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OPERATION ALLIED FORCE: REACHBACK AND INFORMATION PROCESSES

by

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Preface

Military operations of the recent past, particularly Operation ALLIED FORCE, offer unique opportunities to examine the effectiveness of reachback and information processes. With increasing reliance on collection, analysis, and dissemination of information in support of in-theater operations, reachback is essential for successful information processing. Warfighters at every level believe in the enabling and inherent capability of information as a critical tool for decision-makers. I chose reachback and information processes as a topic of further study because I am interested in advancing the warfighter's ability to influence how our nation prosecutes wars.

From the outset, I want to acknowledge my position on bandwidth as a limiting factor in the reachback process. Due to mounting information requirements, it is not surprising to find an increased demand for bandwidth. However, I believe bandwidth is among the least of reachback problems. Effective information management deserves attention and represents promise to complement reachback.

I appreciate the guidance and instruction provided by Major Paul Guevin, my faculty research advisor. His focus on information superiority helped me acknowledge the promises of reachback and information processes in the context of information warfare. As fellow communications and information officers, our ability to see each other's points of view fostered open and meaningful dialogue. Major Guevin created an environment making my research fun and exciting.

Abstract

The study of reachback during Operation ALLIED FORCE reveals information management, rather than bandwidth, posed more formidable challenges. Such study also showed a misperception of bandwidth as greater cause for concern, which clouds the issue of information management as a limiting factor in the reachback process. In order to advance the effectiveness of reachback, managers must identify and implement improvements for handling information.

How will changes to information management practices and improvement effect reachback? They offer benefits in the following three areas: 1) to provide access to timely and relevant information for decision-makers; 2) to obviate commanders of information overload; and 3) to integrate data and information before it reaches commanders. Potential improvements in any one of the three foregoing areas offer promise—and together, their synergistic effect increases improvement opportunities.

Chapter 1

Introduction

Information is increasingly considered a weapon in the warfighter's arsenal.

—General Ronald R. Fogleman

This project is the result of the 23rd Information Operations Squadron's request for study of the limitations of reachback during Operation ALLIED FORCE. Reachback is the electronic ability to exploit organic and non-organic resources, capabilities and expertise, which by design are not located in-theater.[1] This area of study is significant because reachback is an essential operational element of information processing and dissemination. The purpose of this paper is to address limitations and constraints of information management and offer recommendations for improvement. This paper will help decision-makers measure information management vulnerabilities, and provide a methodology to overcome systemic problems associated with human interfaces and information integration. The ability to identify shortcomings in the information management provides occasion to enhance information processes, and thereby yields better support to the warfighter. Real-time sharing of information is a mechanism to improve situational awareness. Inherent benefits other than timely information include a smaller information architecture afforded by cutting-edge technological innovations. Such innovations enable processes to traverse sophisticated satellite systems for sending

raw data back to the United States and, transform it into information and knowledge for in-theater decision-makers. While some observers attribute bandwidth as a limiting factor of reachback, I submit that there are other, more salient limitations. Limitations include a lack of integrated systems, problems introduced by human friction, and increasing incidences of information saturation. Although the availability of bandwidth presented challenges during Operation ALLIED FORCE, optimizing the information management process was more challenging. Chief concerns included competing information resources, filtering and integrating information, and leveraging knowledge management. The ability to better handle information by improving management practices and procedures offer opportunities for making reachback more efficient.

From the introduction of information processes as a limiting factor of bandwidth to a set of recommendations to alleviate the limitations of information management, this research project developed through the following four-step methodology. The first step was to define the objective. The objective is to demonstrate limitations posed by information processes in reachback. The second step was to identify assumptions. There are four assumptions. Assumption one is that data is gathered in a variety of ways—from sensors (both active and passive), from command, control, communications, and computer (C4) systems, and through situation reports from senior, subordinate, or lateral commands.[2] The second assumption—for the quality of information—is that many sources of information are imperfect and susceptible to distortion and deception.[3] The third assumption is that all information described in this project has been afforded adequate protection where required.[4] The final assumption—for unity of effort—is that

C4 systems should help a military force and its supporting elements combine the thoughts and impressions of multiple commanders and key warfighters.[5]

Beyond the first two steps of the project methodology—its objective and four assumptions—are two additional steps to highlight selected aspects of information processes and to discuss recommendations. Selected aspects of information processes 1) show added complexities when large volumes of information compete for information handlers' time and attention; 2) demonstrate challenges of information filtering and integration; and 3) introduce the concept of knowledge management, as it relates to information filtering. Project recommendations are designed to evoke thought about innovative and creative methods to improve information management support to warfighters. This paper culminates with information management risk tolerance guidelines and a checklist to help improve information filtering and integration.

Information increasingly plays a vital role in the conduct of military operations. Former Air Force Chief of Staff General Ronald Fogleman noted that our information management capacity will leverage our ability to pinpoint an adversary's centers of gravity.[6] While the efficiency of information management depends on the proper handling of time-sensitive information, the evidence shows that in some cases the system works, but in others cases the information management process leaves room for improvement. The U-2 aircraft taking photographs of targets in Kosovo during Operation ALLIED FORCE were bedded down in-theater with strike aircraft sent to bomb those same targets, but pictures taken by U-2s traveled halfway around the world and back before the photographic intelligence found its way back to pilots of strike aircraft.[7] A combination of efficient information processing and dissemination, and

computer-satellite link capacity enabled near real-time information processing. In contrast, Brigadier General Michael Peterson, the Director of Communications and Information at Headquarters USAFE during the Kosovo conflict explained, "…we are great communicators, but we may not always be good information management people."[8] During an interview following the Kosovo conflict, Brigadier General Peterson provided additional impressions about the use of communications in Kosovo operations related to information management:

> "After a long talk with the operations and intelligence communities here it was clear that bandwidth was not the problem, it was the last 400 feet and applications matched to the communications environment. If it appeared to be a problem, it was generally the last 400 feet, or the information was not located and tagged in a place that was easy to find or get to. So if it was information that you wanted, which was not intuitively known how to find, such as how to work your way through a web site or to a location for that information, then it was [seen as] a bandwidth problem. But as we know, it was not bandwidth, it was the information management process. I think that's one of the things that we have to do better."[9]

Major contributions provided by reachback in-theater include a reduced footprint for deployed forces and the ability to make direct contact out-of-theater by sending raw data directly back to the US through satellite communications. In his article on reachback in *Air Force Magazine*, Richard Newman said this smaller forward footprint translates into fewer gas masks, beds, tents, mess halls, and other equipment needed to support troops.[10] The underlying technology afforded by reachback enables communicators and information systems specialists to deploy with minimal systems hardware. The information management concept of operations fundamentally requires in-theater forces to rely on satellite transmissions designed to traverse computer networks. Information and data processing in-theater is the exception rather than the rule, and therefore the warfighter's ability to reachback stateside to high-information processing and

dissemination systems is essential to mission effectiveness. Formal reachback is resource-intensive and involves third-party, out-of-theater personnel.[11] A deployed unit may identify an information requirement that they cannot meet with either in-theater resources or through informal reachback [placing a telephone call or manually searching global Internet or defense Intranet web sites for required information].[12] The unit then contacts a central information resource, articulates its requirement and depends on the resource to research and provide an answer.[13]

In order to continue equipping our operators with tools for improving situational awareness and enhancements to prosecute wars, C4 systems planners must develop new ways to overcome the limitations of reachback. Additives to the 'fog of war' and principal barriers to reachback occur in the information management realm. For example, it appeared that NATO was able to collect, process, and disseminate military information at will while denying the Serbs the same capability.[14] However, NATO forces did encounter intelligence and information problems, including instances of the Serbs using non-technical methods to manipulate NATO analysts' perceptions, resulting in misrepresented information.[15] Serbian civilian and military personnel were able to use civilian telephones and radio links to pass military information.[16] Such non-technical offsets either thwarted information collection or corrupted NATO information superiority.[17] The human link in the NATO analytic process was less successful in interpreting information, reducing uncertainty, and providing a clear intelligence picture of the battlespace than expected.[18] This example points out how easily the information management process may impede, and even disrupt the successful prosecution of war.

