Strategy Research Project

KNOWLEDGE CENTRIC WARFARE: AN INTRODUCTION

BY

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USAWC CLASS OF 2009

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KNOWLEDGE CENTRIC WARFARE: AN INTRODUCTION

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ABSTRACT

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KNOWLEDGE CENTRIC WARFARE: AN INTRODUCTION

On 15 January 2009, the Chairman of the Joint Chiefs of Staff (CJCS) published his Concept for Joint Operations, calling it the most fundamental of all US military concepts.[1] In it, Admiral Mullen describes a vision for the future joint force in terms of four military activities: combat, security, engagement, and relief and reconstruction. He lauds US forces today as the most capable in our nation's history. However, after praising people as our greatest advantage, he states that our patriotism, training, discipline, leadership, and ability to adapt are not enough to meet future challenges. Somehow, something is missing.

Missing are new capabilities and improved capacities of existing ones. New doctrine, tactics, techniques, and procedures are missing. The CJCS advocates new methods of integration, as well as better selection, education, training, equipment, and management of the force – led by broadly educated, adaptive, thinking professionals to meet the full spectrum of national security challenges. Beyond the professional commitment and honor imbued in the current force, we must cultivate the all-important ability for proper action in the absence of specific guidance.[2]

The Chairman offers 17 institutional imperatives for the joint force to fulfill his vision - 8 of which direct more coherent development of knowledge and/or adaptability within our force:[3]

- Improve knowledge of and capabilities for waging regular warfare.
- Improve knowledge of and capabilities for nuclear warfare and operations in chemical, biological, and radiological nuclear environments.

- Improve knowledge of and capabilities for security, engagement, and relief and reconstruction activities.
- Markedly increase language and cultural capabilities and capacities.
- Institute mechanisms to prepare general purpose forces for new mission sets.
- Improve organizational solutions for protracted missions that cut across geographical boundaries.
- Develop innovative and adaptive leaders down to the lowest level.
- Improve service and institutional adaptability to deal with rapid change.

The Chairman's imperatives signal both a shift of focus within and expansion of the military domain from today's framework of Network Centric Warfare (NCW) towards what Phister and Plonish call Knowledge Centric Warfare (KCW).[4] This first appears to be a simple evolutionary step from the centricity of the 80's platforms and the 90's networks to the future centricity of knowledge.[5] But it is also a profound shift back to what has been most important all along – the physical and mental capacity/capability of our Soldiers, Sailors, Airmen and Marines, as well as of the professionals supporting them.

The shift is timely and appropriate because the threat has changed. Instead of the formerly effective and more clearly defined Westphalian concept of political and military competition between states, we now do battle with conditions. Although U.S. and coalition military might is unrivaled, our collective political objectives are frustratingly elusive. Fortunately, in improving each warrior's understanding of the broad range of the tools of war and techniques for the local or national application of the instruments of power, we become more effective. By integrating knowledge itself more

thoroughly into the force, we create the capability to be successful not only in a war against people, but also in a war among the people.[6]

This paper proposes we more carefully consider the focus of the collective joint force in order to support the Chairman's vision. It proposes a knowledge-centric framework for understanding the complex nature of warfare at all levels. It suggests that the necessary evolutionary step that will both capture the promise of and fill the voids within NCW resides in centering our war-fighting ontology on the people who fight wars and what they know– not the technology supporting them. This thesis is overtly philosophical: knowledge resides in those who know – living, breathing, understanding, failing and succeeding, fallible but potentially brilliant people who are central to any enterprise. This thesis presents an epistemological challenge to those who misunderstand the subtle but enormous difference between knowledge and information, born of the gradual corruption of what it means to know.

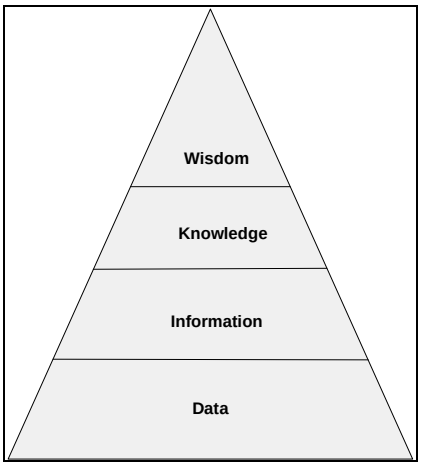

Figure 1: The Knowledge Pyramid[7]

Because of the tremendous gains in our capacity to store, process, and manipulate information in the modern age, many now mistakenly equate the capture of data and information, however contextually rich, as the preservation and distribution of

knowledge. Accordingly, knowledge centricity is a response to the lament that while we swim in information, we are starving for knowledge.

KCW takes the best of the network-centric operational concepts to the next level.[8] It culls the proven ideological tenents from the less viable ones and refocuses on the warrior, applying all we have learned. In 1998, the introduction of NCW revolutionized the way both warriors and thinkers view war, yet the concept remains somehow incomplete. The complex, intricate, and awe-inspiring technological marvels of silicone and steel we have created do not quite capture what Clausewitz called the passion of war. KCW focuses on what we know and how we know it – on what is in our minds and how it got there. It is knowledge of ourselves and the enemy in a broader, more integrated context, creating a knowledge edge by "leveraging and exploiting information, communications and other technologies, and by the application of human cognition, reasoning and innovation."[9] Knowledge Centric Warfare, empowered by technology, embraces the fundamentals of Knowledge Management (KM) to generate an advantage by influencing decision-making and enhancing effective execution.[10] KCW centers on the war-fighters, developing then synthesizing the mental acumen and technical savvy required to fulfill the Chairman's vision while developing a collectively superior force.

