a reasonable level of understanding and move onto the next discourse. The experience of the design team was that the decision to move to the next step of discourse was intuitive and somewhat naturalistic.

Understanding of the current strategic picture is essential to commencing the SOD process. Normally this would be implicit in the day-to-day operations of an RCC. The design team on UQ '05 attempted to 'read' themselves into the situation in order to be in a position to commence system framing. To achieve a level of geo-strategic awareness, the team used a system of context structuring (what the team called 'strategic framing') that attempted to bring the team 'up to speed' on the scenario and its background. Obviously, the greater the knowledge of a situation, the easier SOD discourses will flow.[30]

One observed benefit from SOD is that in viewing the problem holistically, a greater understanding of the geo-strategic picture was developed and that plans were not developed in a military vacuum or stove-pipe, but in the context of all elements of National Power and interest. Conversely, SOD has attracted some criticism in that it leads to discourse over areas outside of military control, namely diplomacy and economics. In the IDF, the scale of issues and structure of the government appears to allow the design teams to have representation and from these areas.

[30] After having experienced two different scenarios, the Case A team observed that only real world scenarios should be used as contrived scenarios have no real depth for the SOD process to investigate, interpret and exploit. The exercise artificialities impaired the demonstration of the full potential of SOD.

Although this is an aspiration for the RCC staffs, the ability to have substantive interagency discourse is currently limited.

Capturing Insights

As mentioned previously, it is essential to accurately recording the SOD discourse to allow the creation of a fully developed design. The structure of the method of capture can take various forms. The team used both a graphical text capture system called Hydra and simple text capture using Microsoft Word, both backed up with white boards for capturing conceptual drawings and sketching relationships.[31] For UQ '05 the team settled on using Word, capturing text within a pre-formatted table. (See sample table at Appendix V). The format for the tables was flexible and changed frequently during the discourse. Importantly, the speed of capture of the discourse actually drove, or controlled, the pace of the discourse. Discipline was essential to avoid missing thoughts and suggestions. Though there is a clear purpose in the order of the discourse given in Chapter 2, the team found the best way to mitigate this disruption was to quickly capture the point being made, recording it in the appropriate place, and return to the primary area of discussion.

Communicating The Design

Planning and design at the operational level are not traditionally separated.[32] Although discussed earlier in the monograph, this remained one concept that took some getting used to both for the design team (remaining cognizant of delving into planning, whilst also creating adequate specificity for the planners) and for the planners who received the design. In the IDF the designers *are* the planners and simply fall in on a larger planning staff. For UQ '05 the design was handed off to a plans team and this brought with it many problems, akin to the traditional

[31] Hydra is proprietary software of Meta-Thinking Operational Tank (MTOT) Insight Ltd. Hydra proved useful during Ex Tally Ho but was unavailable to the team for the remainder of Unified Quest.
[32] The closest approximation to design in the US system as is attempted in SOD, is the Combatant Commander's strategic concept. This is closer to a design in the SOD sense than a plan.

problem of handing over a plan from J5 to J3. To properly employ SOD, it is essential that the designers flow into the planning team.

Communication of the design in a coherent manner was as important as producing an effective design. The design team for UQ ’05 were not shown examples of a written operational design as used by the IDF, and therefore created their own template. The method selected was a written campaign design based loosely on the formats used for Operation TORCH (the invasion of North Africa in 1942) and for the re-capture of the Philippines in World War II. Alongside the text there existed the need for schematics and conceptual maps to help the planners understand the enemy and the wider system. For example, the team found the following graphics to be useful: The rival as a system, the rival’s operative map and the rival’s conceptual map.[33] These all helped with the understanding of the rival and communicate the various tensions identified within the system. The visualization tools and design text were also necessary to communicate aspects of the system up the chain to the strategic sponsor, as well as down to the planners.

Organizational Learning

The most essential aspect of SOD was the ability to conduct and utilize learning. By its very nature, SOD will not produce a design going from deployment through decisive victory, to redeployment. Prediction of a rival’s response, while serving as possible food for discourse, is no basis upon which to plan, as previous chapters have alluded to. SOD required learning to occur to guide further action. This learning was based upon “rationalizing the emergence”, that is understanding what has happened in response to the actions taken, identifying patterns, learning from this, and then creating appropriate responses.

Though the exercise structure provided little opportunity for organizational learning, it is clear that learning comes from two main areas. Firstly, learning occurs by observation of the response of the rival to the initial actions, through both direct observation and use of a variety of

[33] Due to the non-disclosure requirement of the UQ ’05 scenario, examples of these tools are not included within this monograph.

networked sensors.[34] Secondly, learning is carried out by reports and discourse with the tactical level fighting elements. These elements report what has occurred, but do so in a way that enables the higher levels to gain insights. This second way of learning is one that will require a change in the way tactical commanders report their observations, particularly in terms of less facts and more judgments and impressions. It requires tactical commanders to be aware of the system logic that has been developed within the campaign design. In essence, despite SOD being utilized in higher level operational planning, it will require understanding of its very nature down to the lowest levels and changes in the way reports are fed up the chain. Tactical level commanders fulfill a unique role in their interaction with the system and their subsequent ability to compare the virtual logic with reality. The success of learning as a process in a timely and effective manner is crucial to the utilization of SOD. Institutionalizing the learning process throughout the chain of command will be a great challenge.

Once the operational commander and design team received, interpreted and understand the information 'learned', a process known as "reframing" occurs. In essence, this is a procedure, again run within a discourse, where the design team asks what has changed and what does it mean. By moving through the seven discourse areas again in light of what has been learned, the team can assess and create further direction for the planners. Reframing is a continuous process and is carried out in light of observed changes. The observation may require a change to an element of the rationale or may require a more fundamental change to the established logic. The setup of UQ '05 did not permit for full reframing to occur. The mechanics of this process and its structure is an area for further work.

Issues and Implications of Using SOD

The team's impression is that the holistic analysis of SOD ultimately produced a better product than the application of current processes alone, but its application in the US military

[34] SOD is informed by networked sensors, including tactical units, but it is not driven by it.

raises issues with respect to current organizational structures and service and joint planning processes. The application of SOD will clearly require training and education for officers and staffs beyond the standard Intermediate Service School (ISS) qualification. SOD thinking requires the ability to think both in traditional, linear, reductive, analytical terms and in non-traditional, non-linear, constructive, visionary terms. The development of this dual cognitive approach will challenge the current officer professional education system.

Integrating SOD Into Current Planning Processes

Utilization of SOD by a RCC will challenge and strain the current institutional structure that supports strategic and operational level planning. Current US doctrine emphasizes that operational level planning occurs at the regional combatant command level or at a subordinate Joint Task Force. SOD appears to complement current planning processes at the RCC level in that the development of the operational design can be created by a small nucleus of designers at the RCC level. However, the breadth of the analysis produced by the SOD process fully encompasses all the instruments of national power which requires the RCC to discourse with the higher levels of Department of Defense (DOD), National Security Council (NSC), and other governmental agencies.[35] The holistic analysis of the strategic environment and the rival resulting from the SOD process can lead to an assessment that the most favorable course of action involves significant contribution from the other instruments of national power. In the development of the operational design, critical discourse and decisions are required to influence and initiate activities beyond the control of the RCC.

Currently, US military strategic and operational level policy, planning and assessment are conducted primarily by two interconnected planning processes: the Joint Strategic Planning System (JSPS), and the Joint Planning and Execution System (JOPES). These two systems

[35] Discussions with a former operational commander from Operation Iraqi Freedom, revealed that he felt he did not have the expertise on his staff to fully explore the implications of his actions on the other instruments of power and was reliant on greater interaction with other departments.

ranging from the strategic to the operational level are bridged by one key document, the Joint Strategic Capabilities Plan (JSCP). The JSPS is a tool utilized by the Chairman of the JCS to translate national interests and national security strategy and objectives into planning guidance for contingencies, and assessment of present and future capabilities and risks. It is a military strategic system that links into the non-military strategic planning system (NSC system).[36] JSPS informs JOPES, which is a staff procedure used by operational level commanders to determine the best method of accomplishing assigned tasks and to direct actions necessary to accomplish those tasks. The joint planning in turn produces Operation Plans (OPLANs), Contingency Plans (CONPLANs), Theatre Security Cooperation Plans (TSCPs), and actual campaign plans. Acting as a bridge between the JSPS and JOPES is the JSCP, which directs deliberate and contingency planning to the combatant commanders through directed planning tasks, planning assumptions, and apportioned resources (forces and lift).

SOD challenges these systems. The sophistication of a holistic systemic analysis conducted at the RCC level will challenge the logic of the processes that produced the JSCP and the strategic directives that initiate crisis action planning by the combatant commander. SOD analysis conducted at the RCC level requires discourse with the strategic sponsor to challenge and validate the logic of the strategic directive. The current structures and processes do not support this level of discourse. Incorporating SOD at the RCC level may require utilization of SOD in the development of the JSCP and the strategic directives driving crisis action planning.

Implementation of SOD represents significant institutional, regulatory and cultural changes within the government and the military, particularly in the realm of deliberate planning. Whereas the RCC has many opportunities to influence strategic action and his environment, he is somewhat limited by the current JCS processes in terms of deliberate planning. By the time the JSCP is published and a combatant commander receives his specific planning tasks, the strategic

[36] Joint Pub 5-0.

problem set has been framed and he is somewhat limited in what he can actually create in terms of an operational design. The commander may need more opportunity to influence and participate in the formulation of this critical planning document.[37] Additionally, the rigidity within JSPS and JOPES makes discourse with the strategic sponsor at this point in the process difficult and stifles the combatant commander's creativity in creating his operational design.

Use of the SOD process in Crisis Action Planning (CAP) will be easier than the more rigid Deliberate Planning structure due to the more fluid nature of current events creating the crisis and time sensitivity. CAP provides a flexible process for the President to receive recommendations from other government agencies, organizations and the military. This dynamic lends itself to the discoursive nature of SOD and provides the combatant commander access to key decision makers in other areas of government. The dynamic of crisis makes a collaborative holistic approach to problem setting feasible within the rigidly structured higher levels of DOD and the government.

Implication of Training of SOD Practitioners

Application of SOD will challenge our current officer education systems. As mentioned previously, SOD thinking requires the ability to think both in traditional, linear, reductive, analytical terms and in non-traditional, non-linear, constructive, visionary terms. It is the creative tension between these two perspectives, acting synergistically, that enables the creative, synthetic, and practical problem-solving that lies at the heart of SOD. Traditional thinkers alone can only replicate and repeat past practices, and conceive of incremental improvements; non-traditional thinkers alone cannot adapt visions to practical necessities; each needs the other for creative and practical problem solving. These two perspectives may reside in the same person, or they may be

[37] The commander retains a great influence in day to day operations and national policy through his interaction with the politico-military hierarchy both in the US and in his assigned region.

distributed among different people in a team, but both perspectives must be represented in any group trying to perform SOD.[38]

The training and education requirements for producing a SOD trained officer will be beyond the standard professional military education program for field grade officers. The SAMS officers trained in SOD for participation in UQ ’05 underwent two weeks of formalized SOD training separated by a month of individual study. Based on the success of the Case A participants in utilizing SOD, this training model will be offered as a baseline for the training of future officers in the SOD process.

Prior to the formalized SOD training the SAMS officers shared the following prerequisites prior to undergoing SOD specific training: each was a resident Command and Staff College graduate which included Joint professional military education (JPME) phase 1 qualification, had an above average knowledge of classical military theory and current service and joint doctrine, and a basic understanding of General Systems Theory. This educational foundation appears to be the minimum requirement necessary for learning the SOD process. The additional theory aptitude in the Case A participants was a product of the Advance Military Studies Program (AMSP), but this level of understanding could be incorporated in the standard ISS programs or other unit professional development programs. SOD practitioners need not and should not be limited to SAMS, School of Advanced Warfighting (SAW) or School of Advanced Air and Space Studies (SAASS) graduates. The SOD specific training occurred over a period of 2 weeks with approximately one month separating the first and second weeks.

The first week of training was taught by the OTRI cadre and devoted two days to philosophical underpinnings of SOD and a detailed explanation of the utilization of the seven discourses of SOD. The remaining three days of the week were devoted to a JTF level exercise where a strategic directive was issued to the design team and the SOD process was used to

[38] Maltz, Richard Stuart, Comparative Perspectives on Operational Art. Unpublished paper.

develop an operational design. This week was an extremely intense introduction to SOD where the students essentially “drank from the fire-hose”.

The second week of training followed approximately one month after the first. The interim month proved to be value added in that it allowed the students time for personal reflection of the SOD process and additional study time, specifically in General Systems Theory. The second period of SOD training devoted five days for a replay of the original exercise introduced in the first period. During this process the students solidified their understanding of the SOD process and their own nonlinear, systemic cognitive processes.

The format that the SAMS team used to learn SOD was considered successful. Alternate more concentrated programs may be equally successful. Two weeks of formalized training with the OTRI cadre separated by one month for individual study produced a SOD competent design team that successfully applied SOD to the complex strategic problem presented in UQ ‘05. Additional formalized training and design exercises will serve to enhance the students understanding of SOD, but a solid baseline proficiency can be gained utilizing by the method outlined.

