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**14. ABSTRACT**

Coupled with the great evolution of increasingly more powerful computers, a revolution in the use of corresponding military information technology has attempted to change how commanders collect, process, and distribute information. Desiring to create information superiority over an adversary, the military has developed a vast network of interconnected systems to help clear the "fog of war." This provides vast amounts of information continuously flowing into a headquarters which is designed to assist the commanders and their staff in the endeavor. However, this paper indicates this flow of information is degrading the decision making process instead of improving it. It demonstrates the cognitive capability of the human brain is limited and the disparity between the finite ability of the brain and the almost infinite flow of new information is overtaxing the human brain. In addition, it explains how military information systems also increase the friction and uncertainty for commanders since they are prone to breakdown or attack and produce too much irrelevant information. Drawing from this analysis, it concludes all of these factors are actually increasing the friction and uncertainty for a commander. Finally, the paper recommends areas for further research by focusing on the slowest part of the decision making process – the human brain.

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**NAVAL WAR COLLEGE**
Newport, R.I.


**The Battle of Cognition against the Tyranny of Information Overload**


**by**


**Chad T. Bates**

**Major, U.S. Army**


**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.**


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**03 May 2010**

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**Abstract**

*The Battle of Cognition against the Tyranny of Information Overload.*

Coupled with the great evolution of increasingly more powerful computers, a revolution in the use of corresponding military information technology has attempted to change how commanders collect, process, and distribute information. Desiring to create information superiority over an adversary, the military has developed a vast network of interconnected systems to help clear the "fog of war." This provides vast amounts of information continuously flowing into a headquarters which is designed to assist the commanders and their staff in the endeavor. However, this paper indicates this flow of information is degrading the decision making process instead of improving it. It demonstrates the cognitive capability of the human brain is limited and the disparity between the finite ability of the brain and the almost infinite flow of new information is overtaxing the human brain. In addition, it explains how military information systems also increase the friction and uncertainty for commanders since they are prone to breakdown or attack and produce too much irrelevant information. Drawing from this analysis, it concludes all of these factors are actually increasing the friction and uncertainty for a commander. Finally, the paper recommends areas for further research by focusing on the slowest part of the decision making process – the human brain.

**Introduction**
Much of [command] is inherently intellectual because people must transform data into information, then knowledge – and they must do it quickly.  Mental acuity and the intellectual component of [command] will become critical as our future Army increasingly depends on the benefits of knowledge.   - Brigadier General Huba Wass de Czege.[1]

   With the concept for Moore's law[2] written in 1965, the power of computers has

continued to exponentially increase in capability every decade for over half a century.

During this evolution in computing power, a revolution ignited in military information

technologies which harnessed the rising potential in these systems.  To further direct this

growing movement, new theories were penned on how future commanders will use these

new information systems to better visualize, interact with, and understand their battlefields.

Research, experiments, and exercises, funded by the military and other research centers, were

conducted to determine how newly acquired technologies would lift the "fog of war" for

future commanders.  One of these new theories, Network-centric warfare (NCW), was

designed to facilitate greater potential from these technological innovations in order to gain a

distinct informational advantage, or information superiority, over future adversaries.

However, most of these theories neglect the weak link in the whole process – the human

mind and its limited cognitive abilities.

   Even though NCW is based on scientific facts, the enigmatic abilities of the human

brain cannot be so easily defined.  The problem is much more complex than finding the right

information system.  Can the human brain (especially the brain of the commander) actually

process and act on the critical information in a timely fashion?  Instead of focusing on this

1. Huba Wass de Czege and Jacob Biever, "Optimizing Future Battle Command Technologies," *Military Review* 78, no.2 (March-April 1998): 15.
2. Dr. Gordon E. Moore presented his theory in the article "Cramming more components
onto integrated circuits" in the April 19, 1965 issue of *Electronics Magazine*.  Moore's law describes a long-term trend in the history of computing hardware, in which the number of transistors that can be placed inexpensively on an integrated circuit has doubled approximately every two years.  This basically says that every two years the computing power of a computer will double.  http://en.wikipedia.org/wiki/Moore%27s_law (accessed 27 April 2010).

very difficult question, the military, and the society as a whole, have looked for technical solutions to this human problem by relying on the power of the computer.  This has created a "misplaced reliance on abundance of information to improve the timeliness and quality of decision-making, instead of focusing energy and resources to ensure decision-makers have the right information on which to act."[3]  This leads to the thesis of this paper.  The military needs to focus more resources on overcoming the limitations of the cognitive abilities of the human brain in order to gain information superiority; the current over-reliance on military information technologies is degrading a commander's ability to make decisions.