KCW, like KM, is an integrative concept – it attempts to reassemble our perception of the world in some semblance of how it "really" is by beaming its messages at the intersection of people, process, and technology. The ambiguity of the "information age" environment initially fostered the development of Information Technology (IT) solutions to KM with the vague promise that organizational commitment, zeal, and money might transform the seeking firm into the vaunted "learning organization."

Relying on a build-it-and- they-will-come mindset, urged on by a host of “knowledge management” IT consultants, companies invested in IT and waited for the KM revolution. Many are still waiting.

The notion that KM can be purchased from a software vendor and deployed by an institution initially blurred the KM picture by emphasizing the wrong node of KM’s process-people-technology triad. Current research and a deeper understanding in the quest to manage knowledge is shifting institutional focus away from primarily IT solutions to a more integrated, people-centric view, thereby relegating technology to a supporting, though still an essential role. The organizational imperative of knowledge transfer is now assuming a more social character in the form of Communities of Practice and other IT enabled forums.

Similarly, KCW is a broad, abstract concept centering at the intersection of our technological capacity, the processes embedded within our war-fighting apparatus, and, most importantly, the people using both to prevail in the modern struggle of wills. In *Power to the Edge: Command, Control in the Information Age*, the authors discuss four dimensions of C2: physical, informational, cognitive, and social (see Figure 2). [11]

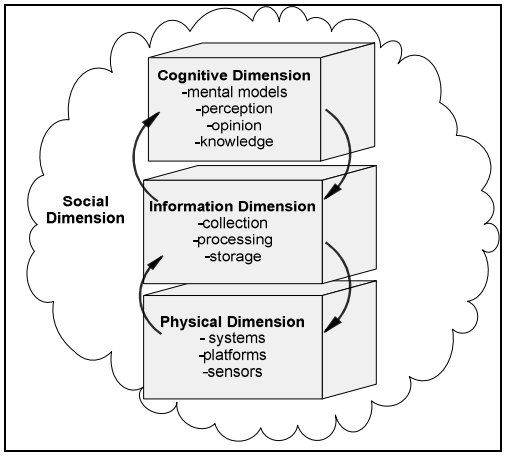

Figure 2: The Information Environment[12]

Physically, NCW connects platform sensors and systems into a cohesive whole. At the information level, data is pulled, posted, processed, and stored.[13] Often overlooked (or assumed) is the cognitive development of the people using these systems and sensors as well as the social domain in which they operate. KCW emphasizes the cognitive and social domains not only of C2, but also the nature of warfare itself.

Philosophical Roots: Epistemology, Semiotics, and Cognition

What is knowledge? This is certainly a question for the ages, and one that philosophers, scientists, poets, religious leaders, and the rest of the world's great thinkers have struggled with for recorded history. Indeed, one's answer to this question frames one's approach to many things, but a workable answer is a core component of KCW. Fortunately, by standing on the shoulders of the great thinkers of our time, it is possible to develop at least a working definition of what knowledge is for the purposes of creating the KCW framework.

Epistemology (from the Greek word *episteme,* meaning "knowledge") is a branch of philosophy that considers the nature, origin, and limits of human knowledge and understanding. [14] Among the ancient philosophers, both Plato's theory of forms and Aristotle's examination of cause and effect hold that knowledge is possible when subjected to reason and logic. Conversely, ancient skepticism, like that of Pyrrho, is a philosophy of doubt that generally suspends judgment on our capacity to know anything and holds that true knowledge is impossible, masked by appearances and sensory misperceptions.[15]

Modern (17th-19th century) philosophers and epistemologists – Descartes, Locke, Hume, and Kant among them – pondered the true nature of knowledge and set rigorous standards for what constituted actual knowledge as opposed to some lesser form of intellectual activity. Two principal schools of thought emerged: rationalism, which posits that certain a priori knowledge exists in the mind; and empiricism, which asserts that all knowledge is experiential.[16] Though rooted in more ancient philosophy, John Locke's "blank slate" is a modern expression of empiricism.[17] Famously, Descartes' *Cogito Ergo Sum*, or "I think, therefore I am," is a skeptical philosophic proof. After careful examination, he determined all of his previous knowledge was simply belief when subjected to his standard that all knowledge is certain cognition and certainty is freedom from doubt. The only irrefutable claim to knowledge he could make was that because he could think, he must exist, and his existence was therefore true.[18]

Kant, inter alia, distinguished knowledge from opinion and faith by theorizing about levels of ascent, wherein each level is subject to increasingly stringent justification. At the lowest level, a knower can hold a proposition weakly supported by reasoning – an opinion. More stringent, but nonetheless subjective beliefs are assents held strongly, but they lack objective sufficiency. Knowledge, the final rung, is "assent that is sufficient both subjectively and objectively."[19] Clearly, Kant's classifications rely on their sufficiency – they need some form of internal or external justification to cross the thresholds of propositional ascension.