Insights from Use of SOD

Based on the experience of the Case A Design Team during UQ’05, SOD can be used at the RCC level with only a small nucleus of SOD trained designers. Case A replicated a small 6 person design team within the J5 that created the operational design utilizing the SOD process. The design team then presented the design to the larger Operational Planning Group (OPG) (that was not trained in SOD) with the task of developing a campaign plan from the design utilizing current doctrinal planning processes. This technique could be used on an actual RCC staff. The design team should consist of a small group within the J5 augmented with other functional representation (logistics, intelligence, air, maritime, and interagency expertise). This team should be well trained in SOD with the ability to think traditionally and nontraditionally (as mentioned previously) in order to allow the creative tension required for problem solving and also ensure the

more abstract operational design is clearly articulated to larger planning staff, which may not utilize SOD. This team could expand and contract as necessary to accommodate the required subject matter experts.

To better support SOD, current intelligence products and presentation formats must be revised. In order to fuel discourse and provide the necessary qualitative detail that allows systemic analysis, intelligence should focus on relationships and behaviors rather than emphasis on facts. The application of SOD still requires the information provided by this traditional intelligence focus. However, it also requires an evaluation of all those elements that give the system its character. It requires anthropological and cultural information, an understanding of economic and political forces and whatever factors assist in the explanation of the behavior of the system under scrutiny. The identification of tensions within the system is based upon the dynamic character and complexity of the interaction and interdependence between the various elements of the system. In UQ ‘05, the necessity of this type of intelligence product became apparent at the outset.

During UQ ‘05, it was learned that upon completion of the operational design the best technique for campaign plan development was to have the designers participate in the campaign planning process to ensure that the logic of the design remained consistent throughout the planning process. This technique avoided the current structural friction that exists in the handoff of responsibility between plans and operations (this problem was especially acute during UQ ‘05 since the designers were the only ones trained in SOD). This implies that SOD may be implemented at the RCC with only a small SOD trained design team (as per UQ ‘05). This is not the optimal condition. For a more efficient planning process there must be an understanding of SOD within the Operational Planning Group (OPG), specifically in the J5, J3, and J2. Additionally, UQ ‘05 brought to light the difficulties in the format of the operational design that was the source document for campaign plan development. Should the decision be made to continue to separate designers from planners, then further investigation needs to be undertaken to

facilitate communication of the design to the planning staff. Observations from UQ ‘05 suggest this communication needs to be in written and discoursive form. A discourse rather than a brief is essential to communication of the design.[39]

[39] The artificial construct of UQ ‘05 removed the commander from the design process. His presence under normal circumstances would improve communication and ensure he is positioned to fully evaluate the adherence of the plan to the logic of the design.

Chapter 4 - Conclusions and Recommendations

Answering the Primary Research Question

The proposed research question is: What is Systemic Operational Design and how can SOD be employed as a campaign design tool for full range operations? The secondary research questions include how does one execute campaign planning (which includes both design and planning) utilizing SOD; how can one introduce SOD into US Doctrine; and how does Systemic Operational Design compare to current procedures (are there relationships between the theories)? Chapter 2 described what SOD is and Chapter 3 examined the issues of how one employs SOD in a campaign design process. This chapter will summarize the monograph, make some initial conclusions on the introduction of SOD into US doctrine and offer recommendations for future research.

Benefits and Limitations of SOD

Despite all of its promises SOD is still in its infancy. That said, however, SOD is a useful tool. Using new metaphors challenges existing assumptions and may promote problem-setting and designs that are more relevant and effective than what would have resulted from employing traditional operational art. The discoursive methodology may create an organization that expects learning and will subsequently adjust its Intelligence, Surveillance and Reconnaissance efforts to accommodate that mindset. In addition, the methodology may also promote more agile situational understanding, and consequently, more timely (relevant as opposed to rapid) decision-making.

On the negative side, in its current form the SOD vocabulary is inter-disciplinary, specialized and not directly mapped to traditional operational art. The historical and cultural background from which SOD was developed may result in aspects of the methodology not being directly transferable to the US military scale of operations. There are also challenges associated with transferring such agile design methods into large organizations. Perhaps the largest problem

is the problem itself -- anyone can answer questions, it takes critical thinking to ask the right questions.

SOD in a nutshell?

SOD is an attempt to rationalize complexity through systemic logic. It is a process that is posited to be more appropriate to the operational level of war than present alternatives. As a methodology, it relies upon discourse as the vehicle for inquiry and utilizes an open, flexible structure. This enables a holistic approach to problem solving and avoids bounding and compartmentalizing as an inherent element of the process. In doing so, SOD offers the opportunity to evade devolution into a checklist or formula.

The theoretical foundation of SOD in its application of General Systems Theory is equally enticing. There appears to be a growing dissatisfaction with the present linear, deterministic view to the conduct of warfare. Arguably, the nature of warfare has not changed and the complexity experienced in the contemporary environment has always been present. Nevertheless, the increasing role of polymorphic actors, globalization and the pervasive presence of media have prompted interest in an epistemological approach that accounts for this phenomena. Systemic theory and its greater accountability for variance within and between elements found in the modern battlefield promises a superior paradigm to existent frameworks.

SOD is fundamentally an alternative method of problem framing to aid the design of campaigns and operations. It makes explicit perceived realities- ours, neutrals, and rivals. Are traditional methods rendered obsolete? No. But given the realities of a globalized battlespace, multivariate actors, coalition warfare and pervasive media, the required set of actions is likely to be broader than the traditional military instrument can provide. SOD provides a richer insight into what those coherent actions may be. SOD still is about the application of military force and actions, but allows an operational commander a broader appreciation of the context to which he acts and a richer understanding of how he may impact a broader dynamic system.

SOD explores why we are designing an operation (as a campaign or as an operation within an active theater) and what we wish to achieve. This exploration assists the operational commander in understanding the type of war into which he is about to enter. SOD allows an exploration of the problem through structured discourse that creates a more comprehensive, holistic design. Design is just the jump off point to deliberate or detailed planning.

SOD is not a dramatically new methodology for operational campaign planning. In fact some see in SOD basic leadership and problem solving tenets. SOD methods to synthesize and apply judgment to the problem through a more fruitful dialogue intended to discover, not only potential COA's, but also to map out and frame interrelationships that are potentially more useful. Second, and also key, is that each discourse and action is expected to be a learning experience.

SOD emphasizes design over planning and better bridges the gulf between strategic client perceptions of the problem and tactical artisan action. Because the framework of military purpose involves interaction between partially-known systems, SOD is a methodology that values learning as an integral part of problem-setting, designing and execution. The final conclusion of the six officers exposed to SOD is that the process greatly merits further research and experimentation.

Areas For Future Research

Although this monograph answers the primary research question by showing the usefulness of SOD within the campaign design process there is much work to be done.[40] Suggested areas for further research include:

How can SOD be employed within the Joint Strategic Planning System?

Where in the command and organizational structure can SOD be best employed?

[40] In their book Eliot Cohen and John Gooch stress that military failures are not the result of individual failures, but stem from the failure of the system to function within its environment. They identify three major reasons for military failure. These are failure to learn, failure to anticipate and a failure to adapt. Within this, they state that the ability to adapt is the most important for any military. Eliot Cohen and John Gooch, *Military Misfortune: The Anatomy of Failure of War* (New York: The Free Press, 1990), 21-23 and 161-163.

How, when, where and can SOD be included in the Professional Military Education System?

Can SOD be scaled up for the US military for it to be effective in the contemporary operating environment?

APPENDIX I – Acronyms, Glossary of Common Terms and Concepts

Acronyms

AMSP	Advanced Military Studies Program
AWC	Army War College
C^2	Command and Control
CAP	Crisis Action Planning
CAS	Complex Adaptive System(s)
CEOD	Classic Elements of Operational Design
CGSC	Command and General Staff College
CJCS	Chairmen of the Joint Chiefs of Staff
COG	Center of Gravity
CONPLANS	Contingency Plans
DOD	Department of Defence
EBO	Effects Based Operations
EBP	Effects Based Planning
EUCOM	European Command
FCC	Functional Combatant Command/Commander
FM	Field Manual
FRAGO	Fragmentary Order
GST	General Systems Theory
HUMINT	Human Intelligence
IDF	Israel Defense Force
IO	Information Operations
ISS	Intermediate Service School
JCS	Joint Chiefs of Staff

JFCOM	Joint Forces Command
JOPES	Joint Planning and Execution System
JSCP	Joint Strategic Capabilities Plan
JSPS	Joint Strategic Planning System
JTF	Joint Task Force
MEL	Military Education Level
MDMP	Military Decision Making Process
NSC	National Security Council
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OPG	Operational Planning Group
OPLANS	Operation Plans
OTRI	Operational Theory Research Institute, Israel Defense Forces
RCC	Regional Combatant Command/Commander
RCT	Reflexive Control Theory
RDO	Rapid Decisive Operations
SAMS	School of Advanced Military Studies
SAASS	School of Advanced Air and Space Studies
SOC	School of Operational Command
SOD	Systemic Operational Design
SOF	Special Operations Forces
SSC	Senior Service College
SSS	Senior Service School
TTP	Tactics, Techniques, Procedures
TSCP	Theater Strategic Cooperation Plan
TRADOC	Training and Doctrine Command

UK	United Kingdom
UQ	Unified Quest
USA	United States of America
USAF	United States Air Force

Glossary of Common Terms

These definitions have been compiled from the source documents:

Bifurcations. A Bifurcation is the splitting into two modes of behavior of a system that previously displayed only one mode. It represents a transformation from one type of behavior into a qualitatively different type of behavior. This splitting occurs as a control parameter is continuously varied.

Chaos theory. The study of non-linear dynamics.

Cognitive. Of, relating to, being, or involving conscious intellectual activity (as thinking, reasoning, or remembering)

Complex System. Any dynamic system composed of many simple, and typically nonlinear, interacting parts.

Complex Adaptive System. A complex system whose parts can evolve and adapt to a changing environment.

Complex Systems Theory. The study of Complex Adaptive Systems.

Conceptual: Being or characterized by concepts or their formation; An abstract or general idea inferred or derived from specific instances.

Conditions. A state at a particular time. A mode of being or form of existence of a person or thing; An assumption on which rests the validity or effect of something else; (usually plural) a statement of what is required as part of an agreement. The state of (good) health (especially in the phrases 'in condition' or 'in shape' or 'out of condition' or 'out of shape'). Information that should be kept in mind when making a decision. The procedure that is varied in order to estimate a variable's effect by comparison with a control condition. Establish a conditioned response. Train by instruction and practice; especially to teach self-control. Specify as a condition or requirement in a contract or agreement; make an express demand or provision in an agreement; Put into a better state.

Convergence. The occurrence of two or more things coming together. The approach of an infinite series to a finite limit. A representation of common ground between theories or phenomena. The act of converging (coming closer).

Co-adaptation and co-evolution. Co-adaptation refers to the mutually selective forces acting on entire groups of organisms in an ecology to accumulate favorably interacting genes in the gene pool of the population. Complex systems deal with not just one organism adapting to a given set of circumstances, but with many organisms, all adapting to, and evolving with, all of the organisms that make up their environment.

Constraint. Constraint is the measure of the reduction in variety or reduction of freedom. If the actual variety of states that the system can exhibit is smaller than the variety of states we can potentially conceive then the system is said to be constrained. Mathematically speaking the relationship level of constraint (C) and variety (V) is represented as $C = V_{max} - V$.

Decentralized Order. Decentralized order refers to the fact that the spontaneous appearance of order in a complex system is typically due solely to parts acting locally on local information. The global order thus emerges without any need for external control. There is no God-like "oracle" dictating what every part ought to be doing.

Effect. Something that inevitably follows an antecedent (as a cause or agent; power to bring about a result.

Emergence. The act or an instance of emerging; any of various superficial outgrowths; penetration of the surface by something new.

Emergence. The act or an instance of emerging; any of various superficial outgrowths;

End state. What the NCA wants the situation to be when operations conclude; both those where the military is the primary instrument of national power employed and those where it supports other instruments.

Epistemic. Of or relating to epistemology; the philosophical theory of knowledge.

Equilibrium. There are biological, physical and chemical definitions of this term. In the physical sense an object is at equilibrium when it is at rest. This may be due to the absence of any forcing acting on it, or the canceling out of two equal, but opposite forces. In chemistry it refers to the balance of the transmission of energy in the sense that if an object is emitting heat at the same rate as the environment can absorb it, the system is said to be in equilibrium. Finally in biology the idea of equilibrium is given to a system that is not developing. For the sake of this monograph a system is said to be in equilibrium when it is in a particularly simple, quiescent state such that its properties are constant and spatially and temporally uniform. The most uninteresting systems, from the point of view of complex systems theory are systems that are in equilibrium. The most interesting systems are those that exist in far-from-equilibrium states, continually seeking new ways to adapt to their environment.

Fitness. Fitness is an assumed property of a system that determines the probability that the system in question will be selected to survive, reproduce or be produced.

Form. The shape and structure of something as distinguished from its material; the essential nature of a thing as distinguished from its matter; a standard or expectation based on past experience.

Frame. To construct by fitting and uniting the parts of the skeleton of; to give expression to; to fit or adjust especially to something or for an end.

Logic. Reasoned and reasonable judgment; the principles that guide reasoning within a given field or situation. A system of reasoning.

Logical. Capable of or reflecting the capability for correct and valid reasoning. Marked by an orderly, logical, and aesthetically consistent relation of parts. Based on known statements or events or conditions. Capable of thinking and expressing yourself in a clear and consistent manner.

Logics. Reasoned and reasonable judgment. The principles that guide reasoning within a given field or situation; a system of reasoning.

National Command Authority. Consist of the President and SECDEF or their duly deputized alternates or successors. The term NCA is used to signify constitutional authority to direct the armed forces military action. Both movement of troops and execution of military action must be authorized by the NCA. By law, no one else in the chain of command has the authority to take such action.