One approach to assist warfighters in the information domain may rest in placing all types of information on a level playing field.

Notes

[1] Major John M. Neal, "A Look at Reachback," *Military Review*, September-October 2000, 39.

[2] Joint Publication 6-0, Doctrine for Command, Control, Communications, and Computer (C4) Systems Support of Joint Operations, 30 May 1995, I-3.

[3] Ibid, I-4.

[4] Ibid, I-5.

[5] Ibid, I-5.

[6] General Ronald R. Fogleman, "Getting the Air Force into the 21st Century," speech before the Air Force Association's Air Warfare Symposium, Orlando, Fla., 24 February 1995.

[7] Richard J. Newman, "Reachback," *Air Force Magazine*, June 2000, 43.

[8] Brigadier General Michael W. Peterson, interviewed by Dr. Thomas S. Snyder and Dr. Larry M. Morrison, Air Force Communications Agency Office of History, 14 October 1999.

[9] Ibid, interview.

[10] Newman, 43.

[11] Neal, 39.

[12] Ibid, 39.

[13] Ibid, 39.

[14] Timothy L. Thomas, "Kosovo and the Current Myth of Information Superiority," *Parameters: US Army War College Quarterly*, Spring 2000, 13.

[15] Ibid, 13.

[16] Ibid, 13.

[17] Ibid, 13.

[18] Ibid, 13.

Chapter 2

Competing Information Resources

CTAPS will tie-in with the Combat Intelligence System which will provide us the enemy's order of battle through imagery and integrated threat data.

—General Ronald R. Fogleman

The level of sophistication and technological advancement in information systems processing has reached staggering proportions. In his article reported by *Computerworld*, Gary Anthes reminds us of the escalating achievements in information technology. Anthes said: "In 1965, an engineer … named Gordon Moore [and co-founder of Intel Corporation] noted that the number of transistors on a chip doubled every 18 to 24 months. A corollary to 'Moore's Law,' as that observation came to be known, is that the speed of microprocessors, at a constant cost, also doubles every 18 to 24 months."[1] Two years ago, it was a common phenomenon for standard desktop computers to process data at 1.4 gigahertz (GHz) clock speed. Today, desktop computer clock speeds have reached 2.2 GHz, and speeds are climbing. Installed at the Carnegie Mellon-Pittsburgh Supercomputing Center is a Terascale Computing System (TCS) that ranks 70th among the world's top 500 supercomputer sites.[2] TCS has a peak capability of 342 billion calculations per second.[3] The final system, when fully installed will have a peak capability exceeding six trillion calculations per second (teraflops).[4] Breakthroughs in the Revolution in Military Affairs continue to challenge our forces to integrate

information, to assess and evaluate time-sensitive data, and to exploit voluminous databases. Technological advances enable more information and lead to better decision-making. Operations, logistic, and intelligence functions all depend on responsive C4, the central system that ties together all aspects of joint operations and allows commanders and their staffs to command and control (C2) their forces.[5] Information systems present the battlespace picture to the warfighter through reachback. In the final analysis, commanders receive a battlespace picture in spite of increasing information resources that compete for their attention. The demand for greater volumes of relevant information necessitates a complex web of advanced information systems. Information handlers are responsible for managing and prioritizing critical information output. For example, information produced by the unmanned aerial vehicle (UAV) information system, Contingency Theater Automated Planning System (CTAPS) data feeds, and 3-D images of target areas all represent products that pass through the hands of military personnel who provide input to theater commanders. The process of disseminating information to decision-makers—when performed in error or in the wrong sequence—might easily place deployed personnel in harm's way. The role of information management practices cannot be overstated because effective military operations depend on accurate battlespace information. The potential for better information management deserves a chance to offset the constraints of information resources competing to enter the commander's decision cycle.

The Effects of Air and Space Intelligence, Surveillance, and Reconnaissance (ISR) Assets

The warfighter's reliance on air and space ISR assets highlights the value of ISR in-theater. Former Secretary of the Air Force Whit Peters said, "When we look at space—whether it's intelligence gathering or whatever—it has to be fused with other information like the Predator (an unmanned aerial vehicle) and the RJs (Rivet Joint Intelligence gathering aircraft). It is most valuable if it is all treated as information—not space information, not UAV information, not RJ information."[6] Well-trained information handlers recognize the wealth and diversity of information at their disposal. However, the inability to integrate and process disparate information not only poses risks to the efficacy of reachback, such diffusion reinforces problems associated with competing information resources.

Decision-makers relish information, but when it is poorly integrated, the quantity of information [competing for his attention] may be construed as a limitation. This scenario demonstrates why it is important to leverage the "pull" capability and "pull" concept. Joint Publication 2-0 explains, "The 'pull' capability is designed to prevent communications circuit saturation. The 'pull' concept results in a Joint Force Commander (JFC) requesting and receiving only intelligence relevant to the mission and current phase of the operation."[7] On the one hand, intelligence analysts stand to enable processes to reduce the sensor-to-shooter timeline, while on the other hand, progress toward fusing ISR data is modest at best. The lack of progress toward information fusion is in part due to the overwhelming amount of information that traverses the communications network. Lieutenant Colonel David Nichols, commander of the 510th

Fighter Squadron at Aviano Air Base, Italy, during ALLIED FORCE, provided the following vignette on the use of the Predator UAV:

> "The Predator would give us an 8 by 10 picture of a tank. We would ask 'Where is it?' And they would say 'Well, it's in Serbia!' …. the Predator had tremendous capability with great people supporting it, but lack of coordinated training meant pilots and command staffs had to improvise during the conflict to find ways of making Predator's capabilities beneficial to the squadrons flying the missions."[8]

Lieutenant Colonel Nichols points out the frailty of human systems. Notable human information processing limitations, coupled with a preponderance of information for decision-making, further complicate the information management process. The following discussion of another warfighting information system illustrates an additional tool for shaping the decision process.

