

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 24-04-2008		2. REPORT TYPE FINAL		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Time, Technology, and Exploitation - Can Future Military Command and Control (C2) Domination be Linked to Effective Knowledge				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) LCDR Shawn Dewey Paper Advisor (if Any) : CAPT James Maynard				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Joint Military Operations Department Naval War College 686 Cushing Road Newport RI 02841-1207				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT For Example: Distribution Statement A: Approved for public release; Distribution is unlimited.					
13. SUPPLEMENTARY NOTES A paper submitted to the Naval War College faculty in partial satisfaction of the requirements of the Joint Military Operations Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.					
14. ABSTRACT Highly effective employment of military force at the operational level will require greater levels of synchronization and harmonization to maximize economy of force and thus combat potential. The evolution of Operational Command and Control (C2) will remain, and become increasingly so, the primary enabler for U.S. joint military operations to accomplish this task. The most effective strategy to optimize this operational function is by increasing the speed of the operational commander's decision-making process by compressing the decision-making cycle. Factor Time must be manipulated and exploited. This paper seeks to determine if the emerging field of Knowledge Management (KM) can successfully apply a three-pronged approach (Knowledge Transfer Systems, Systems Shaping, and Complex Adaptive System Analysis) which can effect this needed change. While emphasizing human-centricity, KM's technological applications are simply tools created to increase human capacity. If this holistic approach is possible, and significant improvement is realized, it will be incumbent upon the commander to find ways to fully exploit this improved capability. As history has shown, superior C2 structures can achieve battle-space domination.					
15. SUBJECT TERMS Command and Control Domination and Knowledge Management					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 24	19a. NAME OF RESPONSIBLE PERSON Chairman, JMO Dept
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED			19b. TELEPHONE NUMBER (include area code) 401-841-3556

NAVAL WAR COLLEGE

Newport, R.I.

Time, Technology, and Exploitation – Can Future Military Command and Control (C2)
Domination be Linked to Effective Knowledge Management?

by

LCDR Shawn Dewey, USN

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: _____

23 April 2008

Contents

Introduction	1
Operational Command and Control	4
Knowledge Management (KM)	6
Compressing the Decision-Making Cycle through KM	8
Knowledge Transfer Systems	9
Systems Shaping	11
Complex Adaptive System Analysis	13
Counter Arguments	15
Conclusion	17
Notes	19
Selected Bibliography	21

List of Illustrations

Figure	Title	Page
1	C2 Decision-Making Process (Traditional vs. KM-applied)	18

Abstract

Highly effective employment of military force at the operational level will require greater levels of synchronization and harmonization to maximize economy of force and thus combat potential. The evolution of Operational Command and Control (C2) will remain, and become increasingly so, the primary enabler for U.S. joint military operations to accomplish this task. The most effective strategy to optimize this operational function is by increasing the speed of the operational commander's decision-making process by compressing the decision-making cycle. Factor Time must be manipulated and exploited. This paper seeks to determine if the emerging field of Knowledge Management (KM) can successfully apply a three-pronged approach (Knowledge Transfer Systems, Systems Shaping, and Complex Adaptive System Analysis) which can effect this needed change. While emphasizing human-centricity, KM's technological applications are simply tools created to increase human capacity. If this holistic approach is possible, and significant improvement is realized, it will be incumbent upon the commander to find ways to fully exploit this improved capability. As history has shown, superior C2 structures can achieve battle-space domination.

INTRODUCTION

*Speed raises "the possibility of catastrophic success,"¹
.....by "getting into the threat's decision cycle."²*

Successful leveraging of factor Time wins wars. Regardless of the level (tactical, operational, strategic), Time is the driver of all things. It can manipulate and dramatically alter any advantages/disadvantages of factor Force and factor Space. Regardless of whether a military commander is ready to make a decision, time will force his hand as action/inaction. Time must be viewed as both a continuum (linear) wherein events are sequenced and as a somewhat nebulous concept (non-linear), simultaneous and inter-related. Some believe that physical constraints will eventually yield a process that is finite with respect to time. Others believe that a process, while retaining its true purpose, can undergo a fundamental change where its time requirements are also dramatically changed. Paradigm shifts and technological advances often pave the road for process evolution and even revolution. *The power of system time compression is based on the premise that faster process speeds can save valuable resources (material, manpower, money) as well as providing an adaptability advantage against an adversary.*