Non-linear. In the most basic sense, non-linear means that the output of a system is not directly or inversely proportional to its input. Linear equations contain only addition, subtraction, multiplication or division. Non-linear ones involve logarithms, exponents and trigonometric functions.

Non-periodic. Non-repetitive, and characterized by never settling into a closed loop behavior in phase space.

Paradigm. An outstanding clear or typical example or archetype; a philosophical or theoretical framework of any kind.

Phase Space. Phase space is a mathematical space spanned by the parameters that describe a dynamical system's behavior. If the system is described by an ordinary differential flow, the entire phase history is given by a smooth curve in phase space. Each point on this curve represents a particular state of the system at a particular time. For closed systems, no such curve can cross itself. If a phase history of a given system returns to its initial condition in phase space, then the system is periodic and it will cycle through this closed curve for all time. For example, a mechanical oscillator moving in one-dimension has a two-dimensional phase space spanned by the position and momentum variables.

Planning. The act or process of making or carrying out plans; to arrange parts of design; to devise or project the realization or achievement of; to have in mind.

Process (psychology). The performance of some composite cognitive activity; an operation that affects mental contents. A particular course of action intended to achieve a result. A sustained phenomenon or one marked by gradual changes through a series of states.

Rationale (law). An explanation of the fundamental reasons (especially an explanation of the working of some device in terms of laws of nature) Defend, explain, clear away, or make excuses for by reasoning. Weed out unwanted or unnecessary things. Structure and run according to rational or scientific principles in order to achieve desired results; Think rationally; employ logic or reason. Remove irrational quantities from;

Rationalized. To bring into accord with reason or cause something to seem reasonable; to attribute (one’s actions) to rational and creditable motives without analysis of true and especially unconscious motives.

Reductionism. The practice of analyzing the behavior of an entire system as a product of the behavior of its components.

Self-Organization. Self-organization is a fundamental characteristic of complex systems. It refers to the emergence of macroscopic non-equilibrium organized structures due to the

collective interactions of the constituents of a complex system as they react and adapt to their environment.

Self-Organized Criticality. Self-organized criticality (SOC) embodies the idea that dynamical systems with many degrees of freedom naturally self-organize into a critical state in which the same events that brought that critical state into being can occur in all sizes. The kinds of structures SOC seeks to describe the underlying mechanisms for look like equilibrium systems near critical phase-transition points but are not near equilibrium; instead, they continue interacting with their environment, "tuning themselves" to a point at which critical-like behavior appears. Put in the simplest possible terms, SOC is nature's way of driving everything towards a state of maximum complexity.

Sensitivity to Initial Conditions. Sensitivity to Initial Conditions (SIC) explains how deterministic chaos is characterized chiefly by the so-called "Butterfly Effect," which alludes to the fact that two initially nearby points of a chaotic trajectory diverge in time. A small change in an initial condition or parameter results in radically different end states.

Spatial. Relating to, occupying, or having the character of space; of or relating to facility in perceiving relations.

Striating. To mark with striation or striae; striae: a stripe or line distinguished from the surrounding area by color, texture, or elevation – a groove.

Structuring Dependent Process. A concept reflecting a synthesis of ideas inferred or derived from specific circumstances where each of the ideas is dependent on the other.

Structuring. Give a structure to; structure: A thing constructed; a complex construction or entity. The manner of construction of something and the arrangement of its parts. The complex composition of knowledge as elements and their combinations.

Subjective. Taking place within the mind and modified by individual bias. Of a mental act performed entirely within the mind.

System Framing. Grouping independent but interrelated elements into a unified whole.

System. A group of independent but interrelated elements comprising a unified whole: instrumentality that combines interrelated interacting artifacts designed to work as a coherent entity; a procedure or process for obtaining an objective; an ordered manner; orderliness by virtue of being methodical and well organized.

Systemic. Affecting an entire system.

Systems Theory. The trans-disciplinary study of the abstract organization of phenomena, independent of their substance, type or spatial or temporal scale of existence. It investigates both the principles common to all complex entities, and the (usually mathematical) models that can be used to describe them.

Temporal. Of or relating to time as opposed to eternity; of or relating to time as distinguished from space.

Tension. Feelings of hostility that are not manifest. The physical condition of being stretched or strained; A balance between and interplay of opposing elements or tendencies (especially in art or literature); (physics) a stress that produces an elongation of an elastic physical body.

Unpredictable Determinism. Sensitivity to initial conditions implies that, despite the dynamics of a system being rigorously deterministic, the long-term behavior of such a system appears irregular and is unpredictable.

Variety. A system's variety measures the number of possible states that the system can exhibit.

APPENDIX II – A Primer in Systems Theory

Systems, Chaos and Complexity Theory

General Systems Theory (attributed to the biologist Ludwig von Bertalanffy who advocated an interdisciplinary approach to the study of systems) emerged as scientists realized that a linear approach to real world phenomena was flawed.[41] Bertalanffy emphasized that systems interacted with their surroundings and thus could adapt to the environment as well as being affected by it. The problem, and the beauty, of systems theory is that it is almost impossible to do just one thing, everything has second and third order effects.

Systems theory has its own plethora of vocabulary, only the essential terms are described here (a comprehensive list is in Appendix I). A system is said to exist when a set of elements are inter-connected so that changes in one element or their relationship with others results in a change elsewhere and the entire system exhibits properties and behaviors different from the parts.[42] The two main types of system are open and closed systems.[43] Open systems take on board excess energy to replace that which is lost in order to continue operating and remain alive. Closed systems seek equilibrium, and because they are denied the ability to take in energy from outside, in accordance with the second law of thermodynamics, die.[44]

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[41] The view of warfare through the Newtonian lens envisages war as predictable as long as we collect perfect information, and through the lens of reductionism, where by we reduce problems to their base constructs to deal with them. Certain elements of the targeting process are good examples of this. Complexity theory offers a broader framework. Newtonian methodologies cannot explain the complex interactions that occur between individuals and groups of systems.

[42] Robert Jervis, "Complex Systems: The Role of Interactions," Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security* (Washington D.C.: National Defense University 1997), 1.

[43] Ludwig von Bertalanffy, *General Systems Theory – Foundations, Development, Applications*. (Eleventh Printing. New York: George Braziller, 1993), 38 and 149.

[44] All About Entropy, The Laws of Thermodynamics and Order from Disorder. Available at http://www.entropylaw.com. The second law of thermodynamics (the entropy law or law of entropy) was formulated in the middle of the last century by Clausius and Thomson. They based their theory on Carnot's earlier observations that, like the fall or flow of a stream that turns a mill wheel, it is the fall or flow of heat from higher to lower temperatures that motivates a steam engine. This law states that over time there will be an increase in disorder as all things break down from complex composites to their constituent parts. For example, when one burns coal, a simple and singular item, it transforms into heat and light (both of which are forms of energy), smoke, and charcoal or dust (dependent on the temperatures involved). This single

Systems are also either dynamic on non-dynamic, and linear or nonlinear. A dynamic system will exhibit a change in response over time due to some input, force, information or energy. Within the realm of the dynamic, there are two sub-types of systems, conservative and dissipative. A conservative dynamic system does not lose energy from friction where as a dissipative dynamic system does.[45] This friction can be thought of in terms of the amount of energy required to overcome inertia, or that spent on a system's feedback loop mechanism, or simply as the Clausewitzian concept. Finally, any of these systems can be classified as either linear (where they are predictable) or non-linear (where they are non-predictable in the long run).

Systems control themselves through a duel process of feedback and internal models.[46] Positive feedback reinforces the input to output ratio (for example growth is followed by more growth, reduction by more reduction). This allows change to occur but can result in the system becoming unstable. Conversely negative feedback acts as a braking mechanism, returning the system to equilibrium but leads to a stable system that will approach equilibrium and become predictable and hence die.[47] Systems that have a preponderance of negative feedback mechanisms are "well-buffered."[48] The system makes decisions based on a realization of its actions with the

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piece of coal has broken down into other forms of energy that have dissipated into the atmosphere. Furthermore one cannot take the products after burning and transform them back into coal; the process is irreversible. Thus over time, all systems will breakdown into their constituent parts and the level of disorder, or entropy, will increase. A shorter discussion can be found in Waldrop, 33.

[45] A dissipative system exists far from equilibrium and efficiently dissipates the heat generated to sustain it and has the potential to develop its level of order.

[46] The study of the control of systems is called *cybernetics*. The internal models analyze the effects of the decisions and the affects of the environment within which they act to coordinate the next move. An example is a trying to pick an object inside a fish tank up with one's hand while observing through the glass. The internal model (the brain) directs the system (the whole body) to move the hand toward the object. With its depth perception hampered by the change in light refraction, the chances of success on the first attempt are slim. The feedback to the brain is via the eyes, and the brain then adapts its internal model to compensate for the refraction and the process starts again. If there was no internal model then the brain would not be able to analyze the result and the system would be unsuccessful in trying to carry out its actions.

[47] The term "states of a system" cover these two extremes. The state of a system is a well-defined condition that the system exhibits and can be used to classify it.

[48] Dietrich Dörner, *The Logic of Failure – Realizing and Avoiding Error in Complex Situations.* (Translated by Rita and Robert Kimber 1996. Cambridge, Massachusetts: 1989), 75. A well-buffered system incorporates many negative feedback mechanisms and can absorb many shocks and not become

environment, which are captured in its internal models.[49] Within this internal model is an aim to which the system synchronizes its mechanistic actions towards.[50] This concept will be covered in more depth in the complexity discussion.

The remaining three issues to understand are variety, fitness and self-organization. Variety will be considered here, the other two within the complexity discussion. Variety is inversely proportional to level of constraint. This level of constraint is determined by examining the difference between the maximum number of states that the system can exhibit and the number of states that can be conceived for that system.[51] If this number is negative then the system is constrained. Thus the more constrained a system is, the less variety it has, and thus the more predictable it becomes. This leads to Ashby's law of Requisite Variety that states that only variety can destroy variety.[52] This theory may be crucial in developing future operational concepts. Does sheer size have an effect? Maybe, as if you completely and utterly outnumber the enemy to the point where he cannot do anything to either effect you or adapt to a position of advantage then it is possible to have forced him to equilibrium, but the causal relationship therein is far from clear.[53] This theory has been applied to military systems, where the input is in the form of reinforcements (to enable formations to continue to fight) and information (that enables the staff to change plans accordingly) to deliver the effect required. Their output is in the form of orders

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unstable. This is both good and bad. By being able to deal with many shocks, the system is unlikely to come apart, but it is also unlikely to embrace change or growth.

[49] These models are initially simple in nature, but develop over time to allow for complex prediction and learning to occur.

[50] Naveh, 14.

[51] A very simple example will explain this. Take a liquid such as water, which can be envisioned to be a gas, a liquid or ice. These three forms which the liquid can be imagined in are also the three states that it can actually be in. Thus, water is not constrained.

[52] W. Ross Ashby, *An Introduction to Cybernetics* (New York: John Wiley & Sons, 1956), 207. The law actually states that the larger the variety of actions available to a control system the larger the variety of perturbations it is able to compensate. Put simply it is easier to predict what some one will do if he can only do a couple of things. The greater their choices the harder it is to predict. If a system can be reduced in its number of options then it can be predicted and thus controlled. This concept has an implication for counter insurgency (COIN) doctrine, as the force deployed to deal with the insurgents must be able to operate at least as flexibly as the insurgents, and ideally with greater flexibility.

[53] The indeterminacy of cause and effect is because size and mass may allow a certain degree of flexibility and that this then equates to variety, or the reverse.

and plans for execution by sub-units. With there being limits on resources and the time to receive them, the ability to process information, etcetera, the best a deployed military system can hope to be is a semi-open system, destined to finally collapse in on itself. In an attempt to alleviate this, mission command acts as a way of keeping the system partly open. Units cut off from their headquarters can still operate to a certain degree for a period of time. Second, systems theory recognizes that "the ability to survive is programmed into every system" and thus has utility in explaining resistance to shock and the temporal aspect of shock's effect.[54]

Why is systems theory so important? First, it recognizes that we cannot expect a threatened enemy system to acknowledge defeat without at first trying to adapt and change.[55] It also explains why systems strive to continue to operate long after they should have been destroyed. Major Madelfia Abb developed this idea in a monograph entitled *A Living Military System on the Verge of Annihilation*.[56] Abb shows how living systems have the choice and the ability to change to ensure survival.[57] She also describes in detail that when a military system is in equilibrium (that is not learning, changing or anticipating) it is combat ineffective and therefore "dead."[58] Abb also claims that the more an organization is capable of self-organizing and operating far from its equilibrium (that is constantly learning and changing its tactics) the more it is likely to survive.[59] Abb cites examples from the Second World War and the Korean War where systems that could not adapt to fight their enemy were destroyed.[60] At the end of the

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[54] Ervin Laszlo, *The Systems View of the World – A Holistic Vision for Our Time* (4th printing. Cresskill, New Jersey: Hampton Press, 1996), 74.

[55] It is analogous with a boxer, who after being almost knocked out in a round, comes out from his corner having changed his stance to protect his chin from his opponent's fists; thus his opponent should not anticipate being capable to deliver any single knock out blow using the same tactics as before.

[56] Madelfia A. Abb, "*A Living Military System on the Verge of Annihilation*." Monograph, School of Advanced Military Studies, US Army Command and General Staff College Fort Leavenworth, Kansas, AY 99-00.

[57] Ibid., 17.

[58] Ibid., 31.