Critical Information System: Contingency Theater Automated Planning System

The availability of automated information processing systems is a luxury that today's warfighters continue to enjoy. It is also a luxury that presents information handlers with a deluge of competing information resources. CTAPS is a single example. CTAPS uses a large assortment of modern computer tools to assists air campaign planning and execution.[9] CTAPS enables thousands of sorties from dozens of bases to be choreographed for maximum effect against the enemy and allows warfighters to carry out the commander's intent in concert with other friendly military activities.[10] On the surface, CTAPS appears to give warfighters a clear advantage to fight and win our nation's wars. CTAPS might very well give warfighters a clear advantage if it were the single system capable of equipping operators with an all-encompassing information domain. On the contrary, CTAPS is one of many information systems crucial to the

warfighter. Together these systems often force commanders to decide between systems because many of them offer identical output. In the warfighter's pursuit for information superiority he must sometimes make hard choices and decide which information system provides superior results.

CTAPS is only one of several information systems upon which warfighters rely in order to achieve and maintain information superiority. The *1997 United States Air Force Issues Books* stated: "The key to achieving and maintaining Information Superiority is a robust ISR capacity that is transmitted to the warfighter and a thorough understanding of Information Operations …. Our contribution to this joint 'system of systems' includes a variety of air- and space-based platforms, as well as the tools that support information processing."[11] The same system of systems that potentially provides a near-real time combat picture to the air commander also threatens to undermine the entire information management process through sheer volume alone.

CTAPS is a system of systems promulgated to enhance information superiority but, by definition and in spite of our goal of integrated systems, it is bound by a complex information management architecture fostered by separate systems. For example, the Theater Battle Management Core Systems (TBMCS) and Air Force Mission Support System will provide primary support tools for theater commanders, creating seamless information flow to the warfighter.[12] These programs will fully support implementation of DOD's Global Command and Control System as part of the Defense Information Infrastructure—Common Operating Environment.[13] TBMCS will provide C2 and Air Tasking Order (ATO) generation through CTAPS, situational awareness, and current intelligence data using the Combat Intelligence System, and a common communication

network for use at Air Force wings (the Wing Command and Control System).[14] Joint Tactical Information Distribution System provides the exchange of data between all netted systems, including fighter, surveillance, and air and ground C2 platforms; and enables joint warfighters to share a common picture of the entire tactical battlefield.[15]

Lieutenant Colonel Nichol's comments about the Predator UAV (the identification of a tank without location) are important because they affirm that systems are not yet fully integrated. Instead, a vast number of systems all weigh on the effectiveness of information handlers—systems that compete for handlers' time and attention. This confluence of systems must be more seamless to achieve information superiority. The fundamental ability to acquire and eliminate enemy targets is wedded to superior information. The management of targeting data discussed below further exacerbates information processes, and provides yet another example of competing information resources. A discussion of imagery databases will also highlight data volume as an area of concern in information management and thus a limitation in reachback.

Imagery Databases with 3-D Images of Target Area

It bears repeating that there is no shortage of information systems, and each system in its own unique way presents a new set of challenges for the warfighter. This is no less true for managing and processing targeting data. Intelligence analysts who rely on targeting data will attest to the growing number of information systems used for targeting enemy forces and functions. Through reachback technology, the 76th Space Operations Squadron at Schriever Air Force Base, Colorado, supported targeting for missions conducted during Operation ALLIED FORCE.[16] One intelligence specialist said: "We take each intended route and target area and put it into the computer. From this

information, the imagery database provides us with a 3-D image of the target area. This gives the crews a better idea of the terrain around the target."[17] Other examples of information systems designed to influence targeting abound. In 1995, General Fogleman forecast the Joint Surveillance Target Attack Radar System (JSTARS) would "dramatically reduce the time required to detect and destroy enemy targets."[18] His forecast proved correct during Operation ALLIED FORCE. The combined air operations center in-theater received data [photograph-like images of targets] from JSTARS and passed them real time to NATO forces so they could prepare, react and respond accordingly.[19] According to Colonel Joseph Stein, a JSTARS commander during ALLIED FORCE, "JSTARS is on-station and engaged in Kosovo. It is making a big difference."[20]

The Global Positioning System (GPS) and the National Imagery and Mapping Agency (NIMA)-in-a-box system are two other examples of systems that influence the targeting process, engage the warfighter, and compete with other information resources to become part of the decision-making process. During Operation ALLIED FORCE, the 76th Space Operations Squadron ensured their readings taken from GPS satellites were as accurate as possible because missiles and smart bombs relied on GPS navigation to strike targets.[21] Also during Operation ALLIED FORCE, the DOD debuted NIMA-in-a-box, a system that compressed maps into 12 to 36 gigabytes on a laptop computer, affecting scenarios from targeting and intelligence gathering to bomb dropping.[22]

The state of today's advanced information systems allows the warfighter access to information on every functional level imaginable. During Operation ALLIED FORCE, Generals Wesley Clark and John Jumper, and other commanders were easily able to

collect requisite information to command and control their forces. If the JFC wanted intelligence information provided by Predator ISR systems, his personnel scheduled collection and developed imagery intelligence reports to meet his requirements. The results allowed the commander to monitor the movement of enemy troops, know the enemy's order of battle, and track training regimens and mobile targets. The commander also used CTAPS to collect information on the status of his own forces, prior to developing the ATO. After executing the ATO, he accessed 3-D imagery to give him, for example, a bomb damage assessment (BDA). These are just a few examples of systems comprising the commander's C2 support infrastructure. Not only do they compete for his attention, but they also provide a foundation for C2 decision-making. The commander's effectiveness depends on his ability to routinely and quickly prioritize, integrate, and process volumes of information. He must manage a decision-making system with the potential to overwhelm even the best decision-maker. It is a system that allows little room for error in judgment.

Notes

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[2] Pittsburgh Supercomputing Center, "Phase One of the Pittsburgh Supercomputing Center Terascale System." Carnegie Mellon University, University of Pittsburgh, 29 January 2001, n.p., on-line, Internet, available from http://www.psc.edu/publications/newsreleases/news/2001/tcs-01.29-01.html.

[3] Ibid.

[4] Ibid.

[5] Joint Publication 6-0, Doctrine for Command, Control, Communications, and Computer (C4) Systems Support of Joint Operations, 30 May 1995, I-7.

[6] Technical Sergeant Timothy Huffman, "Kosovo Shows People Are Key to Integration of Air, Space Operations." Air Force Space Command Public Affairs: Air Force News, 23 June 1999, n.p., on-line, Internet, available from http://www.af.mil/news/Jun1999/n19990623_991228.html.

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[10] Ibid.

[11] The 1997 United States Air Force Issues Book, "Information Superiority," n.p. on-line, Internet, available from http://www.af.mil/lib/afissues/1997/app_b_12.html.

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[16] First Lieutenant Denise N. Shorb, "Space Technology Enhances ALLIED FORCE Bomber Missions," Air Expeditionary Group Public Affairs: Air Force News, 14 April 1999, n.p., on-line, Internet, available from http://www.af.mil/news/Apr1999/n19990414_990673.html.

[17] Ibid.

[18] Fogleman, remarks delivered at the Air Force Scope Warrior XI Dining-In.

[19] Staff Sergeant Michael Dorsey, "Joint STARS Trains All-seeing Eyes on Battlefield," Air Force Print News: Air Force News, 27 May 1999, n.p., on-line, Internet, available from http://www.af.mil/news/May1999/n19990527_991066.html.