Using a proposition construct for the consideration of what constitutes knowledge, the claim to having knowledge of a given proposition requires three things: truth, belief, and justification, each "individually necessary and jointly sufficient"[20] to support the epistemological claim. As such, the Justified True Belief (JTB) construct is a

model for knowledge (where *p* is the proposition and *K* is the knower) generally formulated as:[21]

S knows that *p* if and only if:

- *p* is true;[22]
- *K* believes that *p*;
- *K* is justified in believing *p* (either internally or externally).[23]

The philosophic pursuit of Truth, solidly in the realm of epistemology, exceeds the scope of this paper. But the acceptance of JTB as a working definition for knowledge, however contingent or tentative, is sufficient to the extent that knowledge inextricably requires a knower. Several challenges remain: discovery of how knowledge manifests itself within an organization; methods of capturing, reusing, and generating knowledge; and techniques of representing knowledge are of the utmost concern.

Cognition

Cognition is the process or act of knowing, inclusive of perception and judgment. It is the experience of knowing, as opposed to feeling or willing.[24] Cognitive science is a relatively new interdisciplinary field embracing "philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology."[25] Arguably, cognitive awareness is the *sine qua non* of knowledge and is the threshold for distinguishing knowledge from otherwise contextually rich information.

Semiotics

> All instruction is either about things or about signs; but things are learned by means of signs.[26]
>
> —Augustine (On Christian Doctrine, I:2).

Semiotics is a branch of philosophy that concerns itself with signification and language, particularly as it relates to the concepts or things that signs (sounds or symbols) represent. It is important because it has everything to do with how we convey elements of what we know. More practical than abstract or ethereal, the capacity to accurately convey and interpret meaning both within and beyond organizational bounds poses a significant challenge, even as we use a “common” language to explicate data and information. In an increasingly globalized world, changing languages while preserving meaning is a tremendous informatics challenge. Brodner asserts that semiotic challenges are the principle reason “most real IT implementations have turned out to be a barrier to rather than an enabler for organizing more productive work and value creation processes.”[27] Broadly, semiotics is broken into three categories: semantics, syntax, and pragmatics.

Semantics is the study of meaning within language best illustrated by an old joke that highlights different meanings of the word “secure” within the US Armed Forces:

Commander: "Secure that building!"

- A Sailor immediately turns out the lights and locks the doors.
- A Soldier posts an MP and no one gets in without a special pass.
- A Marine sets up machine gun crossfire, lays down a mortar barrage, and calls for air strikes and artillery support.
- An Airman takes out a two-year lease with an option to buy.

Given the same command, each audience interprets it differently and acts accordingly based on the cultural model to which they subscribe. Discussion of cultural models follows.

Syntax concerns itself with the formal use of rules and standards for combining symbols to convey meaning. Proper grammatical structures for the writer and logical precision for the computer programmer are examples of syntax, which effectively conveys the intended meaning or instruction through the application of specific rules.

Pragmatics involves the study of conveying more meaning than that which is explicitly stated. Inference is required on the receiving end of a pragmatic message to derive its fullest meaning. A moment of reflection might reveal that most misunderstandings between people are the product of pragmatic misfires. Pragmatism requires more than context -- it requires *a priori* knowledge (but not in the Kantian sense) and is sensitive to not only what is said or written, but also to what is not.[28]

Shared meaning reduces semiotic challenges within groups. Developing a shared lexicon is a critical component in the development of shared meaning, especially across organizational boundaries. Beyond shared meaning, understanding how knowledge flows within an organization and how shared meaning becomes a shared understanding is important. In *Dynamic Theory of Organizational Knowledge Creation*, Nonaka cautions “although the terms ‘information’ and ‘knowledge’ are often used interchangeably, there is a clear distinction between information and knowledge.”[29] He then quotes Dretske:[30]

> Information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it. Knowledge is identified with information-produced (or sustained) belief, but the information a person receives is relative to what he or she already knows about the possibilities at the source.

Organizational Learning and Knowledge Transfer

There are three general approaches to knowledge transfer within organizations, or ways organizations learn: the positivist approach in which objects have independent

meaning in the world; the social-constructionist view that assumes knowledge is a social construction whose meaning is derived from its usage; and a socio-cognitive perspective that assumes knowledge is internalized in the mind and body of the knower and then reconciled through external influences. The validity of the accepted approach depends on the philosophical notion of what constitutes knowledge, which then determines the threshold information must cross to become knowledge.

Nonaka posited there are two types of knowledge: tacit and explicit. He theorizes knowledge is created, or transferred, through the conversion of the two types.[31] Tacit knowledge is the knowledge inside one's head, and explicit knowledge is tacit knowledge somehow externalized, recorded in some way to facilitate its disembodied transfer. Nonaka further identifies four modes of knowledge conversion between the two types (See Figure 3):[32]

- Tacit-to-tacit: Occurs between people thru face-to-face socialization – shared experience, observation, imitation, and practice.
- Explicit-to-explicit: Between individuals thru some medium: phone, email, etc.
- Tacit-to-explicit: Externalization of knowledge – recording what you know.
- Explicit-to-tacit: Similar to traditional learning, internalization of disembodied knowledge.