[59] The distance that any system is able to operate from equilibrium is determined by the robustness of its cognitive ability. The greater the level of dissonance that can be tolerated while not preventing the system from working towards its aim the greater the probability of development and emergence.

[60] Ibid., 44-47.

monograph Abb predicts how the theory can be used to help target enemy systems by highlighting three major areas for application:

> Isolating or disrupting the functional networks, military structures and cognitive decision making elements of an enemy system that enables living. Destroying or dominating an enemy's ability to self organize. Force the enemy system to operate toward an equilibrium, making his responses predictive, reactive and limited in number.[61]

Second, systems theory warns us that as war is a non-linear event, no single formula, methodology or capability can predict outcomes or guarantee victory.[62] It also explains why certain inputs, or "shocks" to the system can have disproportionate and unexpected results that change the situation dramatically. Currently the US military doctrine concentrates on attacking things as opposed to systems. Campaign plans are poor attempts at trying to break down a system into its constituent parts and then deal with them individually. In short, despite acknowledging that systems exist, current campaign planning is reductionism at its best. If one subscribes to systems theory, and admits that the world is intrinsically nonlinear, then one must understand the concepts of chaos and complexity.

Chaos Theory

Put simply chaos theory is the study of nonlinear systems.[63] Chaos theory was "discovered" as early as the turn of the nineteenth century by a physicist, Henri Poincaré. Poincaré found that when using Newtonian physics to predict the movement of the planets that a small variation in the initial input values to the system resulted in a large discrepancy in the

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[61] Ibid., 48.

[62] Christopher D. Kolenda, "Transforming How We Fight: A Conceptual Approach," *Naval War College Review* Vol. 56, No. 2 (March 2003): 10.

[63] Linear systems, a product of the Newtonian age, are denoted as sharing three common characteristics. These are proportionality (changes in input lead to proportional change in output); and additivity (the whole is equal to the sum of the parts.) Consequently, even if the linear equation is very complicated, once one knows the inputs one can calculate the output. An excellent, if somewhat long introduction to the topic can be found in Glenn E. James, "*Chaos Theory: Essential for Military Applications*," Advanced Research Program Paper, Naval War College Newport, RI, AY 94-95. ADA 293163.

predictions.[64] Poincaré examined other systems and was able to prove that for several systems that a tiny imprecision in the initial set variables would grow at an enormous rate.[65] Consequently, prediction was only valid for a short time period.[66] Unfortunately, early interest in the field was minimal and the idea faded.

Chaos theory was rediscovered in the 1960s.[67] Further studies in the 1970s by computers proved that while many systems were highly susceptible to their starting values (sensitive to initial conditions or SIC) and apparently unpredictable in their behavior, they could be modeled in a nonlinear manner. Also discovered was that complicated dynamic systems appeared to have points of instability where a small push could have large consequences.[68]

Chaos is an oft-misunderstood term, the term non-linear dynamics is a less loaded and more descriptive term, but is less catchy.[69] Chaotic systems are neither random nor periodic. Randomness would result in an inability to predict anything and the best guess for the outcome of the system in the next iteration as being based purely on the last result. Chaotic systems' futures

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[64] Poincaré showed that the motion of three bodies, although each governed by strict and predictable mathematical equations could not be solved as an interacting system using Newtonian Physics. Up to this point, any linear system could be predicted mathematically by using a set of start variables. Once the start set was defined working out positions in the future was simply a matter of mathematical prediction. An explanation of this phenomenon can be found at http://www.exploratorium.edu/complexity/CompLexicon/chaos.html.

[65] Lessons in Chaos, University of Texas Website. Available at http://order.ph.utexas.edu/chaos/index.html . Accessed 9 August 2004. This web site offers a very user friendly, if somewhat basic, introduction to the theory of chaos.

[66] Prior to this discovery, it had been assumed that any error in the predictive ability of a system was due to an inability to be able to measure accurately the starting variables. In theory, as long as the start values of the variables were measured more accurately the results would be more accurate.

[67] Meteorologist Edward Lorenz, during an attempt to model the weather, developed a software program to try to describe the flow of hot air currents. Despite entering very similar start values for his variables, Lorenz discovered the same results as Poincaré. An infinitesimally small difference in the start values produced drastically different end values. This effect has since become known as the "Butterfly Effect." The idea is that a butterfly flapping its wings could theoretically create enough turbulence in the atmosphere to lead to a storm some time later. The "Butterfly Effect" is often attributed to Lorenz.

[68] James Gleick, *Chaos – Making a New Science* (New York: Penguin Books, 1997), 19.

[69] Steven R. Mann, "Chaos Theory and Strategic Thought" *Parameters* Vol. 22, No. 3 (Autumn 1992): 57. The word chaos carries too many images of randomness and anarchy for what is effectively a mathematical discipline. In the article, Mann highlights the use of chaos theory in strategy. A counter argument for the prevalence of chaos in strategy can be found in Colin S. Gray's book *Strategy for Chaos – Revolutions in Military Affairs and the Evidence of History* (University of Reading, Frank Cass & Co Ltd, 2002).

are dependent on their initial conditions. They are not periodic because their behavior never repeats (although it may come close and set a pattern). This is an important point to consider and will be developed later. Despite being relatively unpredictable, these systems can be modeled by equations, and bounded by principles and rules.

The problem with chaotic systems is that they can only be predicted to any degree of accuracy in the very short term. It is possible, however, to estimate how many key variables drive the system and from there begin to attempt to model (and thus potentially control) the system. By analyzing the "attractors" within a chaotic system it is possible to try to ascertain the length of time a system will remain "stable" and thus be predictable. It is also possible to predict how long a system placed in chaos will take before returning to the complex environment.[70] The largest issue with chaos theory is that it has not offered many practical lessons to the military planner except remain agile, flexible, and think on your feet.[71]

Complexity Theory

Complexity theory (a relatively new field of research) rose from the twin roots of chaos and systems theory.[72] Chaos theory, despite its promising beginning, was unable to offer solutions to the majority of problems it highlighted, as well as only applying to a restricted set of

[70] An attractor is something that the system gravitates towards when in chaos. An example is the natural leader to whom all turn when something catastrophic happens. These attractors could be considered as depressions within an area as they attract the system when it is in chaos.

[71] Michael J. Mazarr, "Chaos Theory and U.S. Military Strategy: A 'Leapfrog' Strategy for U.S Defense Policy" (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), 1. In addition to this it can be argues that doctrine should be raised to the correct level, away from Tactics, Techniques and Procedures in order to provide the basic underlying principles.

[72] For those wanting to discover the development of chaos, systems and complexity theory a good, if somewhat lengthy introduction to these topics can be found in Kevin B. Glenn, "*Complex Targeting: A Complexity-Based Theory of Targeting and Its Application to Radical Islamic Terrorism,"* (Faculty of the School of Advanced Air Power Studies Monograph, Air University, Maxwell Air Force Base, June 2002): 6-44. A more succinct but complicated version is in Andrew Ilachinski's *Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook*, (Alexandria: Center for Naval Research): 21-23 and 62-63. Complexity Theory is commonly traced back to 1984 and the Santa Fe Institute where elites from differing academic fields began to discuss complex systems in nature.

phenomena that change in unpredictable ways.[73] Complexity theory developed to explain why certain complex adaptive systems that appear to operate close to the realm of chaos are not chaotic and why the second law of thermodynamics did not appear to apply to biology.[74] As one would expect from its name, the definition of complexity theory has turned out to be hard to find.[75] In short, it is about the results of interactions that cannot be explained by linear cause and effect. Dörner defines it as "the existence of many inter-related variables in a given system."[76] Within this he states that two key of the key attributes of the concept of complexity are those of intransparency and inter-relations.[77]

A simple definition would describe a complex system as occurring when "a great many independent agents are interacting with each other in a great many ways."[78]Adding depth to this allows the derivation of complexity theory to be the study of systems which exhibit complex, self-organizing behavior. A complex system is any system composed of numerous parts, or agents, each of which must act individually according to their own circumstances and requirements, but which by so acting has global effects which simultaneously change the

[73] John Horgan, "From Complexity to Perplexity," *Scientific American* (June 1995): 104-109.

[74] Through observation, theorists noted that systems did not spin into chaos with monotonous regularity nor did they approach equilibrium and thus stop evolving. It appeared that certain systems were able exist at the edge of chaos and thus by becoming adaptive could attempt to turn the situations they faced to their own advantage and undergo spontaneous self-organization. This forced a switch away from physics and mathematics as a means of explanation, and instead forced an analysis of the dynamism of cell structures. Complexity theory is thus an attempt to explain the behavior of complex adaptive systems. Pure chaotic behavior would preclude any real coordination and evolution over time. This topic is still hotly debated. It is key to point out that any closed system will obey the second law, but biological systems have a highly developed ability to remain, at worst, semi-open in order to survive.

[75] The problem is not with specific fields of complexity theory where definitions are relatively easy, but with an overarching definition. Perhaps one of the better descriptions is that complexity is a lack of symmetry. Waldrop cites the case where one researcher found 31 definitions of the topic!

[76] Dörner, 37.

[77] Intransparency results in an inability to see all of the problem. The interrelation effect results in an action that is meant to affect one part of the system will affect another, thus guaranteeing second and third order effects and subsequent repercussions.

[78] M. Mitchell Waldrop, Complexity The Emerging Science at the Edge of Order and Chaos. (New York: Touchstone, 1992), 11.

circumstances and requirements affecting all the other agents.[79] Thus, the complexity is not brought about by the number of parts within the system but by the interactive and dynamic nature of the system.[80]

Waldrop describes complex systems as having a great number of interacting independent agents, allowing the system to undergo spontaneous self-organization, active adaptation to gain an advantage, and possessing a dynamism compared to static but complex systems.[81] It is an environment where phenomena are unpredictable, but action is within bounds. Thus, complexity falls into two categories: behavioral complexity and system complexity.[82] Nonlinearity is the absence of linearity. Linear systems exhibit proportionality of cause and effect (twice the input will give twice the output), the idea of additivity (the whole was equal to the sum of the parts), and perfect predictability being possible with perfect information.[83] Consequently, nonlinear systems are hard to predict. They respond in differing ways to varying inputs, develop their internal models over time and thus can either become extinct or develop rapidly (the concept of punctuated equilibrium).

There are four major attributes to nonlinear systems. First, all variables are interdependent; and consequently, everything is interconnected. Reductionism is useless as any action will have second and third order effects. Second, the systems are Sensitive to Initial Conditions (SIC) and so a small change in the initial values can result in a large difference in result. This is identical to chaos theory. Third, the output of the system compared to its input is

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[79] John F. Schmitt, "Command and (Out of) Control." (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), p7.

[80] Schmitt, 1997: 7, and G. Scott Gormann, "*Adapting to Chaos: American Soldiers in Siberia, 1918-1920,*" (Monograph, School of Advanced Military studies, US Army Command and General Staff College, Fort Leavenworth, Kansas, AY 98-99): 6. A system with a great many parts is described as being structurally complex, or as exhibiting detailed complexity.

[81] Waldrop, 11-13.

[82] Ilachinski, Part II, 50-61.

[83] Czerwinski, Thomas J., *Coping with the Bounds – Speculations On Nonlinearity in Military Affairs,* (Institute for National Strategic Studies, Washington D.C: 1998), 25. This topic was introduced in chapter 1.

not proportional. This incorporates the fact that the rule of additivity does not apply (or as is often quoted $2+2 \neq 4$). The collective behavior of a nonlinear system can be greater or lesser than the addition based on the interactions. Finally, nonlinear systems bifurcate into multiple states, as shown in the bifurcation diagram below.[84]

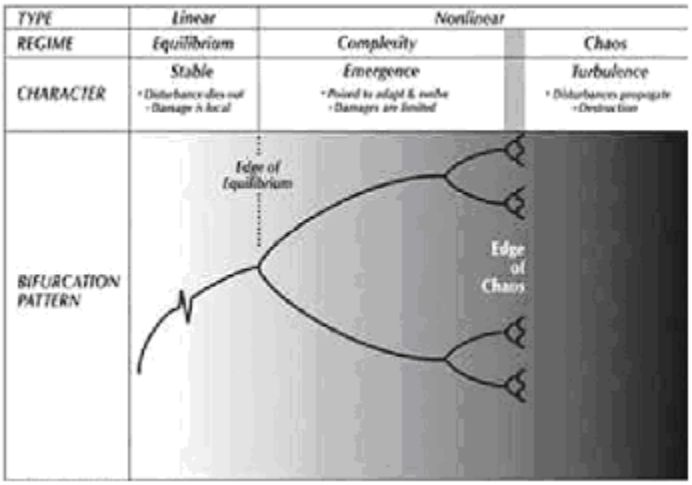

Figure 1: The Bifurcation Diagram – A Graphic Representation Of A System's Potential Evolution From Equilibrium To Chaos. (Source: Tom Czerwinski, Coping with the Bounds: Speculations on Nonlinearity in Military Affairs, 1998), 43.

On the left of the diagram, in the equilibrium zone (characterized by order and linearity), the system is stable without change, innovation, growth, or progress. Existence here implies that regardless of input or disturbance, the system will settle down in a steady state. At the first bifurcation, the systems pass the edge of equilibrium and into the complexity zone. This intervening region between chaos and equilibrium (often referred to as the edge of chaos) is the area in which the development of complexity thrives.[85] It is the point where "life has enough stability to sustain itself and enough creativity to deserve the name of life."[86] A perturbation

[84] Bifurcation means a sudden or drastic change in the pattern or output of a system.

[85] Waldrop, 12. The term "the edge of chaos" describes the place where components never quite lock into place, but are not chaotic either. It usually denotes a balance point, although this does not allow for a zone of complexity, and thus should not be seen as such a black and white case.