[20] Ibid.

[21] Shorb

[22] Senior Airman Angela Furry, "NIMA-in-a-box Debuts During Operation ALLIED FORCE," 31st Air Expeditionary Wing Public Affairs: Air Force News, 9 June 1999, n.p., on-line, Internet, available from http://www.af.mil/news/Jun1999/n19990609_991144.html.

Chapter 3

Information Filtering and Integration

> *We must go beyond narrow stovepipes to take a system-of-systems approach that evaluates the interfaces between weapon systems, intelligence systems, logistics systems, space systems, etc.*
>
> —General Ronald R. Fogleman

As US military forces increasingly rely on information systems, they enjoy more opportunities to fully exploit information at their disposal. We have made tremendous progress to overcome limitations of data systems that must be hand massaged so they may provide useful information that fosters knowledge. The days of isolated, stovepipe systems have largely become a thing of the past, and we often find ourselves challenged by information systems that must work as an integral to render the greatest benefit to today's warriors. Herein lies the potential to create a seamless flow of information to enhance our ability to associate data, establish information relationships, and provide military commanders with better decision-making tools. While we continue making progress toward systems integration, we also recognize barriers to establishing system interfaces. There is a constant and necessary demand for human intervention. Fortunately, automated information systems give consistent results influenced by interfaces and systems integration. However, the same cannot be said when humans become information handlers—information filtering in such cases may yield different results with different information handlers. Although this is clearly a dilemma in the

information management realm, the fact remains that knowledge is acquired through a selection or filtering process.[1] Information managers must value information filtering as germane and, when taken seriously and performed methodically, enhances information processes. Turning to a practical example during Operation ALLIED FORCE, imagine the constant demand for human-machine interaction, and the requirement to rapidly filter and integrate information.

For Kosovo, our military forces had yet another opportunity to demonstrate the value of integrated information for commanding officers. According to General Michael Ryan, former Air Force Chief of Staff, "During ALLIED FORCE, we took a number of steps to reduce the sensor-to-sensor timeline—fusing intelligence, surveillance, and reconnaissance data into actionable knowledge for commanders."[2] The business of information management permits C4 systems planners to decide in advance those functional areas that provide the greatest benefit to the warfighter. Planners, in turn, position hardware and human systems to process, interpret, and integrate information sources. General Ryan summarized the dual requirement for human and automated systems to assist theater operations as follows: "Our U-2s flying over Kosovo and Serbia sent their raw data directly back to the United States through satellite communications. This reachback to Beale Air Force Base (California) allowed us to keep linguists and imagery analysts at home station here in California."[3]

Our efforts were consistent with the overarching premise that in order to achieve information superiority, one must acquire superior information. It is clear from General Ryan's example that the ability to achieve information superiority depends on human intervention for handling information. The result is a mixed system where some portions

are automated, while other portions are left to human interpretation. I submit that such interpretation may impose limitations because of varying degrees of human intellect and more simply, they limit the information management process because information handlers have disparate lenses through which they view information. In order to overcome this limitation, information management experts must better understand the discipline of knowledge management and learn how to standardize its practices. Achieving results in knowledge management is the product of a two-fold evolution of existing knowledge: its enhancement (depth) and its transfer (application).[4] A more vast understanding of knowledge management will yield synergistic effects and accelerate improvements. Moreover, institutionalizing knowledge management is a shared responsibility of everyone who handles information.

In order to promote information processing and knowledge management as enablers of reachback—give information handlers a decided advantage in prosecuting wars—senior leaders will likely look for empirical data. It will be the responsibility of senior leaders to collect such data and show evidence of the effects of improved information management. In the absence of empirical data to support information practices and procedures proper, the evidence is clear regarding military achievements in collecting and integrating a wide array of information sources. But often times, the technologies to integrate information sources outpace the ability to efficiently use them. Lieutenant Colonel Nichols commented, "We can solve this problem if we can get these so-called low-density, high-demand assets and train with them and exercise with them."[5] The colonel saw a need for information handlers to train with the UAV—to improve time-critical targeting, and to successfully destroy mobile targets. Information processes for

such activities are daunting for several reasons, including complex hardware and software systems, large numbers of human information handlers, and of course, human interpretation. Training information systems allows commanders and supervisors to reinforce the decision-making value of the information systems. Training equips information handlers with tools and direction to transform information into knowledge. Knowledge development … stretches along a continuum from learning-by-doing, through which lessons are learned from experience and applied.[6] In the final analysis, it all comes down to practicing knowledge management.[7] The underlying theory of knowledge management is that you can accumulate knowledge assets and use them effectively to gain a competitive advantage.[8] At every opportunity, decision-makers must challenge information managers to develop knowledge management skills because data and information without context add minimal value to the decision-making process. Information handlers must learn to appreciate knowledge management and the filtering process it requires.

Knowledge management and its relationship to the selection or filtering process may be addressed both in terms of human and automated systems. For human systems, people perform their own unique filtering, while automated information systems have pre-designed filtering processes. Former Secretary of the Air Force Whit Peters said: "The fusion of information is critical, but having well-trained people is as, if not more, important."[9] For information management, training must include knowledge management. It must deal with human-knowledge assets, including infrastructures such as organizations, processes, systems, and methods.[10] Information management must address, normalize, and standardize biases introduced by such infrastructures, otherwise

information handlers will continue treating information differently and will likely pass their biases to commanders and other important decision-makers. One of the conclusions that may be drawn here is that the filtering process will continue to require human intervention (at least for the time being).[11] Despite a proposal by a part of the information technology industry, transformation of information into knowledge is not a higher form of data processing.[12] It tends to follow a systemic model where the relevance of pieces of knowledge are given a purpose and a function within the operational environment.[13] The following diagram depicts a systemic model for such an operational environment.

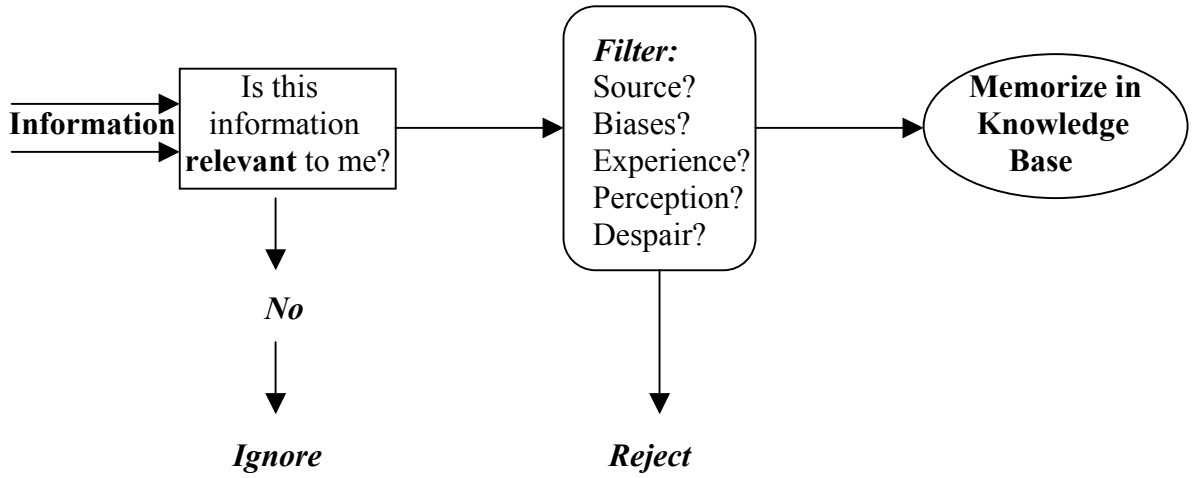

Figure 1: The informal filtering process[14]