Technology is not self-guiding. It does not direct itself but rather relies on the human to direct its development, shape its purpose, and properly apply the finished product. And because the human is not without error, combined with the fact that we live in a world of limited resources, this system can be problematic. Technological advances within the last 50 years are following an exponential curve, and so the question becomes not one of "if" but rather "when" a particular advancement will be achieved. Tremendous resources have been wasted on misapplied technology. In these situations,

the technologies typically did exactly what they were created to do yet the human chose the wrong application which either did not achieve the ultimate purpose or did so in very inefficient ways. This lack of direction is also evident in the fact that despite the incredible number of generic technologies available today, this does not guarantee the horizontal transfer and creation of high demand products. For example, the technology is available to create and mass produce inexpensive water purification systems for third world countries. Yet why does every third world country not have clean drinking water? Perhaps the technology was misapplied and could have benefited by addressing the source of the problem – pollution. In fact, critics of a new product called Lifestraw, a new water purifying straw, mention that in addition to the product's high cost, it doesn't solve the real problem of the typical long distances on foot required to reach the water source which can range 20 kilometers or more.³ This is a prime example of applying superior technology to a poorly understood problem. How can one possibly provide the best solution if the problem has only been partially defined? Technology is not at fault here but rather inadequate human guidance. To refine and enhance this human function, Knowledge Management (KM) was created.

Exploitation is “the use or development of something in order to gain a benefit.”⁴ It can be viewed as changing a fundamental process through technology, doctrine, procedures, etc., whereby one takes advantage of the newly created strength at the expense of an opponent's vulnerability. Operational command and control (C2) is a fundamental military process that is critical to winning wars. *The side which can reduce its C2 decision making cycle (DMC) i.e. observe, orient, decide, act (OODA) will exert a tremendous advantage over its opponent.*⁵ For example, two combatants (A and B) are

engaged in military conflict. Along the time continuum, both A and B are forced to make a decision. If A makes a decision first, this choice will change the presuppositions that B has used to formulate his decision. Hence, when B finally makes a decision farther along the continuum, there is a great chance that it will be a faulty one or one fraught with considerable error. Exploitation of this capacity can crush a rival.

Reducing cycle time or accelerating process speed in the operational commander's decision making process is the ultimate goal here. The question now becomes how can this be achieved? Perhaps even more importantly, can we even define the problem? Are limits imposed and does the solution create more problems than we can foresee? *This paper will argue that the Knowledge Management (KM) fields of Knowledge Transfer Systems (KTS), Systems Shaping (SS), and Complex Adaptive Systems Analysis (CASA) are poised to become the primary enablers in increasing the effectiveness of operational level, military C2 structures.* We will examine the KM approach and how properly applied technology and new ways of thinking can compress the DMC in military C2 systems, translating into operational advantage. While this approach seems logical, there are; however, significant concerns about second/third order effects which may undermine the entire process. Will technology facilitate more centralized control counterintuitive to current C2 thinking of centralized control with decentralized execution? Is technology being emphasized over human involvement and if so, what are the implications?

The roadmap. Establishing the reader's knowledge base begins with a discussion on Operational C2 from the Joint Force Commander's (JFC) perspective and the DMCs central to the process. KM will then be discussed in terms of general concepts and

spectrum of application. Once the background is set, KM's three primary methods, KTS, SS, and CASA, will be applied to the DMC for compression along with practical *recommendations*. The counterarguments mentioned above will be examined followed by a summary analysis of whether KM can actually achieve its objectives. The final discussion will center on conclusions of whether staying or deviating from this course is appropriate.

OPERATIONAL COMMAND AND CONTROL (C2)

“Successful organizations, including the Military, have learned that the higher the risk, the more necessary it is to engage everyone's commitment and intelligence.”⁶

Leading Joint Military Operation (JMO) expert, M. Vego, describes C2 as a process involving “planning, preparing, directing, and controlling one's forces in both peacetime and in time of war.”⁷ While suitable emphasis is placed on the controlling function, the argument can be made that C2 involves a process of creating forces which are *capable* of operating within a particular scheme or system. A force's ability to plan and prepare as dictated by this system will directly impact how well the force is controlled in the field.

There are two fundamental control modalities in military, operational C2 systems – centralization and decentralization. Centralized control is order-centric,⁸ while decentralized control is mission centric.⁹ Both are not without their advantages/disadvantages. In the aftermath of WWII and following the emergence of the Cold War; however, evolutionary changes in Operational C2 doctrine were necessary to function and thrive in environments increasingly reliant upon greater and greater information requirements.¹⁰ This doctrine which is still present today is based upon fusing advantages of both C2 modalities (centralization/decentralization) to create a

hybrid system guided by command directive through semi-autonomous subordinate action – centralized control, decentralized execution. This doctrinal evolution has caused the major components of the JFC DMC (observe, orient, decide, act) to become smaller in magnitude yet greater in number as the decision-making burden become shouldered by more subordinate commanders. *Why is this important? The answer is speed. When overall process speed is increased, the cycles are compressed which allow the operational commander to penetrate and work within the adversary's own decision-making/execution cycle. This translates into tremendous military advantage.*¹¹ The detrimental effects of this intrusion to the adversary are due to added confusion and lag times within enemy cycles.