[86] Ibid., 12.

within this zone will force the system to choose between two options and settle down in one of two possible states. A memory of the choice and the possible outcome (built by an internal model) will be stored for future use. Again, if an input (from either the environment or another source) is experienced then the system has to choose again. As one moves further right, the number of states possible double at every bifurcation.

As the system approaches chaos it is forced to make more and more decisions in shorter and shorter time frames and thus cannot calculate for all of the factors, nor recover as quickly from a bad decision. It has become increasingly sensitive to perturbations. Eventually the system will have an infinite number of states to choose from, and thus will never settle down, and therefore is unstable. At this point, the system is pulled into the area where chaos rules, where feedback loops rapidly cause a system to spin out of control, and it is ripped apart.

This however is not the end of the system in its entirety. Unable to operate in a coordinated manner while in chaos it will find itself eventually being pulled toward an attractor which will allow the system to then operate with a semblance of order. Czerwinski further posits that if a system manages to recover after falling into chaos it will reconstitute itself back in the equilibrium realm and attempt to make its way into the complex environment again.[87] Thus as the system moves out from the region of equilibrium, it begins to develop in complexity. Yet, this gain in complexity forces an increase in disorder. The figure below shows the relationship of this tradeoff.

[87] Czerwinski, 51.

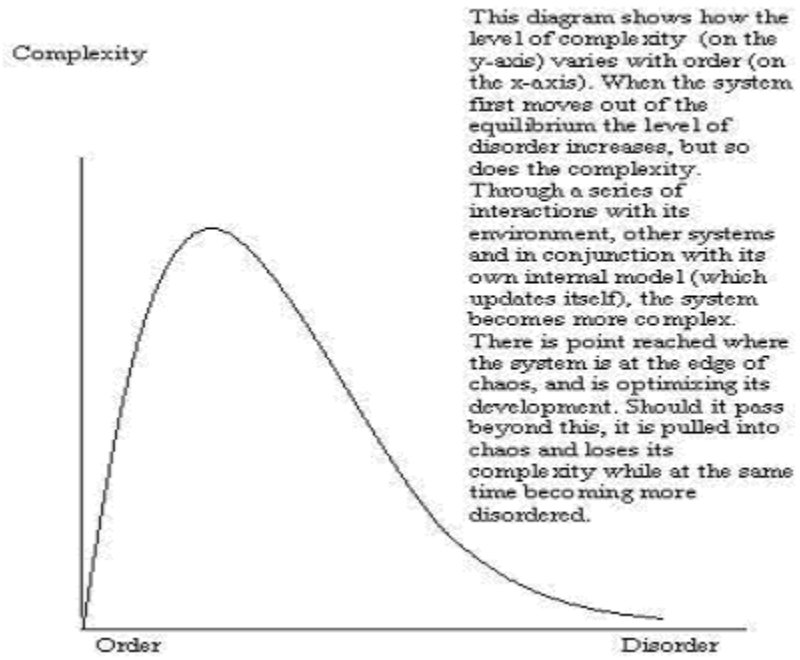

Figure 2: Representation Of The Relationship Between The Level of Disorder and Complexity In A System (Source: Andrew Ilachinski, Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook (U) 1996), 73.

The Fitness Landscape Model, Adaptation and Self-Organized Criticality

Most systems, once they enter the complexity domain, desire to interact with both the environment and other systems to become more complex. Not to do so dooms them to either extinction or a return to the equilibrium zone. This development takes place within a fitness landscape, a model based as an abstract of the Darwinian theory of natural selection.[88] The landscape is portrayed as a multi-dimensional map with the topology representing all the possible states a system can adopt. Systems strive to gain the highest piece of ground within their own visual range of this spongy landscape by evolving to take advantage of opportunities. Yet this process costs in energy, and so occasionally sub-optimal solutions may be beneficial. By limiting

[88] Charles Darwin, *On the Origin of Species by Means of Natural Selection*. Available on line at http://www.literature.org/authors/darwin-charles/the-origin-of-species/.

the amount of visibility, sub-optimal peaks are also possible even with a desire to maximize.[89] The degree of fitness or success of the organization (system) with a specific option (state) is depicted by the height to which they rise. The guidance mechanics of the system within this landscape is based on the system's continuously updating internal model, which through the results of previous plays as well as predicted outcomes of possible plays, chooses the action, and then interacts with its feedback to select which bifurcation route to take in order to maximize payoffs.

Systems also influence the landscape through their presence. Because all systems are interacting on this spongy surface the shift of one system will deform the landscape and thus create a change in relative position of the others. This can result in the system moving to a lower than optimal point, or having to expend energy to move to another peak. There is also a danger if a system stays in one place too long, out of sight of other systems, that its development vis-à-vis the other systems will slow down.

Conflict can occur naturally as systems continually strive to climb to the peaks and push their competing systems to the troughs. Systems can choose to expend energy on attempting to regain the peak, or on moving to another peak. They can also decide not to act and simply accept a sub-optimal solution. This whole process leads to uncertainty as systems cannot always see each other and thus are operating with less than perfect information. This lack of perfect information also determines the level of interactivity between the systems; when systems can see each other they can interact, when they cannot the interaction is indirect, and hard to measure. The concept of co-evolution originates from this concept. By the very presence of another system in the same environment as another, they begin to interact, albeit often unknowingly.[90]

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[89] One can see that the US Armed Forces desire for perfect information would result in a perfect understanding of this fitness landscape and thus an ability to act in a manner to always maximize one's development at the expense of another (rival's) system.

[90] There is considerable overlap here with the emerging idea of Reflexive Control Theory (RCT). Traditional prediction is an essential component of strategic and operational thinking; many models exist in

The fitness of a system determines the probability that the system will survive, reproduce or be produced. This quest for fitness helps explain the development of systems via a feedback mechanism into something that is more effective at surviving. At its simplest, it is evolution and survival of the fittest. It does not rule out less than optimal systems but does predict that over time they will die out. Thus over time systems strive to become more suited to their environments. This includes any competing systems, and explains why enemy systems that are not destroyed on first contact will develop in order to try to survive. The idea of the fitness landscape can be seen in figure 3.[91] This links into the concept of a system becoming dominant, that is able to withstand mutations within either a competing system or itself and still remain the one most likely to survive.

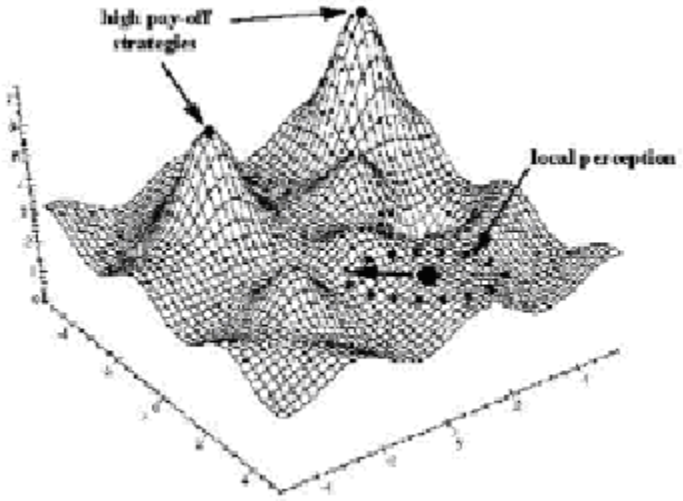

Figure 3: Diagram Illustrating The Concept Of A Fitness Landscape. (Source: Andrew Ilachinski, Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook (U) 1996), 137.

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an attempt to predict the future. The most serious shortcoming of these models is their assumption that the decision-maker is passive. RCT assumes that the decision-maker not only predicts the future by can at least partially affect the future by his own actions. Thus it sees its central problem as developing methods to influence the enemy decision making process by manipulating their perception of reality. This can be done by either affecting the internal model of the CAS or by affecting its feedback mechanisms, or both. The idea is still somewhat in its infancy but shows some promise.

[91] An excellent description of this model can be found in Ethan H. Decker, "Self-Organizing Systems: A Tutorial in Complexity" (Available on line at http://www.ncst.ernet.in/kbcs/vivek/issues/13.1/sos/sos.html.): 8-9.

Finally, one must understand the idea of adaptive self-organization and self-organizing criticality. Adaptive self-organization is how complex systems instead of tending towards disorder or entropy, spontaneously crystallize into more highly ordered states, but without central control.[92] In other words the "organization of a system spontaneously increases without this increase being controlled by the environment of an encompassing or otherwise external system."[93] The key to self-organization is found within the connections and interactions among the part of the system, and thus to ensure that the process continues the system must have a large number of interacting part (or agents).[94]

Self-organization originates from the same variation and natural selection processes as the environmentally driven processes of evolution. Therefore, organizations are born, grow, thrive, decay, die and subsequently disappear. All of this takes place as part of the process that also creates, distorts, and dissolves the structures of which they are part. [95] To achieve this self-organizing ability the system must be thermodynamically open, consist of many parts that can interact locally, and be able to benefit from feedback and be capable of emergence.[96]

Self-organizing criticality explains how systems drive themselves naturally to the edge of chaos where they maintain themselves indefinitely at a critical state in which complex phenomena appear.[97] This is a dangerous place to exist as a mistake by the internal model may plunge the system into chaos, yet self-organization is less likely the further one moves away from

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[92] In its purest form, this is physical existence of the concept of mission command, or the benefit of self-synchronization.

[93] Principia Cybernetica Web. Available at http://pespmc1.vub.ac.be/complexi.html. Last accessed 8 August 2004.

[94] Decker, 3.

[95] Ibid., 8. While living system clearly adapt, it is far from obvious that they adapt toward a critical state, unless this movement toward a critical state is necessary to ensure survival. This is one of the key differences between the biological and physical applications of complexity theory.

[96] Ibid., 2.

[97] The use of the word criticality is usually missed out in non-scientific analysis. Criticality within thermodynamics is used in conjunction with phase transitions. At all temperature other than the critical one, any perturbation will only influence the system locally. At the critical temperature then the whole system is affected, although only the closest neighbors to the point of input interact directly. The system has become critical in the sense that all of the members of the system have begun to influence each other. This allows the link to punctuated equilibrium.

the edge of chaos. Should the system fall into chaos then the remnants of those structures that are ripped apart may be continued in parts of other systems, or may disappear forever. The resilience of a system is partly determined by its self-organizing capability. Akin to the concept of being well buffered, the resilience of a system is its ability to be able to recuperate from attacks on its constituent parts.[98]

This process often leads to what Czerwinski calls punctuated equilibrium, where periods of self-organizing are normally followed by extended periods of quiet, or put another way a semi-chaotic period is simply an integral part of the whole system.[99] This punctuated equilibrium can be initiated by the interaction of the agents, and thus leads to emergence. Emergence is the concept that the product may not be the sum of the parts and more over cannot be predicted, by either the observer or the agent.

Systems adapt over time to try to take advantage of the changing environment. Nobel Laureate Murray Gell-Mann outlined three levels of adaptation over time that a system uses to react to the changing environment.[100] The first level, direct adaptation, is typified by the organization reacting to changes in very specific ways, on a very short time scale. The second level is where there is time in responding to events for one adaptation scheme to compete with and replace another. The third level takes place over an extended time-period, and is usually typified by a Darwinian process occurring to implement what the system believes is the best solution. Information processing is essential to the system's ability to adapt.

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[98] Michael F. Beech, "*Observing Al Qaeda Through The Lens of Complexity Theory: Recommendations For The National Strategy To Defeat Terrorism*." (Student Issue Paper, Center for Strategic Leadership, US Army War College, July 2004): 6. Within this paper, Beech examines the concept of coupling as a method for determining the fitness of a system. Tightly coupled systems tend to fall apart quicker than loosely coupled ones.

[99] This is not the same as bifurcation in the true sense of the term. Bifurcations are more common and less likely to result in a system so developing as to render its opponents useless.

[100] Murray Gell-Mann "The Simple and the Complex," (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), 3.

The core of complexity theory is the Complex Adaptive System (CAS).[101] The CAS is dependant on four main characteristics.[102] First it consists of a set of interrelated parts (agents) each capable of acting autonomously if required. Second, the nonlinear interrelationships between these agents make it a system, and third, their ability to break routine to take advantage of the situation makes them complex (simple systems would have simple input and output rules). Finally, their capacity to cope collectively with problems makes them adaptive. As mentioned earlier their interactions and behavior changes the environment making it more hospitable to one system and not to another.[103]

Despite the lack of a strong central form of leadership, these large collections of agents all interact and operate from the position of being close to equilibrium (but never at it) up to the edge of chaos (though they never fall in through choice). The agents also organize themselves into hierarchies. The CAS is further defined by seven attributes, broken down into four properties and three mechanisms. The properties are: aggregation, nonlinearity, flows, and diversity. The mechanisms are: tagging, internal models, and building blocks.[104]

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[101] James N. Rosenau, "Complex Systems: The Role of Interactions," (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), 4. Also in Thomas J. Czerwinski, *Coping with the Bounds – Speculations On Nonlinearity in Military Affairs*. (Institute for National Strategic Studies, Washington D.C: 1998), 13

[102] Czerwinski, 15-20.

[103] Robert Jervis "Complexity and Organization Management" (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), 5. The classic example given is that of Somalia in 1993. The US force, through its deployment, changed the environment in a way that was not envisaged.