Human systems consider information in relative terms. Much of this relativity is nothing more than human perceptions. Without functional area experts, the human information filtering process might be doomed. The military establishment depends on subject matter experts to design information systems to assist theater commanders in C2 of forces. Senior leaders, and commanders alike, trust automated systems to collect, integrate, and process critical and relevant information. Likewise, when dissimilar functional systems are not integrated, decision-makers empower information handlers to

fuse information, and thus create a seamless flow of information. In the absence of a standard filtering process, human systems [information handlers] tend to value information based on experience and may vary information filtering. An aggressive training program for information handlers appears to be a viable solution to alleviate filtering variances. Only can a knowledge expert definitely bridge the gap between automated information that require integration and information fusion. Though no easy task, C4 systems planners and information management experts must take the lead to advance information fusion. More important, leaders must understand and face the risks associated with leaving information filtering and fusion to chance.

Notes

[1] Godbout, Alain J., "Filtering Knowledge: Changing Information into Knowledge Assets." *Journal of Systemic Knowledge Management,* January 1999, n.p., on-line, Internet, available from http://www.gmgconseil.com/pub/doctech/td9867.PDF.

[2] General Michael E. Ryan, "Beyond the Horizon: Realizing America's Aerospace Force," Remarks to the Annual Space Convention, Air Force Association-Los Angeles, 19 November 1999, Beverly Hills, CA.

[3] Ibid.

[4] Godbout

[5] Phillips Business Information, Inc., "Air Force Urges Decentralized Time Critical Targeting, More Integrated Training." *C4I News,* 19 October 2000, n.p., on-line, Internet, available from https://web.lexis-nexis.com/universe/printdoc.

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[8] Ibid.

[9] Technical Sergeant Timothy Hoffman, "Kosovo Shows People Are Key to Integration of Air, Space Operations." Air Force Space Command Public Affairs: Air Force News, 23 June 1999, n.p., on-line, Internet, available from http://www.af.mil/news/Jun1999/n19990623_991228.html.

[10] Godbout

[11] Ibid.

[12] Ibid.

[13] Ibid.
[14] Ibid.

Chapter 4

Lessons of Knowledge Management

> *While technology cannot prevent all human error, the United States cannot afford tragic mistakes such as the accidental bombing of the Chinese Embassy.*
>
> —William S. Cohen

The knowledge base of information handlers is germane to the information management process, and moreover, to knowledge management. The most promising occasion to leverage knowledge management is through an ideal filtering process. Five factors influence the filtering process. They include: 1) source, 2) biases, 3) experience, 4) perception, and 5) despair.[1] The following describes how each factor presents unique challenges and opportunities to information filtering.

Information handlers value information at their own choosing. Their first consideration is the source of the information. Information handlers are better disposed towards information that comes from an authoritative source.[2] This tendency places at odds the usability of information from less than authoritative sources, and exposes the information management process to inconsistency and breakdown. When there are no standard operating procedures for knowledge management, information handlers develop unique information perspectives and knowledge bases. That is, they may choose to either accept or reject information based on their impressions of the information source. This is a phenomenon that commanders and decision-makers should carefully consider along

with bias. Bias is the next filtering phenomenon for discussion and is another process decision-makers must learn to manage.

The foregoing characterizes the information filtering process as a mirror image of the individual who processes the information. Information handlers are products of their organizations. The second factor, for consideration in the filtering process, is bias.[3] Organizational biases translate into summary judgment whose function is to reinforce beliefs.[4] Beliefs do not have to be truths, they therefore do not qualify as knowledge, but they are an integral part of an appreciative system and act as filtering agents in knowledge retention.[5] When military teams form, they often rely on the judgment of other team members for accurate information. The possibility of filtering out information altogether should shift decision-maker concerns from how accurate the information may be to its availability. The next filtering consideration is the information handler's experience.

One of the essential elements of a military fighting force is that each team member brings something to the fight. The third factor in the filtering process is experience.[6] Team members not only introduce their service doctrine, training, and individual skills, but teams depend on each member's experiences and expertise as frames of reference as they handle the unit's information. Information handlers tend to accept information that reinforces their personal experiences.[7] Lieutenant Colonel Steven Hopkins, night shift officer-in-charge at Spangdahlem Air Base, Germany, during Operation ALLIED FORCE said: "The ability to meld people from different organizations is a result of the continuous refresher and monthly training conducted at home station."[8] Lieutenant Colonel Hopkins's observation, coupled with an individual's experiences reinforces the

idea that systems [human information handlers] tend to accept information that follows a predictable pattern more easily than information that disrupts a pattern.[9] This experiential element of the filtering process is the third filtering factor and a consistent example of how vastly different information handlers may treat information. It is also rationale to support why commanders and decision-makers should expect information handling variances. Decision-makers must recognize the inherent risks associated with all filtering phenomenon, including perception and desperation. Both are discussed below.

The concept of human knowledge management might prove less challenging if human behavior were more predictable. The fourth filtering factor is perception. It supports a social consensus that backgrounds in a variety of domains will enable a person to draw on a broader base of reference models when evaluating information.[10] As organizations are unable to choose team members, they can expect wide-ranging information assessments and perspectives from unit personnel. One of the early lessons from the conflict over Kosovo was: "U.S. intelligence collection is better than ever but it is still not getting through the filters fast enough to help the warfighter."[11] When human information handlers are the repositories for information collection, both timeliness and the filtering process become variables. People who are familiar with the basics of a science or a discipline can more readily make sense out of otherwise disparate pieces of information.[12] Knowledgeable receivers [of information] tend therefore to make better use of information.[13] Conversely, an ill-informed information handler is more likely to discard information due to unfamiliarity and risk dismissing potentially valuable information. The final filtering phenomenon follows.

Anyone who understands high operations tempo during a conflict will have little trouble appreciating the fifth filtering process—desperation. The reality of information management is conditioned by the availability of factual data and measurable results.[14] Information managers become desperate when they cannot find some crucial information.[15] For the war in Kosovo, former Deputy Defense Secretary John Hamre reported to Congress: "We have spent an enormous amount of work trying to get national intelligence capabilities transparent to each other and information available down into the field. We don't know where there were problems [and] bottlenecks."[16] Under these circumstances information managers will accept almost anything that seems pertinent.[17] When the information management process reaches a state of desperation, it becomes a liability that further burdens the effectiveness of reachback. It is more likely than not that today's military members confront many desperate situations and find themselves at a loss for satisfying insatiable information demands. Having considered desperation and other filtering phenomena, it is appropriate to consider viable alternatives to an uncontrolled filtering process.