To effectively apply KM to the JFC DMC, one must first gain an understanding of the cycle components which are receptive to KM influence. While there are numerous DMC theoretical models available, the U.S. Army's OODA cycle (observe, orient, decide, and act) is both simplistic and poignant enough to explain the exceedingly complex behavior of the JFC when tasked with a mission. Prior to arriving in theater, the JFC's **observation** phase begins which involves building the operational picture (enemy, self, environment). The information flow at this stage is being *pushed* in large quantities. This flow requires filtering, processing, and refinement¹². Gaps remaining in the picture will form the basis of the commander's critical information requirements (CCIRs). This will be *pulled* information, more relevant with less processing requirements.

Orientation consists of the position the commander is in when required to make a decision i.e. was a particular decision expected (deliberate) or unexpected (crisis).¹³ The commander's **decision** phase is a culmination of staff assessments and personal judgment

based on the first two phases of the cycle.¹⁴ The final phase is the **act** or execution phase.¹⁵ It is important to note that the cycle is *continuous* in that after the commander has acted, he/she will observe the enemy reaction and thus determine any follow-on action.¹⁶

KNOWLEDGE MANAGEMENT (KM)

“As gold which he cannot spend will make no man rich, so knowledge which he cannot apply will make no man wise”¹⁷

Before describing how KM can be applied to decision cycle components, one must understand the concept of KM and why it was developed. The Information Age has created an ever increasing population of information dependents on a global scale. Marketplace dynamics require companies to leverage information in order to master the environment and react faster to changes than their competitors. This economic warfare is not dissimilar to military warfare and in fact the principles remain the same – the exploitation of the knowledge of one’s environment. Further strengthening this interrelation, an explosion of information technologies (IT) has occurred to meet demand. Overtime, this relationship has become self-sustaining yet the balance between mass information and the IT systems has traditionally not been equal. Overwhelming amounts of information are being pushed by people and systems which are limited by filtering capabilities as well as a *fundamental misunderstanding of what types of information can answer the questions being sought. In an attempt to restore this balance, a new paradigm shift is occurring - KM.*

KM is about identifying, categorizing, and applying relationships and patterns from the torrential flood of information. Its colloquial meaning includes “retrieval,

storage, discovery, and capture of knowledge and aims to facilitate the flow of information across an enterprise.”¹⁸ It touts an ultimate end state of “getting the right information to the right people at the right time.”¹⁹ It facilitates the transformation of data to truth through the intermediate steps of data to information, information to knowledge, knowledge to wisdom, and wisdom to truth.²⁰ The underpinnings which makes each of these steps possible involve understanding the context (data to information), pattern relationships (information to knowledge), and the basic principles causing the patterns (knowledge to wisdom).²¹

Within the increasingly diverse field of KM studies, three areas will be applied to DMC time compression. These are Knowledge Transfer Systems (KTS), Systems Shaping (SS), and Complex Adaptive System Analysis (CASA). KM’s utility in both business and military organizations is its ability to address problems and increase efficiency in all major information dependent projects. As the relative importance of information and knowledge increases, organizations are realizing that its knowledge base is its most important asset. Housed primarily within individual members, knowledge requires extraction, categorization, and dissemination via KTS. This will ensure that regardless of the rate or trend of member change, the organization’s valuable knowledge base will continue to expand.

SS answers the question of what is the best fit technical solution to a particular problem.²² Its primary purpose is to minimize the significant loss of time and resources inherent in traditional new product development (NPD) cycles. It uses a holistic, regressive planning approach, integrating inputs from core and peripheral influences within a past, present, and future context.

CASA is a new paradigm of thought about understanding systems that consist of “a large number of interacting components whose aggregate activity is nonlinear and typically exhibits hierarchical self-organization under selective pressures.”²³ There is considerable theory associated with this field and the topics range from economies, ecologies, weather, military/social organizations, etc...²⁴ The most promising end products are small yet powerful simulators which attempt to predict behavior.