[104] James K. Greer, "Operational Art for The Objective Force." *Military Review* Vol. 82, Iss. 5 (September/October 2002): 29. In this article Greer gives an excellent description of the various properties and provides military analogies. Aggregation is the ability of a system to adapt when it encounters problems that are more complex by simply combining smaller systems together (platoons, companies, etcetera). Building blocks are the components of the system that are aggregated to provide new capabilities (units or weapons), or that are produced by the system to allow it to deal with the new challenges. Tagging is the means by which the system identifies itself within the system (Drop Zone (DZ) flashes, colors etcetera). Flows are the movement of information and agents through the system (passing of orders or ammunition). Internal models are self-explanatory (Tactics, Techniques and Procedures (TTP), etcetera). Diversity is the ability of a system to use a variety of agents, models and building blocks to create multiple options for survival (for example the variety of combined arms in battle). Finally, nonlinearity is the means to avoid symmetrical and predictable, and thus open to domination (innovation and out of the box thinking.)

As discussed earlier, spontaneous self-organization allows for massively disorganized structures to crystallize.[105] This crystallization would produce new entities or stable aggregate patterns of organization and behavior arising from the interactions of agents. Thus, "a CAS on one level is made of a CAS from a lower level."[106] These groups form, by interaction with other groups, super-groups that again can act as agents, interacting with other agents and so forth, continuing the process. Within this collectivism, however, each part of the hierarchy (be it group or individual) is driven by two opposite tendencies. The first is an integrative tendency, which forces it to act within the larger whole, where as the second is a self-assertive tendency, which encourages the agents and the groups of agents to preserve their individuality. This results in a form of creative tension that can be exploited to reduce the system to component parts.[107]

The overall behavior of complex systems is self-organized without a centralized agency that dictates what every part ought to be doing, although in the military there is a need for some central processing. This is the internal model referred to earlier. After the individual sub-agents have interacted while the system may still be the same on the outside in a holistic sense, its internal operating mechanisms will be very different. The new system's stability originates solely from its feedback loops that keep it within a certain tolerable band of complexity.

The CAS exhibits adaptation and co-evolution tendencies, which in the process of evolving and interacting, change and thus change their environment. Even the most complex system can maintain itself in a period of relative stasis before undergoing new adaptive transformations (what complexity theorists call phase transitions). This punctuated equilibrium is usually followed by a further period exhibiting stable patterns of activity, as the system updates

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[105] This is what could happen in chaos realm once they have been drawn to an attractor.

[106] Robert R. Maxfield "Complexity and Organization Management" (Edited by David S. Alberts and Tom Czerwinski, *Complexity, Global Politics, and National Security*. Washington D.C.: National Defense University 1997), 3. Examples of this are the person, the family, the clan, and the firm. Military examples also abound (soldier, squad, platoon, company, etcetera). People are members of several CAS at once (person is a member of a family and a soldier).

[107] From this description, it is possible to see how armies, guerrilla formations and terrorists fit the description.

its internal models. Again, this is something that may be taken advantage of by striking quickly after an enemy CAS has undergone a phase change.

Unfortunately in open complex adaptive systems, it is usually impossible to predict when the transitions will occur or what the outcome will be. This means that even when it appears that the enemy is becoming predictable they may morph into something else, *without the other system immediately realizing*. The issue of forcing a phase change by pushing the system into chaos will be covered in chapter 3. The key to the CAS is its ability to process information. This enables the system to realize its position in the fitness landscape, to recognize threats and opportunities and also to be able to analyze the likely results of its actions and the responses both of the environment and potential enemy systems. Thus, two immediate ways to influence a CAS are by either changing its internal model (which is hard) or influencing the feedback to the system. A third way involves taking advantage of the system's desire to replicate success. A CAS, in its attempt to replicate itself, may not take into account recent or current information. This is because all human predictive models are not linearly regressive in nature.[108] This can be used against the system as if it is allowed to reproduce using incorrect or flawed data.

In summary, because of their behavior, CAS cannot be described by reductionist methods. In the act of exploring their properties in isolation, reductionism loses sight of the dynamics. The lifeblood of all complex adaptive systems is the continuous cycling of information from top to bottom to top to bottom.[109] Unfortunately, complexity theory currently lacks the ability to predict accurately, which planners do not like.[110] There is also a risk of confusion, as

[108] Put simply we allocate more weight to events that have occurred more often in the past to one that has just occurred. Although this does not allow us to predict large changes, it is by far the easiest method of forecasting.

[109] Andrew Ilachinski. "Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook," (Alexandria, VA: Center for Naval Analysis, July 1996), 12.

[110] Horgan, 104-110. Indeed there are still those who think that like Chaos Theory before it, Complexity Theory is unable to deliver on the claims it made to be able to explain a vast number of natures unanswered questions. Despite this, by identifying the undesirable outcomes for the enemy system, planners can attempt to create conditions through actions that prevent the living enemy system from doing anything except the undesirable choice

one needs to draw from both the study of physics and biology where the concepts of chaos and equilibrium in the two fields are somewhat different. Finally, there is also a risk that complexity theory will fail to deliver all that it promised only a decade ago.[111]

Yet, from a military planner's view by recognizing the inherent individuality and the fact that both systems (ours and the enemy's) are currently and constantly unfolding highlights a point of focus. Assuming that the enemy's system cannot be chaotic for any long period of time (as this would preclude any real coordination and evolution), but is evolving, it must be operating near the edge of chaos.[112] This position however, is one of both strength and weakness. If a tool is developed that will push the system towards stability (and thus away from the zone where evolution occurs), it will force it to be less complex and so easier to deal with in a standard manner. Alternatively, if the planner could force the enemy system into the chaos band it can very quickly be consumed by its own inability to keep up with its changing system.

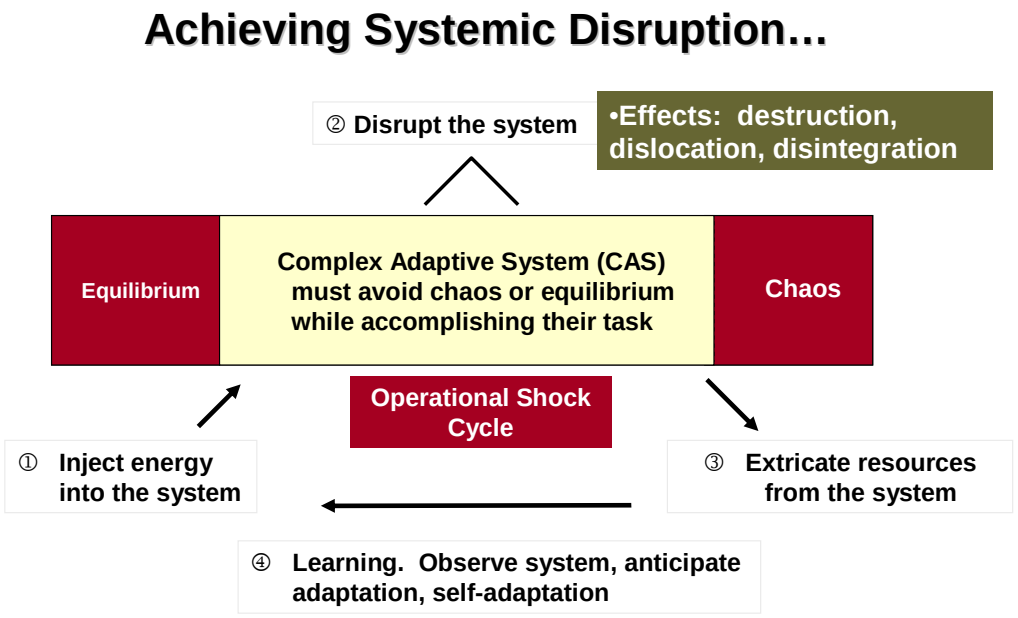
The above should come with a word of warning, as not only bad things happen in the realm of chaos. In line with the common view that if given an infinite number of monkeys, typewriters and time, that one would produce the complete works of Shakespeare, from the flames of chaos a new phoenix can emerge, more powerful than the last.[113] Once the system has been pushed into chaos our ability to predict its behavior rapidly diminishes, only long term trend analysis is possible.

Current doctrine and operational constructs have concentrated on concrete means and materials that allow fighting to occur and not the essential elements of will or motivation. Yet, motivation on its own is not sufficient. It must interact with the other elements to ensure that it

[111] Rosenau, 1.
[112] Waldrop, 12.
[113] The aim is not to suggest that Shakespeare was a monkey, but to draw attention to the concept that when one begins to work in the infinite then probabilities of an event occurring at least once tend to unity.

can project its force. Thus there is a need to consider both the CAS approach and the issue of will or motivation.

Representation of the Spectrum of Complexity and the SOD Cycle[114]



[114] The above chart is a conceptual cycle describing the use of energy to disrupt systemic conditions and systemic functions. The application of force is designed to exploit the underlying conditions of the system (initial conditions) and anticipates nonlinear change. The system itself will attempt to adjust to the new energy and seek a new balance (a new state or character).

APPENDIX III - Systemic Operational Design: Its Perspectives as a Start Point for Thought on Operational Art

Systemic Operational Design is fundamentally a structured thought process used to design a concept for the application of military force.[115] The practitioner using SOD methodologies explicitly invokes a series of inter-related discourses to rationalize (in other words- create) baseline understanding about the problem to be addressed. It is the problem setting and the context generation that sets SOD apart from other operational design methodologies, namely Classic Elements of Operational Design (CEOD) and the MDMP.

SOD resides at the operational level of war. Geographic Combatant Commanders and Staffs, as well as deployed Joint Operational Commanders and Staffs are the primary practitioners of SOD methodologies. Operational level headquarters *create* military operational logic through design. Military operations may range from full war plans (also known as campaign plans) on the upper end of the spectrum to the Operations conducted within a theater of operations. For example, campaigns such as Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) are war plans and initiate the application of military force against an identified adversary, within a broader context of war. Within each of these theaters, now active since the end of the "decisive" phase of the conflict, operational level headquarters still design, plan and execute military operations. Operations such as Fallujah I and II within OIF, Operation Anaconda and subsequent spring offensives within OEF serve as operations designed, planned, and executed by the operational level commanders responsible for military operations in each of these theaters.

Users of SOD methodologies explore the "white space" of operational art and campaign design or operational design from several key perspectives:

[115] The observations in this Appendix are the summation of the experience had by the authors following five weeks working with SOD, the senior mentors, and BG(R) Shimon Naveh.

Operational art serves as a translating function between the strategic purpose (aim) and the tactical action.

The operational commander, either as a RCC or as a JTF commander, is positioned to have interaction and discourse with the representatives of the other instruments of power and senior leaders of coalition partners. The tactical commands are generally not structured to do this coherently.[116]

The Operational level of war is qualitatively different from the tactical level of war.

Said another way, the operational level of war is not merely the gross aggregation of tactical interactions. Nor is it merely a linear increase in scope of command perspective. The qualitative differences between the tactical and operational levels of warfare are created by differences in the time and cognitive dimensions. Tactical actions occur in first order, "real" time dimensions while operational actions are often only understood or observed in delayed or elapsed time- within a second order time dimension. The operational commander must cognitively create his own understanding of the enemy through a variety of perspectives and observations. The operational commander "conceives" of his enemy and makes judgments subjectively about the enemy, his aims, and his entire capacity for conducting warfare over time. The tactical commander is different. His enemy is "real" and is operating in the same physical dimension has his own tactical forces, affected in the truest sense by the physics of the battlefield environment. The tactical commander can physically interact with his enemy -- see him, kill or capture him -- as the enemy is actively seeking the same.

The operational commander can only interact with his enemy in the cognitive realm and *through other agents* within the battle space. Further, at the operational level of war, because of

[116] See USJFCOM Joint Warfighting Center Pamphlet #7, "Operational Implications of Effects-based Operations (EBO)," 27-30.

the levels of interaction in the whole of the environment, the operational commander must view his actions and therefore conceive of the operational design, as occurring within the flux of an open, dynamic system. The tactical commander is different. His world is not abstract. For the most part, his problem is already structured for him -- by the design, by allocated forces and defined geographic battlespace, and by the interaction with the enemy in physical space. The tactical commander, because of his "real time" dimension, the physics of the battle space, and the "real" physical enemy he faces -- views his interaction through engagements and battles in terms consistent with a closed system. The logic of tactics does not scale to the logic of operations.[117] **Military force cannot produce a preconceived operational level "end state" through an engineered series of actions**.

The SOD practitioner approaches operational design from a perspective perhaps different from the predominant view of the use of military force – that is its application will produce preconceived end states. The predominant view seems to be that once a crisis or a significant need arises to use military force in the pursuit of war aims against a rival, that somehow the unconstrained or minimally constrained application of military force through employment of the tools of joint and coalition warfare can secure pre-determined and enduring outcomes for the political sponsor in a globalized, dynamic framework.

Consistent with the above paragraph, the operational level commander operates continuously within a complex, dynamic environment. Not only is he responsible for the military actions he directs but is a co-producer of systemic conditions within the greater environment. He must understand the context of his force with regards to the interaction with other social systems

[117] This also begs the question of whether a superb tactical commander necessarily has the qualities for operational command. There is a difference between direct leadership, organizational leadership and strategic leadership in terms of qualities, skills and attributes. Command also requires a different interaction of personal attributes than solely leadership. Commanders in the traditional sense were selected based on experience and demonstrated competence in solving problems and recognizing patterns. This is important at the tactical level. At the operational level, commanders will face problems that are never a repeat of previous patterns and are always "unique" and singular in context. The operational commander must lead from the center, lead thought, "mine" the minds of those he interacts with, and create vision through discourse.