**Network-Centric Warfare and Information Superiority**

The U.S. Department of Defense's Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Cooperative Research Program defines network-centric warfare as "an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization [that], in essence, translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace."[4]  This integration of systems and networks allows commanders and their organizations to create information superiority.  Joint Publication 3-0, *Joint Operations*, defines information superiority as "the operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while

3. Peter R Marksteiner, "The threat from within E-mail overload degrades military decision-making," *Armed Forces Journal*, 1 September, 2008, 32.
4. David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, DC: U.S. Department of Defense C4ISR Cooperative Research Program, 1999), 2.

exploiting or denying an adversary's ability to do the same."[5] Designed to collect and

disseminate huge amounts of data and information, military information technologies are

very capable in these functions. However, the key to information superiority is the ability to

process this "uninterrupted flow" of information. This requirement is purely a cognitive one

that must be accomplished by commanders and their staffs.

**Information and the Cognitive Hierarchy**

In order to properly receive the information relevant to the visualization and decision

making process, commanders must "manage their information resources, combine judgment

with the knowledge of their staffs and subordinates, and use information systems to know the

battlespace better than their adversaries."[6] The key to information management is the

commander's ability to decide on what information is relevant to their decision making and

their ability to add meaning to it through analysis and evaluation. This process is defined in

the Army's Field Manual 6-0, *Mission Command: Command and Control of Army Forces*

and visually shown in Figure 1, "The Cognitive Hierarchy and Processing Information

Diagram." It shows how data is changed into the highest cognitive level of "understanding."

The process begins with data collected through networked military sensors and other

technologies. Further organized by personnel or automated military computer systems,

different pieces of data are connected to form information. From this bottom level, the

human brain and its cognitive abilities are needed to analyze and evaluate numerous pieces of

information to produce knowledge. Lastly, evaluating multiple forms of knowledge, the staff

and commander can distill their judgment to create an understanding of the operating

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5. Chairman, U.S. Joint Chiefs of Staff, *Joint Operations*, incorporating change 2, Joint Publication (JP) 3-0
(Washington, DC: CJCS, 22 March 2010), GL-16.
6. Ibid., 11-3.

environment or problem.[7]  Other research has labeled the understanding phase as making "sense" of the situation or "sensemaking."[8]

Within this process, managing huge amounts of data and information through the information systems is critical in order to create understanding.  This process of reducing information "is essential to reaching understanding because it involves reducing the total number of bits to consider at any one time. If integration did not occur, commanders would be overwhelmed by bits



Figure 1 : The Cognitive Hierarchy and Processing Information Diagram (reprinted from U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual [FM] 6-0 [Washington, DC: Headquarters Department of the Army, 11 August 2003], 3-14.

of data or overloaded by a staggering number of factors."[9]  NCW further perpetuates this process by connecting the different systems and commanders through networks.  This interconnectivity facilitates the exchange of everything from data to knowledge.  However, quickly finding and processing relevant information is critical to acquiring and maintaining information superiority.  As the human cognitive processes are consumed in identifying relevant information it must also process this information into knowledge and then understanding.  Paired against the great technological evolutions in military information

7. U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual (FM) 6-0 (Washington, DC: Headquarters Department of the Army, 11 August 2003), 7-1.
8. Gary. A. Klein, J.K. Phillips, E.J. Rall, and D.A. Peluso, "A Data Frame Theory of Sensemaking," in *Expertise out of context*, ed. Robert R. Hoffman. (Mahwah, NJ: Lawrence Earlbaum Associates, 2007), quoted in Berndt Brehmer, "Understanding the Functions of C2 Is the Key to Progress," *The International C2 Journal* 1, no.1 (2007): 225.
9. FM 6-0, *Mission Command: Command and Control of Army Forces*, B-8.

technology, what are the results of how well the human brain is keeping up with its ever-increasing cognitive load?