COMPRESSING THE DECISION-MAKING CYCLE THROUGH KM

“When you make an efficient choice in moments of indecision, you establish more effectiveness within a given time span, saving energy and stress. That's a time shift.”²⁵

Reiterating our objective here, we are concerned with how to optimize operational C2 (planning, preparing, directing, and controlling) by compressing the commander’s DMC (observe, orient, decide, act (OODA)). As Figure 1 denotes, an OODA cycle is integral to each of the C2 components. With KM applications integrated into the OODA cycle, one notices a substantially smaller cycle theoretically yielding a more rapid objective completion time over traditional methods. KTS, SS, and CASA acting within the DMC work to speed up each C2 component. This three-pronged, synergistic approach renders effects far greater than any individual KM application alone. *One must also understand that the JFC’s decision-making speed is primarily based on the transformation of staff capabilities through these processes. Such staff transformations will produce faster and more complete products to the JFC for a final decision.* As mentioned earlier; however, a fundamental question that arises and which will need to be addressed consists of whether this is indeed the correct approach and if so, what *will* it look like or how *should* it look like in the end?

Knowledge Transfer Systems (KTS)

Military organizations similar to their private enterprise counterparts must be adaptively efficient entities. The organization which can react to environmental stimuli faster and within a best-fit approach will have a substantial advantage over the adversary. In order to do this; however, an organization must leverage its accumulated knowledge to aid in decision making for future events. This is problematic for military organizations where personnel turnover is rapid and continuous. *Knowledge lost from departing members translates into significant time and resources lost for new members tasked with reacquiring this knowledge. This reacquisition is also done so at the expense of current operational requirements/tasks.* This knowledge gap must be eliminated and the transition shortened. KTS must be created for military personnel to store, organize, and disseminate all forms of knowledge to anyone requiring its use. All branches of the U.S. military are currently running or in the process of standing up a limited online KTS both unclassified and classified versions: Navy Knowledge Online, Air Force ADLS, Army Knowledge Online, USCG Learning Portal, and Marine Net. This group also includes the U.S. Joint Forces Command (JFCOM) recent Joint Knowledge Development and Distribution Capability project.²⁶ These systems were initially created as learning portals for standardized information for generic career growth and general information distribution. The process is typically non-user friendly, lengthy, bulky, and non-specific within particular fields and specialty areas. *While this is a tremendous first step and one which will remain relevant in the future, these systems are quickly losing the evolutionary race due to emphasis on themselves alone. Stage two in this process needs to be the creation of knowledge portals housing billet/unit/environment specific information.* For

example, an officer billeted to a J3 staff, will need to learn the generics of the JFC organization *and* routine operations. The individual can do this on a *voluntary* basis before leaving his prior billet as well as en route. He will arrive with some rudimentary understanding of the system. This understanding may or may not provide an adequate knowledge base due to the typical lag in update rates which renders such knowledge historically irrelevant or incomplete. With internal command structures under high turnover pressure, this fact is magnified as the organization is forced to operate within highly-unstable and dynamic environments.

Two things need to occur here: one, the billeted individual must be required to complete a minimum level of learning before arriving at the J3 (this occurs in a limited fashion only); and two, a portal must be made available prior to arrival whereby the prospective commander can tap into the current billet holder's portal of operations. Such a portal should allow universal access (wide dissemination potential) to a certain level of individual, whereby he/she can quickly learn the portal owner's current tasks/objectives, environmental conditions, process issues or any other pertinent information. This should be presented in a near real time format. This type of knowledge will complement and refute/support standardized learning. Together, both phases will provide a fast, custom-fit knowledge base which will reduce down time due to extensive on-the-job training.

By being required to maintain a near real time billet specific portal, current billet holders will be able to transfer knowledge into a bank which can be accessed and utilized universally inside/outside the organization. Less down time in training translates into more productive and efficient personnel who can focus on current operations. Because knowledge is continually banked, analyzed, and built upon, the organization will become

better, faster. Specific and timely information pushed to the JFC will facilitate faster decision making. As per figure 1, while KTS can be applied in some fashion to all levels of C2, the most useful domains are planning and preparing.