Can the US military leverage knowledge management? Why or why not? If NATO could have prevented bombing the Chinese Embassy in Belgrade during Operation ALLIED FORCE, they certainly would have done so. It is no secret that NATO struck the wrong target; neither is it hard to conceive that the error was, at least in part, due to human miscalculation. Perhaps on a different day, with a different team of service men and women, NATO would have struck the proper target with limited collateral damage, and the mission would have continued as usual. The unpredictability of human systems provides a case for knowledge management to work on behalf of

decision-makers. Truly, if information handlers filter information based on their: 1) confidence in information sources; 2) biases; 3) experiences; 4) perception or subject knowledge; and 5) urgency for answers—they must not allow their filters to run the gamut from one end of the spectrum to the other. C4 systems planners and information management experts must help normalize the information filtering process. Appendix A provides an information management risk assessment tool to alert commanders to their information vulnerabilities. Appendix B outlines an approach to avoid catastrophic information filtering—an approach to end scenarios like the one at the Chinese Embassy in Belgrade. Appendices A and B, coupled with recommendations in Chapter 6, offer measured and qualitative assistance to information handlers for improving information processes.

Notes

[1] Godbout
[2] Ibid.
[3] Ibid.
[4] Ibid.
[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] Senior Airman Connie Etscheidt, "Wing Operations Center Links 501st EOG Communications," 501st Expeditionary Operations Group Public Affairs: Air Force News, 21 April 1999, n.p., on-line, Internet, available from http://www.af.mil/news/Apr1999/n19990421_990733.html.
[9] Godbout
[10] Ibid.
[11] David A. Fulghum, "Lessons Learned May Be Flawed," *Aviation Week and Space Technology,*14 June 1999, 64, n.p., on-line, Internet, available from https://web.lexis-nexis.com/universe/printdoc.
[12] Godbout
[13] Ibid.
[14] Ibid.
[15] Ibid.

[16] Fulghum
[17] Godbout

Chapter 5

An Alternative to Filtering, Integration, and Knowledge Management

Problems cannot be solved at the same level of awareness that created them.

—Albert Einstein

Are information filtering and integration, and knowledge management the end-all, be-all for alleviating information management as a limitation in reachback? The argument against these solutions is better understood through an alternative approach to improve information management. If one is not convinced that filtering, integration, and knowledge management, through a combination of automated and human systems offers a viable process to bolster information management, then perhaps a brief discussion of artificial intelligence (AI) and decision support systems is in order.

AI is designed to ease decision-making for humans. It is ideally suited for large, complex systems requiring accurate and timely analysis. AI has the capacity to support a broad spectrum of functional areas. After mathematician John McCarthy coined the term "artificial intelligence" in 1955, AI became the focus of extensive research.[1] Many experts believe it has merit, while others are not convinced that machines can mirror human mental capabilities. For information management, AI must know when to integrate and filter information sources, as well as how to manage integration and

filtering to produce knowledge. The resulting knowledge must enable the decision-making process if it is to be a good force multiplier for information superiority in DOD.

There can be no doubt about the potential AI offers—it supports military and civil processes—to include information management, science and research, and business applications. In recent years, the field of decision support systems (DSS) has become more sophisticated to encompass such paradigms as expert systems, intelligent DSSs, active DSSs, and adaptive DSSs.[2] AI-based techniques are being embedded in many DSS applications, thus enhancing the support capabilities of the DSS.[3] Decision-making is an obvious challenge confronting DOD information managers. It is conceivable that AI-based DSSs might provide an alternative for supporting warfighting decision-making. But the alternative is not without significant problems for which there are no immediate solutions. For example:

> AI is based on an idea that has been around in philosophy since Descartes, that all understanding consists in forming and using appropriate symbolic representations. For Descartes these were complex descriptions built up out of primitive ideas or elements. Kant added the important idea that all concepts were rules. Frege showed that rules could be formalized so that they could be manipulated without intuition or interpretation. Given the nature of computers, AI took up the search for such formal rules and representation. Common-sense-intuition had to be understood as some vast collection of rules and facts.[4]

Given a requirement to enhance the warfighter's decision-making process, AI should serve DOD information managers as a source of expert knowledge. In Edward Feigenbaum's book *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World,* he said: "The matters that set experts apart from beginners, are symbolic, inferential, and rooted in experiential knowledge …. Experts build up a repertory of working rules of thumb, or 'heuristics' that, combined with book knowledge, make them expert practioners."[5] Such requisites set the stage for challenging AI

capabilities to replace human systems. Hubert Dreyfus has studied AI since the early 1960s. He contends that the process through which humans acquire skillful behavior alone precludes AI as a suitable replacement for human systems.[6] Dreyfus believes as humans, we learn new skills by instruction first as novice learners.[7] We evolve to become advanced beginners, then competent performers.[8] Finally, we become proficient before becoming experts.[8] In short, the human process for acquiring skilled behavior is evolutionary, yet spontaneous. Skilled behavior is not governed by rules or standards per se, unless they are externally imposed. Dreyfus cautions us that expert systems are never as good as experts.[9] Systems are at best competent because no amount of rules and facts can capture the knowledge an expert stores as a result of experience—the experience of the actual outcomes of tens of thousands of situations.[10]

The advent of AI continues to make significant contributions to information processes. Many expect AI to someday program machines to mirror human decision-making and support knowledge management in ways that DOD, for example, might find value-added. Unfortunately a great deal of work lies ahead before machines will adequately perform as the experts DOD needs today. AI advocates can rightfully identify decision support systems capable of addressing specific knowledge management problems.[11] However, such isolated cases fall short of DOD requirements for information processes to expertly filter and integrate information, and develop knowledge management skills for an immeasurable number of scenarios. Once computers are used for reasoning and not just computation, they should be able to follow rules for deducing conclusions from a host of facts.[12] If the rules which an expert has acquired from years of experience could be extracted and programmed, the resulting program would exhibit

expertise.[13] The problem with this premise was aptly characterized by Feigenbaum when he said: "An expert's knowledge is often ill-specified or incomplete because the expert himself does not always know exactly what it is he knows about his domain."[14] The clear advantage the human system has is the ability to adapt. In the case of information processes, DOD should continue to filter and integrate, and manage knowledge assets through combined efforts of man and machine—to gain and maintain superior information.

Notes

[1] "Dictionary of Philosophy of Mind – McCarthy John," n.p. on-line, Internet, available from http://www.artsci.wustl.edu/~philos/MindDict/mccarthy.html.

[2] Ganesh Datt Bhatt and Jigish Zaveri, "The Enabling Role of Decision Support Systems in Organizational Learning," *Decision Support Systems* 32, no. 3, 1 January 2002, n.p., on-line, Internet, available from http://www.elsevier.com/cgi-bin/cas/tree/store/decsup/cas_sub/browse/browse.cgi?year=2002&volume=32&issue=3&aid=919.

[3] Ibid.

[4] Hubert L. Dreyfus and Stuart E. Dreyfus, "From Socrates to Expert Systems: The Limits and Dangers of Calculative Rationality," The Department of Philosophy, University of California, Berkeley, n.p., on-line, Internet, available from http://socrates.berkeley.edu/~hdreyfus/html/paper_socrates.html.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Ibid.