**The Tyranny of Information**

One of the tenets of NCW is increasing the amount of information to commanders and their staffs through increased connectivity within networks. As stated previously in the NCW definition, increasing the information flow between battlefield entities will create information superiority and increased combat power. Articles written by recent CENTCOM Operating Environment (OE) combat veterans state a reality contrary to this definition. One article in the September-October 2006 volume of the *Field Artillery Journal* describes a concerning experience.

> The process of receiving, assimilating, filtering and conveying relevant information to an individual is a challenge that every Army leader will experience. Over the course of many combat deployments, it becomes evident that the concept of too much or too little information can cost commanders their ability to make sound decisions. Outlining information and determining for the commander where the critical decisions must be made set the conditions for success. Leaders in a deployed unit make far more critical decisions than garrison leaders on a daily basis. Almost every decision a deployed leader makes has implications for accomplishing the mission and the providing for the well being of Soldiers. Too much information wastes time and clutters the decision-making process. Too little information causes the leader to either make the wrong decision due to ignorance or requires a request for more information, which wastes time at a critical moment. Too many units have gotten into the habit of overwhelming leaders with information, beating them into submission with nonessential details. Robust information systems technology allow for the leaders to see vast amounts of information.[10]

These views aren't confined only to the Army. One article from the 1st Marine Division identified similar experiences.

> Every standard problem of bottleneck and overload in information emerged, and almost every "push" and "pull" technique to manage them failed. National intelligence sources were great for developing deep targets, subject to the prioritization of high Headquarters (Division and higher). Navigating the labyrinth of

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10. Timothy J. Doughtery and G. Damon Wells, "The Deployed Commander's Information Band of Tolerance," *FA Journal*, (September-October 2006): 33.

collection tasking processes proved too difficult in most cases to get reporting on Division targets; the problem was certainly ever more complex for Battalion level collections. Communications within intelligence sections were better, but at all levels they were inundated with information and data that had little bearing on the mission and Intelligence requirements.[11]

Examples in the Air Force are also provided.

In one case of friendly fire in Afghanistan during March 2002, information overload, friction between layers of command and inexperienced personnel swamped exactly those air forces and commands that fought in Iraq a year later. Data was so plentiful that USAF squadron commanders could not or did not circulate much of it from ATOs to their pilots, while staff officers would not change their procedures, thus ensuring confusion between all layers of command.[12]

Drawing from these experiences, too much information on the battlefield is hampering mission success. If too much information is "overwhelming commanders," flooding headquarters with information "not related to the mission," or even worse facilitates "friendly fire" incidents, a serious problem exists that the military needs to address. If NCW's intent is to reduce the uncertainty and friction on the battlefield, then why are commanders and their staffs still uncertain about their operating environment?

**The Certainty or Uncertainty of Information**

Uncertainty and friction on the battlefield have been reduced with the evolution of military information systems, to an extent. Global Position Systems, coupled with new ground systems, such as Blue Force Tracker and the Command and Control Personnel Computer, allow forces to see nearly real-time locations of their friendly units or platforms. Units can pass information faster through networked systems, and commands at all levels

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11. John Ferris, "A New American Way of War? C4ISR in Operation Iraqi Freedom, A Provisional Assessment," *Columbus International Affairs Online*, June 2003, 6, http://www.ciaonet.org/olj/jmss/jmss_2003/v6n1.pdf (accessed March 12, 2010).
12. William A. Woodcock, "The Joint Forces Air Command Problem, Is Network-centric Warfare the Answer?" *Naval War College Review* LVI*, no. 1 (Winter 2003) as quoted by Darin Talkington, "Information Technology: When is Enough?" (Strategic research paper, Carlisle, PA: U.S. War College, Strategy Department, 2007), 7.

have an unprecedented battlefield visualization enabled by the military battle command systems. However, while the advent of new technology reduces friction and uncertainty in one aspect of a battle it, in some indirect ways, creates greater uncertainty and friction in other parts. BG H.R. McMaster states that "while it is vitally important to take all possible measures to reduce uncertainty and friction, it is equally important to recognize those factors that preserve uncertainty as a basic function of war"; thus, "as technology advances, new sources of uncertainty emerge."[13]

New military information technology not only introduces additional friction to the battlefield while alleviating others, it also creates new vulnerabilities. Regardless of level of sophistication during any conflict, the nature of war remains unchanged and "cannot be eliminated" because of the "existence of uncertainty and chance, unpredictable actions of other actors, frailties of machines and information, and humans."[14] Given the susceptibility of information systems to failure or attack, and the existence of a hostile, thinking enemy, the uncertainty and friction of the battlefield will continue to remain.