Systems Shaping (SS)

The JFC relies on near real time information of the environment, self, and enemy to make a decision. The speed at which this increasingly tailored information can be provided to all pertinent individuals translates into faster decision making speed for the Joint Staff and hence the JFC. C2 at the operational level is becoming more reliant on sensor networks and fusion information technologies to create the joint Common Operating Picture (COP). In fact, USJFCOM's Joint Vision 2010/2020²⁷ places heavy emphasis on the need for the Joint Force to attain and exploit information superiority which it will accomplish in part through Network Centric Warfare (NCW).²⁸ The most challenging goal; however, is to avoid the opposite of the system's intent which is to shorten the commander's DMC as information reaches overwhelming levels. *How does one translate the commander's information requirements into technological realities or ensure that developed systems are properly applied and correctly integrated into existing architecture? SS can and should be the solution here.* An increase in time and resources at the front end of the new product development cycle (NPDC) will ensure the implementation phase is as short as possible, causing less disruption to operational rhythm. More importantly; however, *KM's power is most evident in its ability to answer the question of what exactly is the solution being sought; what should it look like?* This holistic approach considers past issues, present capabilities, and future system expansion goals. Under KM, this process becomes streamlined in all development areas.

To truly appreciate the impact of KM on NCW system development, one should observe the early stages of this new product cycle where KM's influence was *minimal* as compared to the present day situation where KM is now predominant in its evolution. Pre-KM military systems development was often characterized by poor foresight, over budget costs, and lengthy development tracks, resulting in systems being quickly outdated and subsequently removed from service by a better product in a parallel "stovepipe." The conceptual idea of NCW pre-dated Operation Desert Storm and precursors of the system were demonstrated and validated NCW potential in Operations Desert Storm, Operation Enduring Freedom, and Operation Iraqi Freedom.²⁹ With KM ideology being introduced to organizations in the late 1990's,³⁰ only recently has SS begun to influence NCW development. Prior to this period, intra/inter-service parallel product development wasted countless millions when user collaboration and could have reversed this trend while potentially producing an overall superior product. For example, the Joint COP concept (Global Information Grid (GIG)) was the core of NCW program, yet rather than focus all efforts into a joint overarching network, each service began, and currently still is, spending enormous amounts of resources in the development of their own COP – Navy Force Net, Air Force Constellation Net, and Army Future Combat System.³¹ This is a travesty. What must happen now, because of time and resources already invested, is that each individual net must first be completed, followed by a development process enabling proper GIG interfacing. This will be a lengthy and costly endeavor. What should have occurred early in the GIG program, and what is actually beginning to occur only recently is a KM approach within JFCOM.³² By pooling resources, technical expertise, and force perspectives, as well as leveraging the inherent

expertise of each of the military branches, KM can best address critical, inter-service issues such as interface compatibility (within U.S. forces as well as between allies), modular design allowing for future system upgrades, bandwidth limitations, and non-compatible sensor platforms.³³ Minimizing “stovepipe” redundancy and collaboratively creating a potentially superior system, within a shorter amount of time at a reduced overall cost, is SS’s primary goal here. As figure one indicates, SS finds applicability in the technological developments for all C2 areas (planning, preparing, directing, controlling).

Complex Adaptive System Analysis (CASA)

CASA is the third KM field functioning as an enabler for further compressing the JFC DMCs. *This is accomplished through hedging outcomes of complex systems which are inherently difficult if not impossible to predict.* What exactly is a “complex” system? The Advances in Complex Systems Journal considers such a system to be “comprised of a (usually large) number of (usually strongly) interacting entities, processes, or agents, the understanding of which requires the development, or the use of, new scientific tools, nonlinear models, out-of-equilibrium descriptions and computer simulations.”³⁴ While the scope of complex systems which the JFC may face is quite large, this paper will focus on the complex, social phenomenon of counter-insurgency (COIN) dynamics. The behavior of these systems usually conforms to three principles, “order is emergent as opposed to predetermined, the system’s history is irreversible, and the system’s future is often unpredictable.”³⁵ This is particularly evident in post-war Iraq where social interactions are extremely interconnected, muddled, and influenced by vast internal and external sources, some of which are known while most remain hidden. Operating within

and trying to master such situations is extremely difficult, particularly to our conventionally-minded force ruled by linearity. This is changing.

In attempting to master this new domain, we are learning much. By identifying and acknowledging our current limitations, we can work to overcome them. New doctrine is the facilitator of this change in how we think and operate within this new paradigm – the human element. The JFC has access to intelligence resources which provide information with some fusion and context to explain current conditions. What is sorely needed here is a powerful predictability tool for staff planners (J2 – Director for Intelligence, J5 – Director for Strategic Plans and Policy, J7 – Director for Operational Plans and Joint Force Development). A complex social problem like COIN must be broken down into entities, influential factors, and environmental context. This information must be codified whereby its manipulation can then occur within a set of modifiable parameters. Success will be determined by the discovery of relevant patterns and relationships revealed from injected variable experiments. *The predictability tools being sought are small, inexpensive, yet powerful, computer simulation programs.* Sponsored by the Office of the Director for National Intelligence and the U.S. Army War College's Center for Strategic Leadership, Proteus USA has developed a simulation suite for high-operational/strategic use, designed to break down and test complex adaptive systems which evolve.³⁶ Its applicability ranges from “disaster relief, humanitarian assistance, regional peacekeeping, stability and reconstruction, civil war, etc.”³⁷ The JFC staff would greatly benefit from current versions of an Iraq Proteus Simulation program. Simulations can be accomplished on each Iraqi city or regional area. Individual results could be analyzed by themselves, compared with other areas, and perhaps even