(e.g., cultural, economic, political, etc). As such, and the realization that change is constant, the systems based thinking used to inform his design of military operations consider these aspects as an inherent element of the design process. The operational commander views the operational environment as a single ecology; the complex interaction of red, blue, and "white" elements. Although the military instrument can affect systemic behaviors, alter trends and emerging patterns to create new conditions, the military instrument cannot fully assure the realization of a predetermined end state (a static condition) through the application of a series of engineered activities. To believe one can "freeze" a dynamic system and act upon it to reach a pre-selected condition violates the character of dynamic, open systems behavior. This does not mean the military instrument cannot be applied to create and influence change in the direction of the strategic aim. Overarching purpose and the clear articulation of intent are still paramount for driving tactical action.

The operational commander is uniquely positioned to learn.

The operational level commander learns from interaction with the environment, combining perspectives obtained from systemic instruments (e.g., other operational level players, representatives of the other instruments of power, non-governmental players, and operational metrics, military and non-military). They also learn from the insights, observations and physical, tactile experiences of the tactical level commanders in their charge. Moreover, the operational commander inherently includes within the logic of the operational design the anticipation of what is to be learned from each operation that he conducts. SOD builds in the feedback loops for the operational commander to test his hypothesis and adjust his operational framework to better fit within the emerging circumstances of the environment, yet remain consistent with the overall purpose for military action and coherent and supportive of achieving the overarching strategic aim.

Tactical learning is about innovation of tactics and patterns, adjusting Tactics, Techniques, and Procedures (TTPs) to better adjust to emerging tactical requirement. For

example, the armored raids in Phase III of Operation Iraqi Freedom were actually a compilation of tactical learning and experience. V Corps conducted an Urban Operations Seminar at Camp Doha, Kuwait prior to the initiation of the ground offensive, involving commanders at all levels and explored a variety of tactical concepts for operating in cities with large armored and mechanized forces. The first "armored raid" was actually conducted by a company level commander well before COL Perkins initiated a brigade sponsored raid into the heart of Baghdad. Learning from each action informed the actions and TTPs of the next. This is the essence of tactical learning. These series of actions and learning events are not evident at the larger operational level of the campaign.

As OIF unfolded, there seemed to be a lack of operational learning and reframing of the overall campaign. As Fedayeen elements made several appearances on the battlefield, a structured inquiry was not conducted to assess the systemic implications of the behaviors and capabilities to generate sustained Fedayeen actions and perhaps this limited the operational level ability to adjust to this new reality. As we go into year three of OIF, the seeds of insurgency can be traced to the systemic conditions present in the emergence of the Fedayeen. Somehow, the greater system produced a dynamic unforeseen or at least underappreciated by the operational design.

Operational learning is the assessment and synthesis of greater systemic change and the reframing of operational designs and the reformation of tactical behaviors by design. This operational level learning will impact strategic outcomes. "In the beginning you can't know all you need to know to beat the bastard. You need a way to think your way through the problem. We are limited in the ability to comprehend the problems we face."[118]

[118] Discourse notes during UQ ''05 within the Case A team, insight offered by a senior mentor.

Appreciate that understanding of the larger system at the operational level is limited.

The larger system is one ecology, of which the enemy, the friendly, and the neutrals all form sub-elements of the system as a whole. Understanding and judgments formed to explain the system allow the operational commander to form an operational level hypothesis and then test that hypothesis through tactical actions in the form of engagements and battles. The operational level commander creates and tests his understanding of the larger system continuously. It is the up front acknowledgement that full understanding in this context is impossible. The operational commander must, however, only seek a *reasonable* understanding in order to act. He must remain nested to an overall aim and avoid taking actions that may damage or set back the larger set of integrated efforts unfolding in the pursuit greater national or coalition aims. As one senior operational level commander related, the pure logic of militarily operations (the best judgment on how to achieve a military outcome through joint actions) was often rendered illogical when viewed in a broader context by other key non-military players in the same environment.[119] This perspective does not imply the operational commander must act in a manner that places the lives of his soldiers at greater risk or sacrifices his best judgment of how to plan, support and conduct tactical operations. It merely means the tactical operations chosen will be in placed view of a greater set of operational circumstances.

The operational level commander must determine ends, ways and means within an acceptable level of risk (risk to mission, risk to force) and provide assessment to political risk as a part of the design context.

The planner, given a coherent design, has the ends and means determined, leaving him to engage in planning to determine the best ways to accomplish the mission dictated to him by the higher headquarters. The designer however, creates the general form, context and framework logic for the operation considering ends, ways, *and* means. The planner then animates the design

[119] SOD team dialogue with a former senior commander in OIF, week of 2-6 May 2005.

by assembling the allocated or assigned forces in time, space and nested purpose to meet the operational objective. Designers and planners are co-dependent in the formulation of operations. Operational and tactical commanders are co-dependent in the learning and testing of hypothesis through action and feedback. In terms of discourse between operational commanders and civilian leadership, there must exist an open exchange and sharing of perspectives and fundamental understanding at the problem formulation stage, both before and during the application of military force. Though the discourse is likely an "unequal discourse," it is discourse nonetheless and irreplaceable as a function of operational and strategic level command.[120] SOD provides a structured discourse and vehicle for learning with the strategic, political sponsor. It enables clarification of the vision and the rationale or logic for the military action.

The Adversary is not a monolithic, isolated being.

The adversary is a multidimensional actor with internal and external factors shaping his behaviors. He is receiving and evaluating feedback from the larger systemic framework, as is the "blue" operational commander. He may or may not have a higher political authority (in the case of non-state actors) but he will have a target constituency. He is shaped at any given time by the state of his sub-systems and the state of the larger system, as well as the capability he perceives "blue" of possessing.

Crises do not emerge from an isolated set of circumstances.

The issue emerging that requires dealing with has an associated "history." This history encompasses past interactions of the actors within the system frame, cultural perceptions or misperceptions and competing aims emerging from these same interactions, mismatch of cultural perceptions and values, and divergence of strategic aims. An inquiry, known in SOD as the genealogical inquiry or as the "issue history," leads to a better understanding (not a perfect understanding) of how we came to this point in time where we are confronted by the emergence

[120] See Eliot A. Cohen and his notion of "unequal dialogue" in "Supreme Command in the 21st Century," Joint Forces Quarterly (Summer 2002), 48-52.

of an unacceptable circumstance (at least politically) and the attendant need to "do something about it militarily."[121]

Military actions and tactical logic will be bounded and restricted by other factors.

World War II demonstrated the national will to move to a near total war. The stakes for national survival dictated that the near unbridled use of force was acceptable. Carpet firebombing and even the use of atomic bombs aside, the military was in a position due to the unique circumstance of the times, to act with the full support of the nation and the political leadership to achieve desired ends, ways and means commensurate with military imperatives. These are unlikely circumstances in our future, ergo there will always be constraints on action.

Design requires a greater capacity for abstraction than does planning.

Design is problem setting whereas planning is problem solving. Design frames the logical boundaries of the strategic problem. Actions will inherently create new problems. SOD is a systemic methodology to address systemic problems.

[121] See Neustadt, Richard E. and Earnest R. May, *Thinking in Time*: *The Uses of History for Decision Makers* (New York: The Free Press, 1986) for a complete examination of how history and broader mental frameworks may assist senior leaders in problem framing and lead to qualitatively different solutions or options than "traditional" thinking. Neustadt and May address the need of exploring the "issue history" in context with emerging trends. The entire book and its recommendations for examining complex problems is an excellent compliment to SOD methodology.

APPENDIX IV – SOD Structuring Questions[122]

System Framing

Cognitive Components – Depth Structure

Systemic organization of the operational inquiry & conception of the critical frame for the development of the relevant strategic-operational knowledge.

- Construction of a rational framework for understanding the context.
- Structuring of the relevant strategic narrative.
- Illumination of trends implied by the strategic directive, and indication of courses for the transformation of reality.
- Elucidation of the conceptual problems and potential for cognitive failure that may affect the operational learning system and impair the processes of design, planning, and direction.

Systemic organization of the operational inquiry & and conception of the critical frame for the development of the relevant strategic-operational knowledge.

- What is new or different in the emerging context in relation to the prevailing conceptual system and institutional paradigm?
- What are the factors determining the need for a rigorous examination of the "propensity of things", and a critical study of the "flow of reality"?
- What are the strategic episodes and operational experiments that are relevant (can serve as a reference) to the rationalization of the emerging context?
- What are the concepts that will serve us as a referential framework for a critical inquiry/study of the problem?
- What are the conceptual materials that can promote an ingenious study of the emerging context?
- What dimensions in the strategic directive provide orientation to the systemic interpretation of the emerging context?

Construction of a rational framework for understanding the context.

- What logical determinants shape our comprehension of the current emergence?
- What is the difference between the emerging strategic context and "other contexts" that have been experimented and investigated?
- What are the various implications of this difference?

Structuring of the relevant strategic narrative.

- Who are the key strategic actors in the emerging context?
- What are the constituting events that "determine the uniqueness of the context"?
- What are the functional combinations that define the logical trends in the emerging system?
- What are the logical trends that associate these actors into a strategic system?
- What are the relations between the various ensembles of power in the emerging system?
- What circumstantial evolutions have constituted the present strategic constellation?

[122] Structuring questions provided by BG(R) Naveh

- Which circumstantial aspects can be conceived as systemic patterns (patterns of events)?

Illumination of trends implied by the strategic directive, and indication of courses for the transformation of reality.

- What are the implications that derive from a critical examination of the strategic directive in the emerging reality?
- What is the disparity between the strategic realization of the emergence and the strategic anticipation of a desired future reality?
- What are the principal conceptual obstructions and operational problems impairing the implementation of the logic indicated by the strategic directive?
- What are the external sources of legitimacy for a military operation in the current system?
- What are the internal sources of legitimacy for a military operation in the current system?
- What are the external sources for opposition to the emerging operation in the current system?
- What are the internal sources for opposition to the emerging operation in the current system?
- What is the potential for transformation of the current system through the emerging operation?

Elucidation of the conceptual problems and potential for cognitive failure that may affect the operational learning system and impair the processes of design, planning, and direction.

- What are the knowledge gaps and conceptual lacunae that may hamper both our contextual inquiry and our learning in the course of the operation (reflection in operation)?
- What are the conceptual and cognitive implications one derives from the exploration of the logical difference between the institutional paradigm and the emerging strategic context?
- What are the logical tensions between the emerging system and the general political discourse?
- Which contextual circumstantial characteristics may affect our system framing?
- What are the implicit dimensions in the system, and what are the approaches that will enable their exploration?
- What are the conceptual challenges that entail explicit revision and specific adjustment of the design process?

The Rival as Rationale

Cognitive Components – Depth Structure

Characterization of the problems concerning both the rationalization of the rival in the design process, and his extended investigation, in the course of the operation through the application of forces and resources.

- Reflection of the rival as a cultural system.
- Reflection of the rival as a strategic system.
- Reflection of the rival as a command system and illumination of his institutional learning dynamics.
- Reflection n of the rival as an organizational system.
- Reflection of the rival as an operational maneuvering system.

Characterization of the problems concerning both the rationalization of the rival in the design process, and his extended investigation, in the course of the operation through the application of forces and resources.

- What are the state actors and political factors that constitute the functional elements of the rival system?
- How does the "realization of cultural otherness" affect our strategic learning, systemic thinking, and operational functioning?
- What are the conceptual references for the inquiry of the rival in the emerging context?
- What are the implicit components, in the rival system that involve supplementary "research", through force operationalization in the course of the campaign?
- What are the indications that differentiate between the rival's functioning in the emergence and in the past?
- What is the depth structure that organizes the deliberation of the rival as a system?

Reflection of the rival as a cultural system.

- What are the cultural functions that the rival system comprises of?
- What are the cultural sources of the rival system's logic in the present?
- Which of these sources derive from "external import", and which originate from "local production"?
- What are the conceptual "highlights" in the evolution of the rival's cultural discourse?
- What are the cultural sources of the rival's "otherness"?
- What are the cultural sources of the rival system's strategy?
- What are the key components in the rival's institutional discourse?
- What are the cultural tensions in the logical structure of the rival as a system?
- What are the cultural shapers of the rival's conceptual system?
- What are the cultural characteristics of the rival's perception of space?
- What are the cultural characteristics of the rival's perception of time?
- What is the "cultural code" of the rival as a system?

Reflection of the rival as a strategic system.

- What are the strategic functions comprising the rival as system?
- What the organizing logics of the various strategic functions of the rival system?
- What is the nature of the relations and the character of the strategic linkages between the various functions in the rival system?
- What are the strategic implications of the cultural difference between one's own system and that of the rival? (rival's "cultural otherness")
- What are the historical crucial points in the evolution of the rival's strategic discourse? Or, what are the political events and institutional memories that shape the rival's strategic discourse at the present time?
- What are the sources of the rival system's strategic strength?
- What are the sources of the rival system's strategic weakness and vulnerabilities?
- What are the strategic conditions for the disruption of the rival system?
- What are the conditions for a deliberate infliction of a discrepancy between the rival's strategic logic and his operational functioning?

Reflection of the rival as a command system and illumination of his institutional learning dynamics.

- What are the organizing logics and structural characteristics of the rival's institutional learning system?
- What are cultural sources of the rival's institutional form of learning?
- What are the conceptual roots of the rival's command system structure and the forms of his operational functioning?
- What are the key concepts organizing the command system of the rival?
- What are the principal functions of the rival's command system, and how is this observation reflected in the detailed manning of the various functional positions?
- How are the interpersonal tensions in the rival's command system reflected in the routine functioning?
- What are the functional logic and organizational structure of the rival's command system?
- What are the tensions between the strategic logic of the rival as a system, his operational organization, and his form of command?
- How does the rival's form of strategic deployment reflect the rationale of his command system?
- What are the strong links in the rival's systemic chain of command?
- What are the weak (or missing) links in the rival's systemic chain of command?