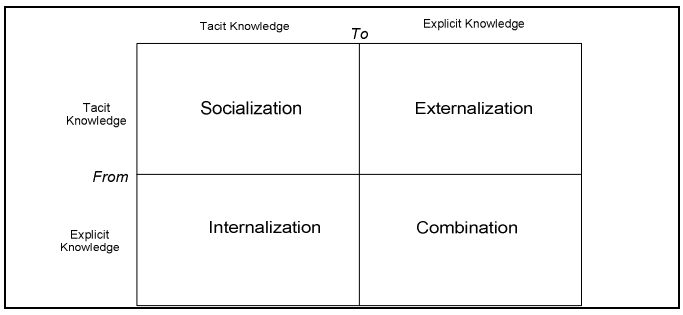

Figure 3: Nonaka's Model of Knowledge Transfer

Nonaka's model exhibits significant explanatory power, but is subject to misinterpretation if not understood, ironically, in his full context. Specifically, the interplay between tacit and explicit knowledge involves a cycle that creates or transfers knowledge through at least one iteration. Contributing to the confusion, Nonaka himself uses explicit knowledge and information interchangeably in his discussion of explicit-to-explicit, or the combination knowledge transfer mode: "The reconfiguring of existing information through the sorting, adding, recategorizing, and recontextualizing of explicit knowledge can lead to new knowledge."[33] This objectification of knowledge, disembodied from the knower as a type of intellectual currency, has allowed terms like "knowledge-base" to replace "data-base" in our evolving lexicon and undermines what it means to know.

The positivist approach to knowledge transfer assumes that disembodied knowledge can be stored and its meaning adequately codified to qualify as knowledge.[34] The principal challenge associated with a positivist perspective is the assumption a retriever will be able to interpret, in context, the captured knowledge.

The social-constructionist approach to knowledge transfer, built upon constructivist theory, posits derivation of meaning comes through usage. Constructivists assert individuals construct knowledge for themselves in the context of the physical world around them while building on knowledge previously acquired. Immanuel Kant, Jean Piaget, and Lev Vygotsky are among important contributors to the constructivist theory.[35] Vanden,[36] cited in Lauzon, asserts, "learning is a constructive process in which the learner is building an internal representation of knowledge, a personal interpretation of experience…an active process in which meaning is developed based on experience."[37]

Situated Cognition is a subset or branch of constructivism developed by Lave. It asserts that while knowledge is acquired through the context of activity, knowledge transfers take place only in a similar situation, and they are largely unintentional.[38] The condition of a similar context is the underpinning of Communities of Practice,[39] or forums of similar experience. Similarity of experience and context enables the transfer of knowledge.[40]

Etienne Wenger and Jean Lave first introduced the term *Communities of Practice* (CoP) more than 15 years ago.[41] In a later work, Wenger, et al., define CoP as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis."[42] The authors assert that while the term is relatively new, the idea of a community of practice is quite old. They cite medieval guilds as an early example. But they believe the concept retains the capacity to create a framework and infrastructure in a modern learning organization.[43]

The shift in thinking from a KM perspective is important as it moves away from viewing knowledge as an object or artifact – a tendency of IT dominated KM efforts that focus on codification and capture. Data, information, and knowledge are culled from their context in a tacit-to-explicit knowledge transfer process, losing meaning. This tendency is affirmed in a 2004 case study of a Danish software firm in which "management's preoccupation with implementing technological solutions for codifying, archiving, and creating global access to information [was] conflicting with the practitioners' focus on seeking context-rich information through collegial networks." [44]

Instead, in a connectionist view of knowledge, in which the knower is a required entity and the separation of the knower from the known is impractical (if not

philosophically impossible), CoPs create a vehicle for sharing tacit knowledge. Nonaka believes that the majority of organizational knowledge is tacit, embodied in the people that comprise the organization.[45] CoPs create and exploit the social/cultural underpinnings of knowledge by facilitating tacit-to-tacit knowledge transfer.[46] This largest store of organizational knowledge may be tapped by creating conditions conducive to the transfer of elusive and difficult-to-capture tacit knowledge.[47] So it is not difficult to understand the broad appeal of a Communities of Practice approach to managing and creating organizational knowledge. CoPs are effective because the shared cultural models upon which they are based facilitate the transfer of information, thereby creating knowledge.

Structure, Design, and Membership of a Community of Practice (CoP)

CoPs can take many forms; they are typically organized around common goals. They can be sponsored by an organization or exist outside any formal recognition.[48] In either case according to Wenger, a CoP shares three fundamental characteristics: a domain of knowledge, a collection of people concerned with the domain, and a shared practice.[49] Practice is the operative word: It is the engine that drives negotiation within the community. Practice fosters sharing of knowledge and best practices by those who are actually engaged in the CoP. The practicing community ultimately discovers new knowledge.

Wenger offers seven conditions upon which a CoP should be designed "with a light hand":[50] the ability to evolve, open dialogue among varying perspectives, different levels of participation, both public and private spaces, a focus on value, a balance between familiarity and excitement, and rhythm. Within this fluid design, Dalkir[51], citing

Kim, breaks community membership into five categories: visitors, novices, regulars, leaders, and elders–, each beginning with different levels of participation that potentially mature through participation.[52] An example would be a visitor who becomes a novice participant because the visitor found value in participating. Through exposure, time, and participation, the individual could evolve into a leader within the CoP.