combined. A trend in one area could be introduced in a simulation of another area to gauge the relative impact. The ultimate goal is to facilitate JFC decision-making through more accurate predictions of COIN trends and the “identification of key nodes and decisive points.”³⁸ The fast, user-friendly Proteus tool potentially provides a level up in the pursuit to achieve mastery of the insurgent environment. Further compression of the JFC DMC would be achieved by reducing the number of branches required for planning. KM’s CASA field provides the JFC with the possibility of operating within the enemy’s decision cycle to gain the initiative and push a desired outcome. As figure one denotes, CASA tools find the most relevance within the C2 steps of planning and preparing.

COUNTER ARGUMENTS

KM as a facilitator for encouraging the growth and development of a learning military organization (JFC) through KTS has few opponents. This is due to the fact that such an evolution is human-centric. Some issues; however, that do arise involve the feasibility of training new Staff arrivals while they are still attached to their previous command. This pre-arrival training is crucial in preventing the disruption normally seen during on-the-job training for both trainer and trainee. This can be overcome by allocating more transition time between the billets in conjunction with other standardized training. On-line prerequisites can be mandated by the detailer as seen in Primary Military Education (PME) requirements for Navy students attending the Naval War College. Standardized learning should begin immediately upon the receipt of verbal orders with billet-specific training commencing immediately upon written orders from the detailer. Continuous self-training training irrespective of the current billet is now becoming more commonplace. Access to on-line learning may also be an issue due to the

classification of the material from anywhere other than the workplace. *The solution coincides with the previous concern which is the growing trend that continuous learning will become the standard and as such, resources/time should be made universally available to the military member.*

Network-Centric Warfare opponents are greatly concerned with the decreasing emphasis of the human element within the operational level DMC. Fear of the potential micromanagement of subordinate commanders by operational leadership is also legitimate – more centralization, less subordinate autonomy.³⁹ Critics are few; however, when addressing KM's Systems Shaping capability which attempts to insert human attributes and requirements into technological purpose - technology is being shaped by the human rather than the human being shaped by technology. *A counter-argument to NCW opponents would be that KM seeks to retain the human as the network center's main processing unit.*

The field of Complex Adaptive Systems Analysis is relatively new. Born out of technological and paradigm advancements, CASA seeks new ways to examine and visualize complexity. Critics argue against over-reliance on such new and unproven systems such as the Proteus engine. *This author is in agreement here, but it must also be mentioned that CASA is simply one way of looking at phenomena – not the only way.* In fact, over-reliance on any one tool such as the Proteus model at the expense of standard methods is nothing less than irresponsible.