A vulnerability that information systems create is they can easily overwhelm commanders and staff because of the "sheer volume of information available and the fact that much of it is conflicting or irrelevant noise."[15] As demonstrated by the articles from combat veterans, the amount of information commanders and their staffs must process, create additional friction within the organization. This friction is created when increasingly more information or requirements enter the headquarters and strain the cognitive abilities and time

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13. H.R. McMaster, *Crack in the Foundation: Defense Transformation and the Underlying Assumption of Dominant Knowledge in Future War*, S03-3 (Carlisle Barracks, PA: Center for Strategic Leadership, U.S. War College, November 2003): 21, on-line at http://www.csl.army.mil/usacsl/Publications/S03-03.pdf (accessed 5 March 2010).
14. Chairman, U.S. Joint Chiefs of Staff, *Joint Vision 2020* (Washington, DC: GPO, 2000), 6.
15. H.R. McMaster, *Crack in the Foundation: Defense Transformation and the Underlying Assumption of Dominant Knowledge in Future War*, 21.

requirements of commanders and their staffs. Further time requirements are placed on them as they work to simultaneously sort through more useless information to uncover the bits relevant to their mission. Since collecting, processing, and disseminating more information takes more time, commanders are left with less and less to make timely decisions.

Another danger hidden in the continual flow of information entering a headquarters is the allure of information creating a risk-free decision. This promise then tempts a commander into delaying a decision for that perfect information that rarely ever presents itself. Unfortunately, wasting time in such an endeavor severely hampers the decision making process and actually places additional risk on the success of the mission. In a future combat experiment conducted by Dr. Douglas Peters and associates, titled "The Time to Decide: How Awareness and Collaboration Affect the Command Decision Making," they concluded commanders and their staffs were addicted to information. Their observations depicted that some "commanders delayed important decisions in order to pursue an actual or perceived possibility of acquiring additional information."[16] The possibility of making a better decision sometimes lured the commander into even riskier situations by sacrificing the agility of their future force formations to "satisfy their perceived need for information."[17] In behavior similar to addicts, they completely lost track of the current situation in order to focus on something better. This is not something new brought on by current technology, but a well documented human decision-making bias, surprisingly powerful and resistant to mitigation. Research has concluded "humans tend to prefer those outcomes that have a

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16. Douglas J. Peters et al., "The Time to Decide: How Awareness and Collaboration Affect the Command Decision Making," in *Battle of Cognition*, ed. Alexander Kott (Westport, CT: Praeger Security International, 2008), 205.
17. Ibid., 205.

greater certainty, even if their expected utility is lower than those of alternative outcomes."[18] This indicates the human brain is wired to shy away from uncertainty and relies on the information it knows for decisions, even if it is less than perfect.

A concluding vulnerability is the complex and sophisticated military information systems themselves. Operating in austere environments these systems are prone to break downs or even adversary attacks. When the network fails or communications are lost, the friction created by their malfunction can affect anything from a small unit or all the units in the battlespace. Being a partner in this network of connectivity also ensures that the unit is at risk of experiencing severely reduced situational awareness or communications when the system no longer works. If units heavily rely on the networks and information systems, then a critical factor or vulnerability is created that an enemy can attack. Such an attack on the information systems or network can have detrimental effect on the command and control of any organization.

Even with significant information processing superiority, the military will never be able to find the information needed to clarify an enemy's intent, their plans, or how they will impose their will upon the battlefield. Information systems might assist in making more sense of the battlefield but it also creates its own friction that creates its own uncertainty. Functioning normally, the information systems produce more information that an organization can cognitively handle. The question remains: why can't the human brain handle all of these requirements presented by the military's information systems?