Reflection of the rival as an organizational system.

- What are the cultural foundations, the demographic basis, the economical sources, and technological roots of the logistical organization of the rival as a system?
- What are organizing logics and the structural characteristics of the rival's logistical system?
- What are the essential functions in the rival's logistical system, and what is the nature of their relations?
- What are the sources of strength of the rival logistical network?
- What are the sensitive seams the systemic vulnerabilities of the rival's logistical network?
- How is the rival's logistical logic embodied in his strategic deployment and systemic organization?

Reflection of the rival as an operational maneuvering system.

- How is the rival's strategic logic reflected in his operational organization, and in the deployment of his fighting resources in space?
- What are the cultural sources of the rival's operational perception?
- What are cultural sources of the rival's "operational otherness"?
- What are the systemic implications of this observation?
- What is the evolutionary structure of the rival's operational discourse and what is the historical structure of the development of his operational perception/doctrine?
- What are the principal concepts in the rival's prevailing operational discourse?
- What are the key functions in the rival's operational maneuvering system?
- Which of these functions may affect the materialization of our strategic directive?
- How does the spatial organization of the rival's maneuvering system reflect the systemic relations between his operational functions?
- What are the logical foundations the structure of the rival's operational deployment in space?
- What are the operational sources of strength of the rival's maneuvering system?
- What are the operational sources of weakness and systemic vulnerabilities of the rival's maneuvering system?
- What are the operational conditions for the disruption of the rival's maneuvering system?

Command as rationale

Cognitive Components – Depth Structure

- The conceptual problems (what to understand), operational learning challenges (how to understand), and the command system (the organization of operational learning).
- The system of external linkages – Relations between the operational command and the strategic system of systems.
- The operational command system – Relations between the operational command authority and the agents representing the various operational trends/directions.
- The operational headquarters – Adapting the command staff to the unique operational circumstances.

The conceptual problems (what to understand), operational learning challenges (how to understand), and the command system (the organization of operational learning).

- What are the unique systemic problems of the context upon which our operational inquiry focuses?
- What are the systemic problems that we are capable of "setting" in the course of the design process, and the setting of which problematic issues will be enabled through the application of forces and resources in the course of the operational direction?
- The investigation and treatment of which systemic problems imply a concrete assignment of operational command agents external to the existing framework of command arrangements?
- Which command conditions can settle the conceptual tensions between the system framing (understanding of the system) and the operation framing (comprehension of the operation)?
- What are the command implications of the rationalization of the rival as a system?
- Which weak links, in the existing command system, are implied by the conceptualization of the system framing?
- Which weak links, in the existing command system, are implied by the rationalization of the rival as a system?
- What are the open questions that will be investigated in the course of the operation, through the discourse between the relevant command agents, performing in the various functioning environments?
- What are the operational learning systems (systemic processes of inquiry and ensembles of operational maneuver) that will explore these questions?
- What are the conceptual parameters for determining quantum changes in logic in the course of the operation/campaign?

The system of external linkages – Relations between the operational command and the strategic system of systems.

- Which strategic assumptions that were studied in course of the system framing and the rival as rationale condition the determination the logical frame of the operational system?
- What are the strategic moves and non-military activities that affect the framing of the operation's logical boundaries?
- Who are the agents that are responsible for executing these activities, and what is the exact character of relations that they will exercise with the operational commander (RCC), both in the planning and execution stages?

- What are the relations between the relevant (our) operation and other friendly operations in the system of systems, what are the conceptual, operational, and organizational problems implied by these relations?

The operational command system – Relations between the operational command authority and the agents representing the various operational trends/directions.

- Which open systemic questions imply the assignment of special operational command agents?
- Which logical directions in the operation need to be surveyed by particular command agents?
- Which functional components of our command system have the potential for illuminating operational ambiguities and informing our operational learning?
- What are the existing operational organizations that can provide the relevant command agents to deal with the learning problems that we have identified?
- What is the conceptual engine that can synthesize/synergize the various command agents into a coherent leaning system?
- What learning arrangements are enablers of discourse between the various command agents in the course of the operation direction?
- The operational headquarters – Adapting the command staff to the unique operational circumstances.
- What are the observed tensions between the appreciation of the unique characteristics of the context and the prevailing form of functioning of the relevant operational command headquarters?
- What is the unique nature of relations between the operational command and the national strategic command, how do these relations affect the mode of functioning of the operational headquarters, and what would be the organizational implications of these observations?
- What are the unique relations between the operational command (theater of war/RCC), the various component commands, and the subordinate theaters of operations, how do these relations affect the mode of functioning of the RCC's headquarters, and what should be the organizational implications of these observations?
- How are the relations between the relevant operational command and other friendly operational commands reflected in the functioning logic and organizational arrangements of the command headquarters?
- Which operational and cognitive problems imply the application of specific organizational arrangements?
- Who are the staff agents/institutions that are supposed to treat these problems, and organize the command learning in emergence?
- Which forms of functioning, methods of inquiry, and working tools will enable those staff agents to synchronize the command learning system?

Logistics as Rationale

Cognitive Components – Depth Structure

- The strategic (national) logistic system and the logistics in the operation – The systemic linkages and the definition of the material potential for the operation.

- The logistic dimension in the operation – Organization of space – Organization of time – Organization of resources.
- The logistic command in the operation: organization of functioning and systemization of learning.

Operation Framing

Cognitive Components – Depth Structure

- The clarification of the conceptual problems that set the comprehension of the current operation.
- The description of the operational end state embodying the logic of the strategic directive.
- The outline of the operation's space.
- The setting of the operation's time regime.
- The framing of the potential for the operation development (defining the problems, restrictions, constraints, fields of responsibility, allocation of principal fighting resource).
- The logical, organizational, and formative structuring of the operational maneuver.

The clarification of the conceptual problems that set the comprehension of the current operation.

- What is the relevant conceptual reference for the investigation of the operation's logical frame?
- What are the inconsistencies between the above mentioned reference and the operational understanding that result from the system framing, the rival as rationale, the command as rationale, and the logistics as rationale?
- What is the relevant experimental reference for the investigation of the operation's logical frame?
- What are the operational implications of the observed tension between the institutional paradigm and the crystallizing understandings about the emerging context?

The description of the operational end state embodying the logic of the strategic directive.

- What is the ensemble of conditions one has produce at the end of the operation in order to enable the materialization of the strategic directive?
- What are the principal problems that may affect our ability to introduce these conditions?
- The introduction of which operational conditions will deprive the rival system of its operational logic?
- What are the operational implications of tension between the positive definition of the end state, and the negative definition of systemic shock?
- What are the strategic terms that condition the materialization of the end state?
- What are the operational terms that condition the materialization of the end state?

The outline of the operation's space.

- What are the conceptual tools that affect our perception of strategic and operational space in the relevant context?
- Which non-military references can contribute to our conceptualization of the spatial dimension in context?
- What are the spatial implications of the strategic logic? Or, how does the strategic directive affect our understanding of the operational space?
- What are the spatial functions that reflect the strategic logic?

- What are the implications of the rival's system rationale on our appreciation of the operational space?
- What is the spatial embodiment of the operation framing (boundaries)?
- What are the spatial functions that reflect the operational logic?
- What are the relations between the spatial frame implied by the system framing and the spatial frame implied by the operation framing?
- What are spatial manifestations of the relations between the relevant operation (ours) and other friendly related operations?
- What is the spatial reflection of the operational end state? Or the introduction of which spatial conditions will terminate the operation successfully?
- What are the spatial conditions that are essential to the attainment of the end state?
- What is the spatial reflection of the operational strike (operationalization of systemic shock)?
- What are the spatial conditions that are essential to the launching of the operation, within the logical rationale of the system framing?
- What is the spatial arrangement enabling the development of the operation with the desired logical frame?
- What spatial conditions are required in order to disrupt the operational logic of the rival's maneuvering system?
- Which spatial components affect our operational learning?
- What is the spatial setting of the logistical logic?
- What is the spatial setting of the command logic?

The setting of the operation's time regime.

- What are the conceptual tools that affect our perception of strategic and operational time in the relevant context?
- Which non-military references can contribute to our conceptualization of the time dimension in context?
- What are the time implications of the strategic logic? Or, how does the strategic directive affect our understanding of the operational time?
- What is the difference between the reflection of time in system framing and its reflection in the operation framing?
- What is the time construct that will order the development of the operation towards attaining its strategic logic?
- What is the time embodiment of the operation framing, or what is the duration of the operation?
- What are the essential time arrangements for initiation of the operation within the logic embodied in the system framing?
- What are the shaping initiatives and efforts that will be external to the space-time dimension of the operation framing?
- What are the key chronological functions that structure the accomplishment of the operational logic?
- What are the time conditions that are essential to the disruption of the rival's operational logic? Which intrinsic functional tensions in the rival system that can be exploited through manipulation of time?
- What is the time setting that synchronizes the application of operational strike (maneuver) with the emergence of systemic shock?
- What are the time considerations that may influence the way our learning system functions? Or, what are the timings of our acute leaning moves?

- What is the time setting of the logistical logic?
- What is the critical time window (duration) for diagnosing the differential between the random materialization of systemic shock (strike) and the deterministic presumption of the end state?
- What is the acute timing (transition phase) for the realization of a shift from the planned operation to the emerging operation?

The framing of the potential for the operation development (defining the problems, restrictions, constraints, fields of responsibility, allocation of principal fighting resource).

- Which conditions determine the realization of the logic of the current operation, and the transition to a following one?
- Who are the functional agents conditioning the above mentioned development, and what is the character of relations?
- What are the "open questions" that will be explored through the application of force, and answered in the course of the operation?
- What limitations that are implied by the strategic directive shape both the logic and structure of the operation?
- Which operational constraints may affect the logic and form of the maneuver?
- What is the tension between the crystallizing conception of the operation and the allocated resources?

APPENDIX V – Example Discourse Recording Template

The tables below are one example of the recording templates used by the Case A team in UQ '05. The italics within the tables offer examples of the content of each column. The adherence to a column format is not strict, what matters most is the ability to record the discourse. The reader should refer to the previous annex on SOD structuring questions for examples of what questions to ask in each area.

Strategic Framing Template

Question	Details	Potential Tension	So what? Implications?
What is unique and what has led us to this point (road to now, national interests)	*Why are we unhappy with what has happened*	*Enduring Nat Interests vs short term objectives*	
What have we been asked to do by the strat sponsor and why (what is the guidance given)	*Directives / Other elms of DIME need to be understood*	*Tension between existing reality and what are we being asked to do by the strategic sponsor*	*Are there trade offs within the conditions and the long term goals?*

System Framing Template

Consider looking at several key player interactions, either in a bi-polar manner, or in triangular manner and developing the linkages accordingly. The same template as shown above can be used, albeit with different questions.

Rival as Rationale Template

Macro Factor	Questions	So What? Implications	Potential Tension	What are we looking for? (Effect)	Soln options (Macro and Systemic in nature)
Tensions btw then and now					
Consider using Political, Economic, Cultural, Military, Social, Informational, Religious, world viewpoint,					

Macro Factor	Questions	So What? Implications	Potential Tension	What are we looking for? (Effect)	Soln options (Macro and Systemic in nature)
epistemological viewpoint etc as a start point					
Tensions within then?					
Tensions within now					
Operational Level Discussion					
Rival as a Command System					
Rival as an Organizational System (includes log)					
Rival as a Maneuvering System					

An original recording matrix utilized tensions as a start but found that the derivation of these was reliant on mental gymnastics. It was felt that this was the wrong way around. Another method is to consider the interplay between what are believed to be key sections of the rival. This can be examined by identifying the players in the sub-system, and then consider which elements need to be developed. This method is harder to hand over to others as it does not allow a full logic stream to be captured.

If there is a need to reframe, one must ensure that some form of order is given to the process to ensure that the old tensions are considered to see if there is anything within them to suggest that they are valid or invalid, and then explain why. This will lead to a modified tension, as opposed a wholly new one. Once this has been done, one must then consider the addition of any new tensions that have not been considered. The need to maintain control within this phase is essential as otherwise it can become an unstructured discourse which cannot be recorded. Consider the use of the mapping of all aspects of the process as a means of visual stimulation. There is also a need to examine the rival as more than just a source of tensions. This must be done in the form of a journey which will then result in a possible tension or a hypothesis that can than be tested with our form of function.

Command as Rationale Template

Factor / Question	Discussion	So What? Implications	Potential Tension	What are we looking for? (Effect)	Soln options (Macro and Systemic in nature)

Logistics as Rationale Template

Factor / Question	Discussion	So What? Implications	Potential Tension	What are we looking for? (Effect)	Soln options (Macro and Systemic in nature)

Operational Framing

The operational effects and forms of function can be considered within the table shown below. Consider in addition to the template creating an outline statement that explains how the operation terminating configuration will provide the conditions for an emerging strategic order (identify what you wish to change in the new emergence). Remember that function drives form and that words will shape the logic of the commander. Closed systems allow for specifics, open systems are fuzzier in nature. Remember that the logic is to first Shape the system, then Inject – Observe – Learn and then either Reframe or Re-inject dependant on the result.

Line within the Operational Frame / Frame Scaffolding	Macro Effect	Elm	Forms of Function	Aim / Remarks (to include any temporal aspect and effect on Redland)

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