CONCLUSION

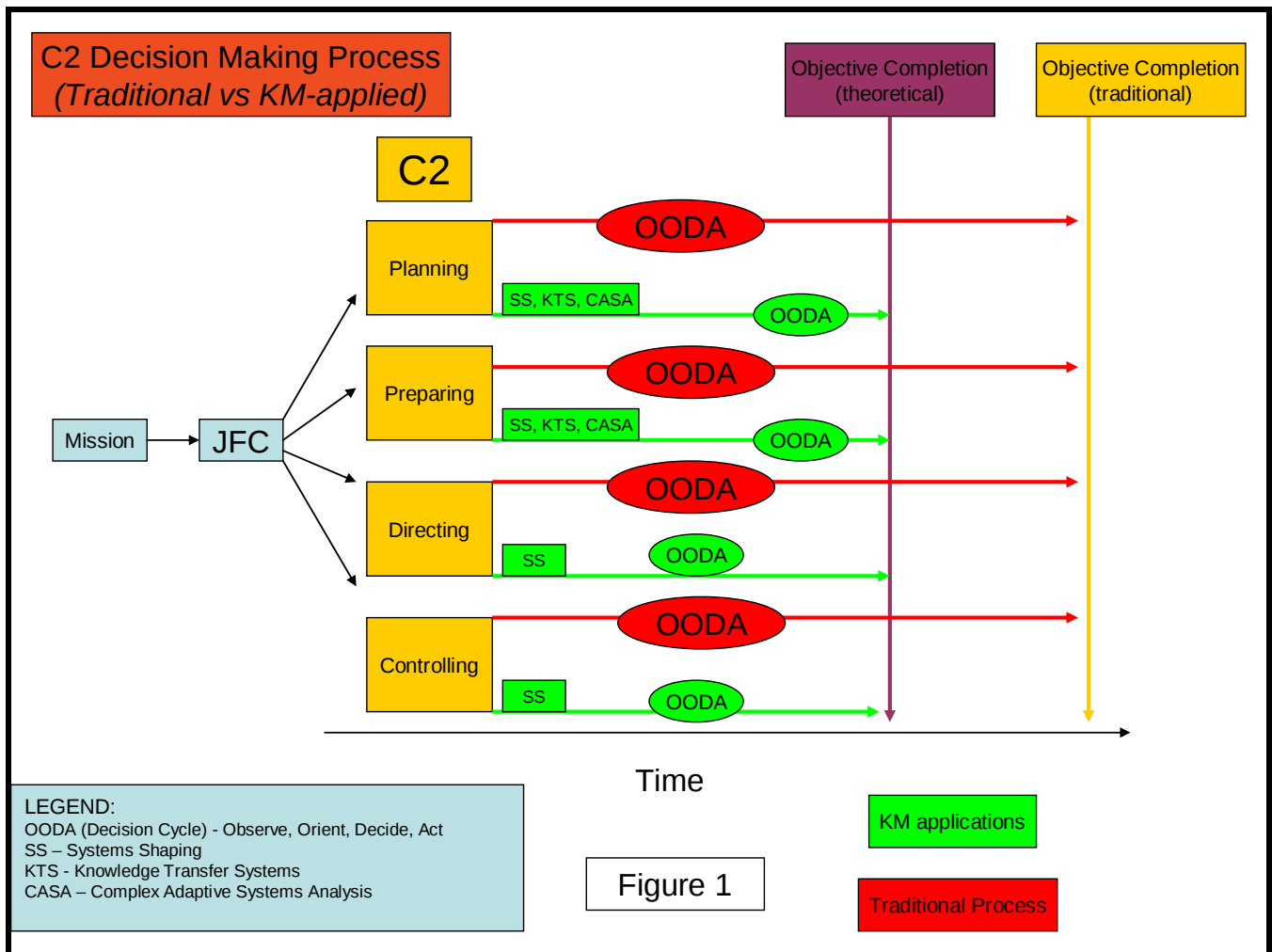
“Of a Truth, Knowledge is Power”⁴⁰

There is widespread acceptance that collapsed decision-making cycles translate into advantage at levels in which they are applied (strategic, operational, and tactical).

Such use at one level can influence the other two. Whether doctrine-based (centralized control, decentralized execution), technological-based (NCW), or a combination of both, any method which can act in this fashion on the JFC DMC, must be heavily invested upon and further developed.

KM potential in both business and military model organizations is increasing in parallel to information technology and the Information Revolution in response to sheer user demand. Economy of force/effort and overall process improvement are but only two attributes to a field of study still in a stage of infancy. The case has been made that three areas of KM have the ability to drastically reduce operational level DMCs through staff integration and use. A fully mature KTS will allow the human to learn better information, faster, while simultaneously upgrading the system itself through the incorporation of his/her newly acquired synthesis of experiences and knowledge. SS will custom tailor technical applications to human needs in a revolution of efficiency. Understanding and mastering new complex environments can be realized through CASA tools which can also provide the operational commander greater focus and reduction in unnecessary efforts.

While critics believe that an overemphasis of military technology for winning wars is a dangerous paradigm, it must be noted that KM is itself a new paradigm which remains human-centric. KM simply offers tools to drastically improve human decision-making, and adherence to its principles will act as a powerful guide to ensuring military technology remains secondary to human will.



Notes

(All notes appear in shortened form. For full details, see the appropriate entry in the bibliography)

¹ Fred Barnes, "The Commander: How Tommy Franks won the Iraq War," 2.

² Ibid., 2.

³ BBC News, "New Straw to Kill Disease as You Drink," 2.

⁴ MSN Encarta, s.v., "Exploitation."

⁵ Global Security, "The Observe-Orient-Decide-Act (OODA) Cycle," Appendix A.

⁶ Brainy Quote, "Margaret J. Wheatley Quotes," 3.

⁷ Vego, *Joint Operational Warfare: Theory and Practice*. X-19.