**The Brain – Grey, Enigmatic, Limited**

Scientists have concluded one portion of the brain is responsible for keeping a person focused, handles short-term memory, solves abstract problems, and is also responsible for

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18. Ibid., 196.

will power; it is the prefrontal cortex.  One experiment by Dr. Baba Shiv at Stanford

University showed there is a limit or maximum "cognitive load" the prefrontal cortex can

handle at one time.[19]  Results dictated that when a greater cognitive load was placed on a test

subject their willpower or ability to resist temptation (a piece of chocolate cake in the

experiment) was degraded.  This experiment further supported the theory originally

published by Dr. George A. Miller in his 1956 article "The Magical Number Seven, Plus or

Minus Two: Some Limits on our Capacity for Processing Information."  It also confirms the

human mind has a limit on how much information or processes it can handle at any given

time.  In his conclusion, Dr. Miller confirmed the maximum or "cognitive load" the human

brain can handle is on average seven (plus or minus two for deviation).[20]  Subjects that had to

handle more information than their limit begin to ignore new information, forget parts of the

information they were retaining, or spend additional time trying to determine what they

forgot and to remember it again.  These are all symptoms of the newly identified cognitive

deficit termed "information overload."[21]  Once a subject was caught in this phenomenon,

their ability to function normally was significantly reduced.[22]

**Collaboration – Gold or Pyrite?**

   Since the military's information systems are overwhelming the cognitive abilities of

commanders and their staff, a counterargument to this paper's premise is the process of

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19. Jonah Lehrer, "Blame It on the Brain," *The Wall Street Journal*, 26 December 2009, http://www.wsj.com/ (accessed 15 March 2010).
20. George A. Miller, "The Magical Number Seven, Plus Two or Minus: Some Limits on our Capacity for Processing Information," *Psychological Review* 63, no.1 (March 1956): 81-97.
21. Information overload - the problem caused by the excessive quantity of Web and e-mail-based information and the Internet's inability to discriminate between useful and useless material. In 1997, the problem of information overload was identified in an influential report from the British MCA (Marketing and Communication Agency). The report concluded that "information overload is not simply the problem of too much information. It is the problem of too much irrelevant information caused by the heavy reliance on one medium (the Internet) to distribute information."
http://dictionary.bnet.com/definition/information+overload.html,  (accessed 27 April 2010).
22.  Jonah Lehrer, "Blame It on the Brain," *The Wall Street Journal*, 26 December 2009, http://www.wsj.com/ (accessed 15 March 2010).

collaboration.  If the decision making process is slowed by the limitations of the human

brain, it is a logical argument that adding more brains to process and analyze the information

will reverse this trend.  This is the basic definition of collaboration[23] and its promise is very

enticing to the unschooled observer.  Joint Publication 3-0 even directs collaboration:

"effective C2 *demands* that commanders and staffs collaborate in forming and articulating

commander's intent and determining the mission, operational objectives, desired effects, and

tasks."[24]  Then why isn't collaboration the complete solution to overcoming information

overload?

The Defense Advanced Research Projects Agency *(*DARPA) has funded several

research projects exploring the effectiveness of collaboration and how to improve it.  While

research shows a well-organized and effective organization or team can improve the

timeliness of information processing, it "is unfounded to expect high levels of performance

by simply connecting individuals with collaboration tools and communication

technologies."[25]  Human collaboration is less about technologies and more about

interpersonal communications and group dynamics.  Teams and staffs must be built and

trained as an organization to be effective.  Only then can commanders expect higher levels of

performance from their staffs.  However, even these organizations have a serious

collaborative dark side.  In the same future combat experiment conducted by Dr. Douglas

Peters and associates titled "The Time to Decide: How Awareness and Collaboration Affect

the Command Decision Making," they placed military commanders and their staffs in

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23. Collaboration, as defined by the *Merriam-Webster Dictionary*, is to work jointly with others or together especially in an intellectual endeavor.  http://www.merriam-webster.com/dictionary/collaboration (accessed 2 May 2010).
24. JP 3-0, *Joint Operations*, III-10. [Emphasis added]
25. Michael A. Rosen et al., "Tightly Coupling Cognition: Understanding How Communication and Awareness Drive Coordination in Teams," The International C2 Journal 2, no.1 (2008): 23.

futuristic, information rich, command and control (C2) systems and let them fight a series of battles in 2018. They concluded "effective decision making can also be delayed and even derailed by collaboration. In certain cases, [they] observed a commander's understanding of the current Blue or Red disposition degraded as a result of collaboration with subordinates, peers, or higher headquarters commanders."[26] Several trends lead to this performance. The first being commander's usually fixated on individual information on their C2 screens and failed to see the battlefield as a whole. In addition, they concluded the more a decision maker shifts attention, the more shallow the cognitive process they apply to the overall picture.[27] This is related to Dr Miller's research on the "Magic Number 7" and information overload. As more information clouds the mental abilities of commanders and their staffs, the less understanding is actually taking place due to a conflict of limited resources – change knowledge to understanding or change information to knowledge.