[9] Ibid.

[10] Ibid.

[11] Ibid.

[12] Ibid.

[13] Ibid.

Chapter 6

Recommendations

A second lesson of the conflict [in Kosovo] was the necessity to keep information flowing at lightning speed to everyone who needs it.

—General Michael E. Ryan

Our military establishment must remain focused on information as a weapon. The ability to effectively manage information in future conflicts will help offset information management as a limiting factor of reachback. There are at least two areas that bear exploiting in order to improve the information management process. They are better-integrated information systems and improved knowledge management. Regarding Operation ALLIED FORCE, former Air Force Chief of Staff General Michael Ryan said: "Our ability to execute this war showed the leverage you have when you are able to move information around rapidly and make decisions based on it."[1] Not only do C4 systems planners have the opportunity to maximize the effects to which General Ryan alluded, but along with enhancing information as a strategic weapon through speed and agility, planners also have a responsibility. Planners must limit the adverse effects of massive information by enforcing integration and practicing knowledge management.

We risk losing the information management battle due to sheer information volume alone. Because of the increasing demand for information, information management requirements will only increase. According to Joint Vision 2020, "… the ongoing

'information revolution' is creating not only a quantitative, but a qualitative change in the information environment that by 2020 will result in profound changes in the conduct of military operations."[2] To balance this revolution in information, C4 systems planners must better integrate the flow of information in hopes of making it seamless, where its sources are transparent to information handlers and decision-makers. Joint Vision 2020 further states: "The joint force must be able to take advantage of superior information converted to superior knowledge to achieve 'decision superiority'—better decisions arrived at and implemented faster than an opponent can react, or in a non-combat situation, at a tempo that allows the force to shape the situation or react to changes and accomplish the mission."[3]

Information integration enables superior information and there are at least three ways to approach integration. First, task C4 systems planners to identify, design, and implement system interfaces to give a comprehensive and closed-loop system of systems. Second, identify functional requirements for a closed-loop system of systems, and build the system one requirement at a time—and thus minimize the challenges associated with different system standards and formats. Standards and format challenges are also associated with requirements to interface and integrate existing systems. Third, task information handlers to develop and build standard operating procedures for human interfaces between systems, and thus establish a closed-loop system of systems. Today's systems depend on human interfaces to round out existing systems, for delivering a comprehensive and closed-loop system. Which of these will yield the greatest benefit to warfighters and decision-makers? General Ryan's observation may help answer this question. He said this system should, for example, retarget, refocus, and command and

control the force within minutes.[4] Working from General Ryan's premise, the system should allow minimum disruption. Building automated system interfaces after systems are built is too costly, too cumbersome, and, in many cases, error-prone. Human interfaces, on the other hand, are too timely and non-systematic. The solution may require a new start, one which includes tasking C4 systems planners to develop a closed-loop system that integrates voice, video, data, sensors, and other relevant information to help commanders command and control forces and prosecute the mission. Currently, DOD warfighters believe the solution to a more fully integrated system lies in the development of a concept labeled the global information grid.[5] The grid will be the globally interconnected, end-to-end set of information capabilities, associated processes, and people to provide information on demand to warfighters, policy makers, and support personnel.[6] The success of such a system depends on the success of knowledge management—requiring human systems to design, develop and sustain an uninterrupted flow of relevant information. Knowledge management is yet another area with promise to improve the information management process.

Functional area experts must advise C4 systems planners on developing a closed-loop system to support the warfighter's information requirements. Each expert will apply a unique knowledge base for information filtering. C4 systems planners must exercise caution against uncontrolled information filtering. To control information filtering, C4 systems planners should consider hiring filtering experts who add the seal of authority to information artifacts.[7] Researchers and documentation analysts, by reviewing incoming information, act as official filters and may on occasion give value to otherwise trivial

information.[8] The goal of C4 systems planners should include developing a comprehensive and seamless set of information products for information managers.

To alleviate obstacles information management poses to reachback, C4 systems planners must come full circle with information processing that is additive to prosecuting the war. Why? Because the DOD vision for the joint force of 2020 is to "use superior information and knowledge to achieve decision superiority, to support advanced command and control capabilities …."[9] For decision-makers, information can easily be viewed as one of two types: push or pull. Push refers to a process when information is channeled to a user, without scrutinizing the user's needs. Pull occurs when the user makes a request for information and is rewarded with only what is required. To further enhance the information management process, C4 systems planners must lessen the information burden to warfighters by providing only relevant information. Based on the advice of functional area experts, C4 systems planners should strive to develop filters that work on behalf of information handlers—not cloud the battlespace picture.

By developing and fostering better-integrated systems, and leveraging knowledge management, C4 systems planners position information as a force multiplier. When systems are integrated, volume is less relevant; it may even be welcomed. Well-integrated systems require less human decision-making and increase standardization by design. Whether the approach to integration is semi-automated or manual, an overhauled information system, or the global information grid, the resulting synergism—superior information, superior decisions, and rapid response—allows DOD to achieve the fundamental tenets articulated in Joint Vision 2020.[10] To enhance the effects of fully integrated systems, information managers must be better knowledge managers.

Managers of information must become familiar with the information filtering process by leveraging personal strengths (appropriately applying experience and skills) and by identifying and correcting counterproductive practices such as biasing information and unsubstantiated data filtering. Better-integrated information systems and better knowledge management are keys to unlocking the limitations of information management. In sum, they empower information management as a force multiplier in reachback.

Notes

[1] John A Tirpak, "Lessons Learned and Re-Learned," *Air Force Magazine*, August 1999, n.p., on-line, Internet, available from http://www.afa.org/magazine/watch/0899watch.html.

[2] Joint Vision 2020, Approved by the Chairman of the Joint Chiefs of Staff: developed by the Director for Strategic Plans and Policy, J5; Strategy Division, 8.

[3] Ibid, 8.

[4] Tirpak

[5] Joint Vision 2020, 9.

[6] Ibid, 9.

[7] Godbout

[8] Ibid

[9] Joint Vision 2020, 10.

[10] Ibid, 10.

Chapter 7

Conclusion

While we have demonstrated the ability to react quickly, we often outpace our own ability to set up appropriate command structures.

—General John J. Jumper

Warfighters use reachback technology extensively while prosecuting the nation's wars. Reachback enables military forces to deploy in-theater without a full complement of forward-deployed information systems. Instead of an enlarged systems footprint in-theater, warfighters rely on satellite communications that allow them to request and receive volumes of information from strategic locations within the continental US. Reachback is a critical enabler, but has some limitations. The classic limitation of reachback is bandwidth—there are never enough communications circuits to allow the ideal volumes of information to traverse continents through reachback. Although critics of reachback are quick to label bandwidth as the chief culprit of reachback limitations, seldom do they recognize the potential to reduce the volume of information through better information management.