⁸ Ibid., X-19. **Centralized control** functions based upon orders issued from senior military commanders implying strict adherence to the task within a vertical command structure. All functions are accomplished and directed by senior control authority. **Vego points out that the advantages of such strict control are a high degree synchronization of forces and unity of effort at the operational level.** This is essential during crises, highly political situations, and in cases where limited resources need to be prioritized. Decision making cycles are compressed yet whether the best decision is being made is a significant concern. This is because the informational requirements for centralized control are usually massive with the central authority itself concerned with sifting through information and acting upon it.

⁹ Ibid., X-19. **Decentralized control** - the operational commander relies on the initiative and abilities of subordinate commanders to execute the mission as they deem appropriate. The advantages include subordinate commanders who are well integrated within their environment ("plugged in") and understand how best to establish the task bridge required for mission accomplishment. **Vego mentions that alternatively, this advantage can also be viewed as a disadvantage due to poor subordinate commander judgment.** Not only is execution speed increased, but operational decision-making speed is increased as well due to a sharing of information processing among subordinate commanders who send finished recommendation/assessment to operational commanders.

¹⁰ Steven E. Ankerstar, *Beyond Centralized Control and Decentralized Execution*, xii.

¹¹ Doctrine for the Armed Forces of the United States. Joint Publication (JP) 1, IV-16.

¹² Global Security, "The Observe-Orient-Decide-Act (OODA) Cycle," Appendix A.

¹³ Ibid., Appendix A.

¹⁴ Ibid., Appendix A.

¹⁵ Ibid., Appendix A.

¹⁶ Ibid., Appendix A.

¹⁷ Google Book Search, "Fourth European Conference on Knowledge Management," 263.

¹⁸ American Institute of Aeronautics and Astronautics, Inc., "Information and Command and Control Systems Technical Committee," 1.

¹⁹ Ibid., 1.

²⁰ Systems Thinking, "Knowledge Management – Emerging Perspectives," 2.

²¹ Ibid., 3.

²² Chips Magazine, "Knowledge Management Insights from Global 2001," 1.

²³ Indiana University School of Informatics, "Complex Systems Monitoring," 1.

²⁴ Ibid., 3.

²⁵ Heart Quotes: Quotes of the Heart, "Time Quotes and Proverbs – Doc Childre, Freeze-Frame," 1.

²⁶ USJFCOM, "Joint Knowledge Development and Distribution Capability (JKDDC)."

²⁷ DTIC, "Joint Vision 2010," 16. **"Information Superiority: the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."** DTIC, "Joint Vision 2020."

²⁸ The Lexington Institute, "The Challenge and Promise of Network-Centric Warfare," 7. **"The goal of network-centric operations (NCO) is to enable forces to accomplish their objectives more efficiently; faster; with fewer troops in harm's way; and with fewer and lighter weapons and other equipment to bring to, sustain, and maneuver in the battlespace."** In-depth discussion of NCW attributes will not be given in this paper due to relevancy issues and limited length requirements, 3.

²⁹ Ibid., 5.

³⁰ Search Domino, "Definition – Knowledge Management," 1.

³¹ The Lexington Institute, “The Challenge and Promise of Network-Centric Warfare,” 7.

³² Ibid.,

³³ Ibid.,

³⁴ Indiana University School of Informatics, “Complex Systems Modeling,” 1.

³⁵ Arizona State University, “Complex Adaptive Systems: A Nominal Definition,” 1.

³⁶ Center for Strategic Leadership, U.S. Army War College, “Proteus Insights and the Protean Media Critical Thinking Game,” 3. Proteus Insights – “Assist strategic and high-operational level decision makers, planners and analysts in “outside the box” consideration and critical analysis of National, military and intelligence issues within the Joint, Interagency, Intergovernmental and Multinational (JIIM) environment by encouraging them to: (1) Consider differing values and perceptions of future target audiences by systematically looking “outside” of the values contained in Western Civilization when considering the application of all elements of national power (Diplomatic, Informational, Military, and Economic); (2) Frame complex issues holistically to identify and consider the 2nd and 3rd order effects and unintended consequences of policy and strategy decisions; (3) Scan the horizon and define the future environment and scenarios to systematically identify discreet threats and capitalize on hidden opportunities.”

³⁷ Ibid., 3.

³⁸ Gary Luck, *Best Practices – The Move toward Coherently Integrated, Joint, Interagency, and Multinational Operations*, 7.

³⁹ Vego, *Joint Operational Warfare: Theory and Practice*, XIII-12.

⁴⁰ Gallagher Financial Systems, Inc., “Knowledge Management and Knowledge Automation Systems,” 1.

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