However, the "growing expectations of the future force's effectiveness and the great amount of information available to [future] battle-command practitioners *require* greater collaboration."[28] More brains will still be needed in the future to analyze the even greater amounts of information that will be produced by those future computers. The challenge is finding the balance between the number of personnel needed to process the information (and keeping the headquarters' size at a manageable level) and the requirement to make timely and accurate decisions.

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26. Douglas J. Peters et al., "The Time to Decide: How Awareness and Collaboration Affect the Command Decision Making," 206.
27. Ibid., 211.
28. Gary L. Klein et al., "Enabling Collaboration: Realizing the Collaborative Potential of Network-Enabled Command," in *Battle of Cognition*, ed. Alexander Kott (Westport, CT: Praeger Security International, 2008), 168.

**Conclusions**

With its expensive investments in new military information technologies, the military planned to create a distinct advantage over any adversary through information superiority. By collecting, processing, and disseminating information quicker than the enemy, commanders would be enabled "to make better decisions more rapidly than their enemies and adversaries."[29] To facilitate this advantage, NCW's concept for networks and connectivity allows sensors, decision makers, and shooters to share almost continuous communications and information. The result of this innovation is huge amounts of information continuously flowing through a commander's headquarters. The allure of this vision is that if only properly leveraged, it can produce a level of clarity and vision no commander has known on any historic battlefield. Unfortunately, these vast levels of information are overwhelming commanders and their staffs and are actually degrading their ability to make effective and timely decisions.

Information must be processed by human cognitive abilities in order to assist a commander in understanding their operating environment. In accordance with the "cognitive hierarchy," data is processed to produce information. Commanders and their staffs then use their experiences, intuition, and other cognitive abilities to make this information into more relevant knowledge. Finally, judgment is distilled into the knowledge to create the highest level of cognition – understanding. Throughout this process, the human cognitive abilities are extensively used and taxed.

To identify the deficiencies of the current approach of reliance on information technologies, commanders must understand the limitations of the human brain. As

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29. FM 3-0, *Operations*, 7-13.

demonstrated in the experiments of Dr. Shiv and Dr. Miller, there is a constraint on how much the human cognitive facility can handle at any one time. This "Magic Number 7" indicates the human brain only has finite capabilities to handle the complex and ever changing world around it. Once this limit is surpassed, mental abilities significantly degrade and create the phenomenon labeled "information overload." Since cognitive capabilities are degraded with "information overload," it increases the friction and uncertainty in the decision making process.

The complex and sophisticated military information network and its systems are also not infallible and are prone to breakdowns and even attack. In addition, the more reliance placed on military information technologies for C2 also has a direct correlation on how much a critical factor or vulnerability it is to mission success. This will then draw the attention of an adversary and increase its likelihood of it being attacked. A localized or battlefield wide cessation of functions, brought on by breakdown or attack, would have detrimental effects on commanders and their C2 capabilities. Even a marginally successful attack will significantly increase the friction and uncertainty a commander deals with during military operations.

As indicated in current military operations within the CENTCOM OE, the friction and uncertainty created by the disparity between the finite capabilities of human cognitive abilities and almost infinite potential of military information technologies is endangering mission success. Officers and commanders are stating their information systems are producing too much information "not related to the mission."[30] Worse, they are indicating these systems are "overwhelming commanders" or "beating them into submission."[31] This

30. John Ferris, "A New American Way of War? C4ISR in Operation Iraqi Freedom, A Provisional Assessment," 6.
31. Timothy J. Doughtery and G. Damon Wells, "The Deployed Commander's Information Band of Tolerance," 33.

disparity is also causing the worse errors on the battlefield, friendly fire incidents.  These are not signs of improved decision making or a signal of a distinct operational advantage as desired by "information superiority."  Commanders must acknowledge the vast powers of the military information technologies and their networked systems are failing to properly support the decision maker on the battlefield.