Fisher's 2004 study on CoP within the Data Management User Technology (DMUT) Division at the IBM Corporation expands Wenger's three fundamentals of a CoP while adopting them in a more formal fashion. Abandoning the light-handed approach, Fisher stresses the important role of common goals and missions within the IBM communities. [53] The purpose of the management-directed formalized goals and missions, as opposed to Wenger's more ad hoc approach, is to provide a rally point for the diverse and cross-functional members of the communities within the Division. Each knowledge domain centers on a product group and communities fall into two distinct categories: skill-based communities and goal-based communities. Employees typically belong to at least one community of each type and can belong to more than one group in a skill-based CoP.[54]

At IBM's DMUT, the skill-based CoPs function much as Wenger describes: Workers with a common skill set share best practices in an informal, collaborative environment. Fisher specified four mechanisms adopted at IBM for the nurturing of these skill communities: company-sponsored skill-based councils whose members form the CoP; collaborative communication and learning facilitated by both the company intranet and Lotus Notes to transfer knowledge transfer and document best practices; mentorship, which closely observes Kim's model; and physical proximity, a deliberate attempt to collocate knowledge workers close to their skill-based communities.[55]

Goal-based communities perform a different function at DMUT. More in line with traditional western corporate hierarchy, these communities form among specific product groups, and their membership is multidisciplinary. They focus on the product – producing it on time and within budget. The goal-based communities interact with each other and govern the skill-based communities. Firmly grounded in corporate reality, Fisher notes that "the skill communities do not exist to exhibit perfection in their skills; they exist to contribute those skills to a specific business-related goal, such as the design, development, and shipment of Product A on schedule on budget."[56]

This valuable case study describes one way to establishment CoPs in a large corporation and offers a concrete example of CoPs in action. Fisher concludes by describing the struggle to find balance between the different types of CoPs at IBM– perfecting skills, creating and sharing knowledge vs. the business imperatives of schedule and budget. The study does not offer any metrics to assess the value added by the CoPs.

For all their utility, CoPs do not offer a complete KM solution in industry, nor are they the panacea for KCW. While there are enthusiastic sponsors of the concept and a growing body of literature on CoPs, actually measuring the CoP contribution to business enterprise remains difficult. If it cannot be measured, how has it managed to create a competitive advantage?[57] In a farming analogy, practitioners are encouraged to plow a fertile field in the proper place hoping for a viable yield; however, this "faith-based" approach is not an option when the security of the nation is at stake. Other models and theories of learning have applicable explanatory power in the knowledge transfer process (See Table 1).[58] Additionally, within CoPs themselves, lurking in dark corners are undisclosed issues that could limit their viability.

Theory	Principal Authors	Key Points	Model
Problem Based Learning	Barrows and Kelson	Hands on active learning Investigation and resolution of messy, real-world problems	Cultural
Experiential learning	Kolb	Four stage cycle Combines experience, perception, cognition, and behavior	Cultural
Affordance Theory	Gibson	World is a perception and perception drives action	Private
GOMS Model	Card, Moran, and Newell	Human information processing Predictive behavior in uncertain situations	Private
Discovery Learning	Bruner	Inquiry based instruction Best for learners to discover facts and relationships	Private
Situated Learning	Lave	Learning is unintentional Role of activity, context, and culture	Cultural
Stage Theory of Cognitive Development	Piaget	Cognition develops in four stages: sensorimotor, preoperational, concrete, and formal	Private
Multiple Intelligences Theory	Gardner	Seven ways people understand the world: Linguistic, Logical-Mathematical, Visual-Spatial, Body-Kinesthetic, Musical-Rhythmic, Interpersonal, Intrapersonal	Cultural

Table 1: Learning Theories

The social dynamic within a CoP is left to nature in much literature. Roberts allows that issues of power, trust, and predisposition are powerful influences in the community. The development of shared meaning within the community might simply reflect the dominance of powerful community members. Issues of trust, based on a host of sociological factors, can inhibit sharing of knowledge. Likewise, members' predispositions regarding participation might limit the degree to which the CoP is a viable solution is certain environments.

Hemre describes the importance of recognizing CoP life cycles and their relative values over time.[59] Wenger offers a cautionary critical consideration on the dual-edged

nature of CoPs: “shared perspectives on a domain, trust, a communal identity, longstanding relationships, and an established practice – are the same qualities that can hold it hostage to its history and its achievements.”[60] Communities might become atrophied in historical best practices and immobilized in the community power structure. These circumstances would inhibit the creativity and innovation that was their charter. In view of the power of doctrine, such obstacles to a dynamic CoP could be debilitating.

The principal contribution to the development of KM and to KCW by the CoP approach is its departure from principally technological solutions toward sociological considerations in the construction of learning organizations. Their reliance on the social nature of learning and knowledge transfer brings rich context to the KCW triad. Whereas only imagination limits technological contributions and lean/six-sigma initiatives aggressively study processes, the CoP concept has brought the same level of attention to understanding the most important component of knowledge and its management – the people.

A more complex and more powerful socio-cognitive approach to knowledge transfer reveals the profound impact of mental models on individual cognitive processes, somewhat in contrast to the social constructionists’ emphasis on shared practice and experience.[61] Cultural and private mental models create an interpretive framework for socio-cultural feedback and strategic thinking processes (categorical and/or reflective thinking). The implication is that nuanced interpretation is a prerequisite to knowledge. Further, the cognitive interplay of the relative strength of cultural and mental models explains how the same data applied to the same scenario by different people, all other things being equal, often leads to different knowledge outcomes. It follows that the objectification of knowledge, on which both the positivist and social

constructionist approach to knowledge transfer rely, is too simplistic.[62] Cognitive processes and the factors that influence them must be accounted for to adequately understand the creation and transfer of knowledge. Ringberg and Reihlen offer a four-step recursive process:[63]

- Cognitive context : embodied cultural and private models
- Cognitive content: reflective/categorical/strategic processing
- Environmental feedback: divergent →convergent social processes
- Cognitive outcome: collective, negotiated, unique, or stereotypical knowledge

The cognitive outcome or knowledge this process produces by using the socio-cognitive model offers a great deal of flexibility and better reflects real-world observed phenomena.

Negotiated knowledge emerges from discrepancies between the mental models of the participants. It is typical of cross-boundary information exchange between practitioners of different disciplines who hold different assumptions.[64] However, the exchange remains valuable as long as the participants remain engaged and dissect, understand, and ultimately resolve their discrepancies. Resolution constitutes an adjustment in the participants' cultural or private models and forms the basis for more effective knowledge transfer in the future (see Figure 4).[65]

Collective knowledge relies on shared cultural models that come from shared experience, education, or training – typical of military organizations.[66] It relies less on reflective thinking and more on categorical thinking. Knowledge transfer in this scenario is akin to the silent hand and arm signals shared among infantryman, produced by intense training to develop shared cultural models. More personally, it is the power of "the look" between a husband and wife, emanating from the shared traditions, customs

and habits developed through a long-standing, intense personal relationship. One of the challenges of this type of knowledge is that it limits knowledge transfer from those outside the group. Empirically, a glimpse of the challenges among the military branches, services, and the interagency support this concept.

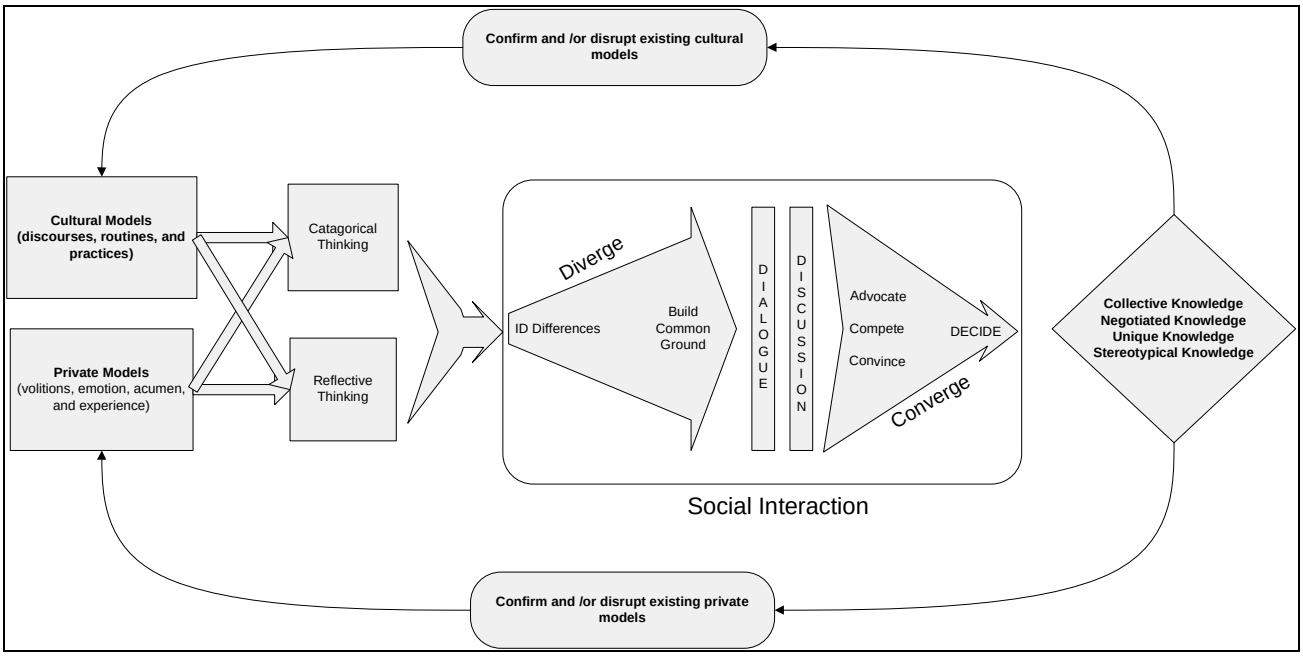

Figure 4: Cognitive Outcomes on Knowledge Transfer (adapted from Ringberg and Reihlen)

The remaining two knowledge transfer scenarios relate to the degree of categorical thinking or reflective thinking involved. Unique knowledge embeds a high degree of reflection, with limited social interaction and little categorical influence.[67] Self-created conceptual worlds dominate the cognitive capacity of those with unique knowledge. The transfer of unique knowledge is rare due to limited social interaction of what Ringberg and Reihlen call an emancipated postmodernist disposition. However, often those with unique knowledge are able to contribute disproportionately to off-the-

wall or out-of-the-box thinking perhaps foreign to categorical thinkers, provided a social bridge connects the two.[68]

Stereotypical knowledge refers to transfer scenarios where categorical thinking dominates with little evident reflection. Routines for the sake of the routine characteristic of large bureaucracies are a typical manifestation of stereotypical knowledge.[69] Dangerously, without reflection, stereotypical knowledge leads to blind spots or cognitive comfort in situations that should in fact be alarming.

Adopting a more complex view of knowledge creation and transfer, where private and cultural models are of critical importance for the generation and identification of the four types of knowledge is a key step in the evolution of KCW. Additionally, the active development of our private and cultural mental models, applying relevant aspects of the learning theories described in Table 1, is fundamental to achieving the shared situational awareness envisioned by NCW's architects.