Dr. Milan Vego states in his book *Joint Operational Warfare: Theory and Practice*, and indicted in the definitions of NCW and information superiority, "The *decision-making cycle* at the operational and strategic levels should be as short as possible," and "the speed of making a decision depends on the speed of the slowest element in the cycle."[32]  As indicated, the slowest and most limited part of the process is the brains of the commanders and those of their staffs.  Since the brain is the most restraining factor in the decision making process, the military must focus its resources on finding solutions to overcome its cognitive limitations.  "The challenge, then, is to build battle-command tools that match the minds of human commanders and their staffs – both their strengths and weaknesses."[33]

**Recommendations and Lessons Learned**

Thoroughly understanding there are limits and that unfettered information flow is not the answer can better prepare commanders and their staffs to properly apply current solutions to overcome those restrictions.  Collaboration, even with its dark side, is still critical to future mission success because of the "growing expectations of the future force's effectiveness and the great amount of information available to [future] battle-command practitioners *require*

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32. Milan Vego, *Joint Operational Warfare: Theory and Practice* (2009 repr., Newport: U.S. Naval War College, 2007), III-24 [author emphasized].
33. Alexander Kott, "Concluding Thoughts," in *Battle of Cognition*, ed. Alexander Kott (Westport, CT: Praeger Security International, 2008), 213.

greater collaboration."[34]  It is not a panacea commanders can easily apply to this problem,

but it is one of several tools available to assist them in improving their staff performance.

However, the commander must remember collaboration is less about technologies and more

about interpersonal communications and group dynamics.  Training, exercises, and team

cohesion must be enhanced in organizations in order to process relevant information and

knowledge for the commander.  Just as it is important to understand the limitations of the

human mind, the commander must understand collaboration is not perfect and it is subject to

miscommunications, misperceptions, human error, and just plain bad luck.[35]

An over-reliance on any single method or technology is very risky for a commander

that fights against a hostile, thinking enemy.  As demonstrated during Millennium Challenge

in 2002 when the Red Forces commanded by LTG(R) Paul Van Riper were pitted against the

technologically superior Blue Forces.  Being a thinking adversary, LTG(R) Van Riper

understood the vulnerabilities and limitations of the Blue Force systems.  Adopting an

innovative and unexpected methodology (which a thinking enemy can use), he soundly

destroyed the Blue Force fleet within the first hour of the hostilities.[36]  An intelligent lesson

to draw from this exercise is how the U.S. military will react to a direct or indirect attack

against our superior military information technologies.  Proper preparation and

corresponding exercises and training must be undertaken to ensure backup procedures and

protocols are established prior to an attack on our information technologies and systems.

Even in today's current conflicts, most units deployed to the CENTCOM OE will experience

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34. Gary L. Klein et al., "Enabling Collaboration: Realizing the Collaborative Potential of Network-Enabled Command," 168.

35. Richard H. Sinnreich, "Variables and Contraints: How the Battle Command of Tomorrow Will Differ (or Not) from Today's," in *Battle of Cognition*, ed. Alexander Kott (Westport, CT: Praeger Security International, 2008), 12.

36. Malcolm Gladwell, *Blink: The Power of Thinking Without Thinking*, (New York, NY: Little, Brown and Company, 2005), 109-110.

a severe degradation of their C2 systems.  Taking this into account, commanders must understand their information technologies are vulnerable and make the appropriate plans to counter their potential negative impacts upon mission success.

**Final Remarks**

Obtaining an advantageous ability to quickly collect, process, and disseminate an uninterrupted flow of information over an adversary, and gain information superiority, will continue to challenge commanders in the future.  This dynamic problem can only be solved by relying on a multitude of innovative solutions constantly adapting to new problems.  The vulnerabilities of today's military information technologies cannot be overlooked and must be aggressively guarded against attack and neglect.  In addition, commanders must understand the limitations of human cognition, human decision making biases, and how the military's information systems are degrading the decision making process.  Finally, staffs must be empowered to work efficiently together while coupling them to the power of the military's information systems.  Through this combined process commanders and their staffs can "make better decisions more rapidly than their enemies and adversaries."[37] As with all missions, regardless of the challenges of the current operating environment, "Information is commanders' business."[38]

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37. FM 3-0, *Operations*, 7-13.
38. FM 3-0, *Operations*, 7-1.

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