Toward the Centricity of Knowledge

This paper offers theoretical justification to alter the philosophical aim-point in the development of the future force. Our professional development should focus on the cognitive capacity of those who populate our networks, as opposed to the technical capacity of the network itself. This shift will enable us to build a force more capable of embracing the full spectrum of traditional and emergent military responsibilities. This cognitive development, in turn, requires deliberate focus on developing the mental and cultural models inherent in everyone. Importantly, evolving from NCW to KCW requires a reexamination of the assumptions upon which NCW rests.

David Alberts describes NCW as having four basic tenets: First, a robustly networked force shares information more readily. Second, sharing information both increases the quality of the information shared and facilitates collaboration. Third, shared awareness is the result of greater collaboration and leads to self-synchronization. Finally, taken together, the previous three tenents dramatically improve mission effectiveness.[70] This analysis assumes that when connections have been established, they will be used to achieve effective ends. Implicitly, NCW assumes connected people will collaborate to generate new levels of knowledge because they are connected.

At the heart of NCW is Metcalf's law: Introduced by George Gilder in 1993 in an article about Metcalf's observations, the law states that the value of a network is proportional to the square of its users.[71] In the case of NCW, this value is roughly analogous to war fighting capacity. It follows simply that more nodes equal more combat power. Additionally, Alberts asserts that network-centric operations apply to more than just high-intensity, force-on-force warfare. He claims networks create the potential, albeit more subtly, to be successful in irregular warfare when appropriately applied.[72]

However, we are really using ALL of the networks to create knowledge in the minds of the human beings. So we should focus on the cognitive dispositions of our force through a deliberate effort to create the conditions that give rise to new knowledge.[73] A more viable assumption is that technical capability will continue to increase due to the global nature of computing in the information age. It is more effective to develop our minds using the networks of the moment, social and technical, to generate a war-fighting advantage.

The modularization of war-fighting organizations into smaller, self-contained fighting enterprises empowered by our ability to share information is a move away from industrial age organizational theory.[74] The older requisite rigid command-and-control (C2) mechanisms have grudgingly yielded to flatter, more efficient structures. In the newer construct, the demand for strategic knowledge at the tactical level compels development of an intellectual adroitness across the entire force. The ubiquitous nature of information flow in modern society respects neither linear nor vertical lines of communication. The premise of the "strategic corporal" whose real-time tactical actions have strategic consequences relegates the formal chain of command to nothing more than simply another actor on the national security stage.[75]

Private mental and shared cultural models perform the sense-making function in cognition. Taken together, they form the multifaceted lens through which we view the world. KCW, specifically categorical thinking, are the point of leverage.

The deliberate development of reflective thinking is another lever. Strategic thinking is not the exclusive domain of national strategists. Strategy, or the artful application of ends, ways and means to achieve national security, can be used at any level in an organization -- the end can be local or global. The socio-cognitive model of knowledge transfer provides a method to understand the impact of mental model development and the resultant types of knowledge produced. Fortunately, a renewed KM effort is underway. If it is properly applied, it may provide the strategic advantage necessary to accelerate the evolution of the force and realize the CJCS's vision.

Knowledge Management in the U.S. Army

The Army first recognized KM in 2001, emphasizing the IT demands of the emerging concept in vogue at the time. More recently, the Army published FM 6-01.1, Army Knowledge Management (AKM). The doctrine advances 12 principles largely adapted from the civilian sector. But it usefully develops and articulates those concepts (see Figure 5).[76]

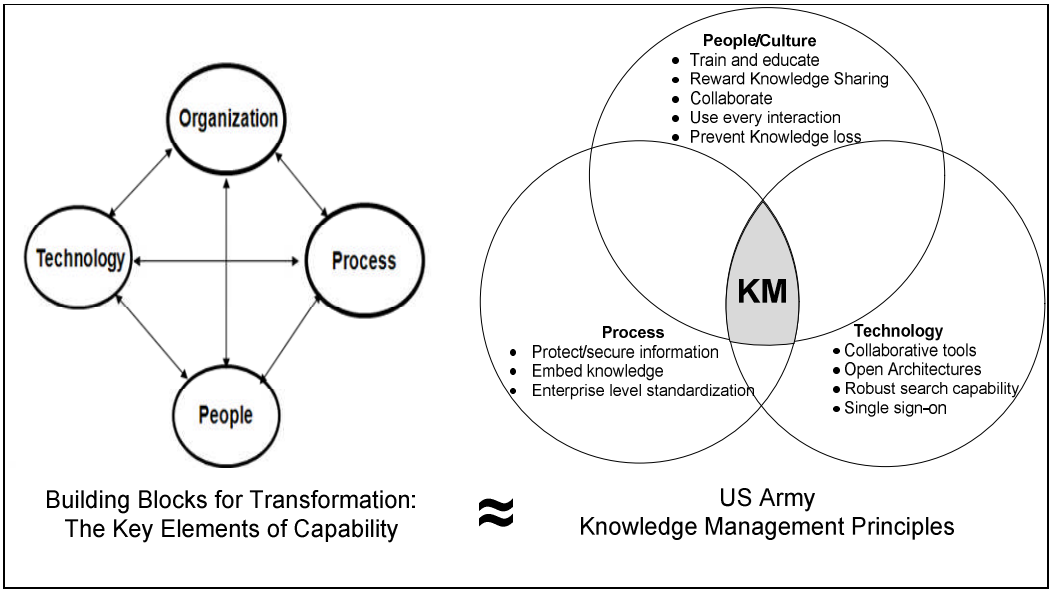

Figure 5: Transformation and KM Principles

"It's all about increasing collaboration, and that has huge implications for war fighters," according to Bob Neilson, KM adviser to the Army's CIO. "It's about not only sharing information but having the responsibility to provide knowledge across the enterprise."[77] FM 6-01.1 relies heavily on Nonaka's theories of knowledge types and transfer processes.[78] Consequently, mixed messages regarding what constitutes information as opposed to knowledge and critical semantic difference remain. However, the document is a significant step forward because it establishes structure and functions for a KM staff in support of commanders.

Conclusion

A compelling factor in warfare through the ages, technology in and of itself is but one factor accounting for the superiority of one force over another. Currently, the dominant technologies are the computer networks born of the information age. Although this burgeoning technology can capture and store information, as well as process and deliver information at the limits of imagination by means of vast arrays of granularity and concise summation, it does not create knowledge. The analysis and synthesis leading to genuine understanding is irrevocably a mental process. As such, increasing the usefulness of the networks, both socially and technologically, must depend ultimately on the development of the cognitive capacity of those who use them.

KCW lies at the intersection of people, processes, and technology. This composite concept crosses academic and organization boundaries by definition. KWC focuses on developing knowledgeable war fighting professionals: what they know, how they know it, why they believe it, where they learned it, how that knowledge enables others and is not lost when the person who knows it inevitably is. KCW facilitates enterprise-level thinking in an effort to achieve strategic synergy at the joint and interagency level.

Just as NCW built upon Platform Centric Warfare, KCW will build upon NCW- a logical, more refined, and powerful concept that focuses on using the tools rather than building them. The focus of NCW has been to build, protect, and populate the net, the focus of KCW is use the net, to develop and protect the knowledge, and thus know the net thoroughly.[79] KCW is about war-fighters and their capacity to know.

The true strength of a knowledge centric approach is it its intrinsic ability to prepare warriors for the unexpected. In *Inevitable Surprises*, Peter Schwartz advises

that while we will be surprised in the future, we can be in a position to deal with it by increasing our ability to both see opportunity and respond to surprise. He admonishes readers to place "very, very high premium on learning" while noting that most failures to adapt are in fact failures to learn quickly enough.[80] KCW creates a framework that enables us to learn quickly enough to respond vigorously to the inevitable surprise, and thus protect the nation.

Endnotes

[1] Adm Mike. G. Mullen, *Capstone Concept for Joint Operations* (Washington, DC: U.S. Joint Chiefs of Staff, January 15, 2009), iii.

[2] Ibid., iv.

[3] Ibid.

[4] Paul W. Phister Jr. and Igor G. Plonish *Information and Knowledge Centric Warfare: The Next Steps in the Evolution of Warfare*. (Rome, NY: Air Force Research Laboratory, June, 2004), 8.

[5] Ibid.

[6] Gen Rupert Smith, *The Utility of Force: The Art of War in the Modern World* (New York: Alfred A. Knopf, 2007), 19.

[7] Jennifer Rowley, "Where is the Wisdom that We Have Lost in Knowledge?" *Journal of Documentation* 62, no. 2 (March 1, 2006): 251-270, in Proquest (accessed March 25, 2009).

[8] Knowledge Centric Warfare is discussed in Edward Dawidowicz "Performance Evaluation of Network Centric Warfare Oriented Intelligent Systems," http://www.isd.mel.nist.gov/research_areas/research_engineering/Performance_Metrics/PerMIS_2001_Proceedings/Dawidowicz.pdf (accessed February 20 2009) as a "sibling" of NCW. This paper proposes that NCW is more properly a sibling of KCW.

[9] Dr. Michael Evans, "Knowledge Management and Warfare in the Information Age" briefing slides, Canberra, AU, Land Warfare Studies Centre, 2002.

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[11] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, DC: DoD Command and Control Research Program, 2003), 113.

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[14] Matthias Steup, "Epistemology," in *The Stanford Encyclopedia of Philosophy (Winter 2008 Edition)*, http://plato.stanford.edu/archives/win2008/entries/ epistemology/ (accessed March 17, 2009).

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[17] Peter D. Klein, “Epistemology,” in *Routledge Encyclopedia of Philosophy* (London: Routledge 1998, 2005), http://www.rep.routledge.com/article/P059 (accessed March 24, 2009).

[18] Markie, "Rationalism vs. Empiricism."

[19] Steup, "Epistemology."

[20] Ibid.

[21] Ibid.

[22] Although the truth-condition enjoys nearly universal consent, there is a reasonable objection to it. Consider Newtonian Physics as a part of our overall scientific knowledge. But Newtonian Physics is false. Is it possible to know something that is false? The answer is no, with a two-fold caveat. The first is that when we clam to “know” Newtonian Physics, we are claiming to understand the explanatory power of the theory in the realm in which it applies, implying an understanding of recently discovered weaknesses - a true assertion. Secondly, we can distinguish between Newtonian physics and updated theoretical physics at the cutting edge where the more recent absorbs the former and explains how and where Newtonian Physics fails.

[23] A famous article by Edmund Gettier in 1963 challenges JTB. The “Gettier Problem” involves the transference of justification from an ultimately false belief to a belief that is coincidentally true. Both propositions have met ascension criterion for knowledge, yet one of the propositions is false and thus not knowledge.

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[63] Ibid., 924.

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