The US entrusts military leaders and commanders to practice expert decision-making. Yet in the fog of war, commanders handle overwhelming and disparate information that adds to the complexities of war. General Ryan pointed out: "Our reliance on reachback to the United States for information and support increased our

requirement for bandwidth five-fold since DESERT STORM …. [During ALLIED FORCE] linguists and imagery analysts used specialized equipment and collaborative intelligence links across the US to turn raw data into finished information that was disseminated back to the theater commanders."[1] The nation equips warfighters with state-of-the-art and state-of-the-practice weapon systems designed to reduce the sensor-to-shooter timeline. The operator tries to quickly target and destroy enemy capabilities. Commanders depend on operators to collect, process and act on real-time information as they track and destroy enemy targets. Lieutenant Colonel Nichols echoed this sentiment:

> … overcoming the challenge of time critical strikes against targets capable of moving once they have gathered information or fired their weapons would require teamwork between command and control and execution ….[2]

There is no shortage of information processing, nor is there a short list of decisions weighing on the shoulders of theater commanders and other warfighting decision-makers. Although many warfighters struggle with the challenges of bandwidth in the reachback process, sooner or later they must aggressively address the limitations of the information management process.

In order to aid C4 systems planners in the design and development of smarter, streamlined information management processes, subject matter experts must team with planners and posit on the leading edge of filtering information systems. Together, planners and subject matter experts must integrate and delimit information to help provide the JFC, for example, with information superiority. Joint Publication 2-0, *Doctrine for Intelligence Support to Joint Operations*, 20 March 2000, states: "In addition, time-sensitive intelligence will be 'pushed' to JFCs and components by way of dedicated broadcasts in response to pre-planned PIRs [priority intelligence

requirements]."[3] This doctrine outlines a process to deliver pre-planned intelligence requirements—a clear signal that information dissemination should be relevant and selective. The care with which planners filter information will be directly proportional to the quality of information. Quality information, according to Joint Publication 6-0, *Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations*, is attributable by relevance and brevity.[4] Relevance means information that is available in time to make decisions; and brevity includes information that has only the level of detail required.[5] To further ensure a streamlined information management process, planners must enforce information fusion. The ultimate goal of C4 systems is to produce a picture of the battlespace that is accurate and meets the needs of warfighters.[6] This goal is achieved by fusing (i.e., reducing) information to the minimum essentials and putting it in a form upon which people can act.[7] The ability to precisely filter and integrate information leading to better decision-making and an accurate battlespace picture lead to strategic advantages—and information superiority. The DOD must depend on C4 systems planners to seize opportunities to develop and implement information processes to achieve strategic advantages.

The effectiveness of information management—for providing superior information—correlates to the effectiveness of knowledge management. Human systems accumulate knowledge, and build their functional expertise as a result of continuous learning. When C4 systems planners seize the opportunity to create a knowledge management discipline and insert knowledge management standards into the information management process, the results will astound information handlers. Knowledge management is a discipline based on the premise that information handlers should work

smarter, not harder. Knowledge management will encourage information handlers to: 1) trust information sources; 2) turn biases into gains; 3) better exploit experience; 4) capitalize on informed perception; and 5) avoid desperation to acquire information. Ultimately, knowledge management enables information filtering, which, in turn improves quality of information. Properly filtered information is ready for integration—this fusion enhances and coalesces decision-making in general, and the battlespace picture in particular.

The warfighter's experiences during Operation ALLIED FORCE taught several lessons, not least were challenges posed by the information management process. This paper includes material to consider before the next conflict: Appendix A, an Information Management Risk Assessment, and Appendix B, Information Filtering and Integration Checklist. Both appendices regard information and knowledge management as processes in need of repair, as well as opportunities for their improvement. For the operation of systems, Jomini said: "...if the offensive is but an attack upon the enemy's position, and is confined to a single operation, it is called taking the initiative."[8] The information management process was no less an enemy during ALLIED FORCE. To institutionalize information and knowledge management—and improve the information handler's situational awareness—is to seize the initiative. Can US forces afford not to? This question must not remain unanswered until warfighters develop lessons learned of the next conflict. Our forces should heed Jomini's admonition and seize the initiative. Jomini also offered the following: "…the offensive is almost always advantageous, particularly in strategy."[9] Finally, C4 systems planners and functional area experts are well suited to develop our nation's strategy to improve information and knowledge

management. C4 systems planners are also the vanguards responsible for dismissing immature technologies—for filtering, integrating, and managing information—such as AI to solve DOD information process challenges. Hopefully planners will continue to develop the man-machine relationship and succeed in implementing information- and decision-superior systems. These developments are indispensable to information processes in reachback if information will ever become the strategic advantage everyone believes it can be.

Notes

[1] Ryan, remarks.

[2] Phillips Business Information, Inc.

[3] Joint Publication 2-0, *Doctrine for Intelligence Support of Joint Operations*, 9 March 2000, IV-11.

[4] Joint Publication 6-0, *Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations*, 30 May 1995, I-5.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Henri Jomini, *From Antiquity to the Nuclear Age: The Art of War in World History*, edited by Gerard Chailand (Berkeley and Los Angeles, Ca.: University of California Press, 1994), 740.

[9] Ibid, 740.

Appendix A

Information Management Risk Tolerance

Information Source:

a. Your organization requires on-site subject area expert(s) to ensure information handlers properly filter information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

b. Your organization requires policy for assigning credibility to information sources.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

c. Your organization requires policy to validate the credibility of information sources.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

d. Policy for assigning credibility to information sources should be relaxed when problems require immediate solutions.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

e. The source of information is important.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

f. The source of information (for human systems) should be prepared to validate information content.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

g. The source of information is unimportant when problems require immediate solutions.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

h. Information handlers should consider the credibility of the information source.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

i. The credibility of the source of information is unimportant when problems require immediate solutions.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

j Information handlers are encouraged to seek assistance before dismissing information as trivial.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

Personal Bias and Experience:

a. Information handlers should handle information in an objective manner.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

b. Information handlers should not oppose or question information that disagrees with their personal beliefs.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

c. Information handlers are not encouraged to apply advanced education to solve current problems.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

d. Information handlers are not encouraged to use sources external to the organization to solve current problems.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

e. Information handlers are not encouraged to make judgment calls, without assistance, about information before passing it to decision-makers.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

Individual Perception:

a. Information handlers should draw from a broader knowledge base when evaluating information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

b. Information handlers should organize information and establish relationships between events.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

c. Information handlers should organize information and establish relationships between information sources.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

d. Information handlers should be proactive in making an initial assessment of information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

e. Information handlers are encouraged to collate and understand the meaning of disparate pieces of information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

Desperate for Information:

a. Information handlers expect to handle factual data, with measurable results.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

b. Information handlers are encouraged to seek assistance when unable to find crucial information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

c. When unable to find crucial information, information handlers must guard against accepting anything that seems pertinent.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

d. Information handlers are encouraged to know and understand their role in the decision-making chain of events.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

e. Information handlers are encouraged to analyze information.

1. Strongly disagree 2. Somewhat disagree 3. Agree 4. Somewhat Agree 5. Strongly Agree

Instructions for assessing information management risk tolerance. Your answer to each question carries a maximum value of 5. If each of your answers yielded a 5, your total points awarded are 25 x 5, or 125, for an average of 5. You have a low information management risk tolerance. Conversely, an average of less than 5 requires further study if your goal is to lower your risk tolerance. Begin your study by tracking the results of your actions in each category. Your consistent failure in any one the 25 areas may indicate a trend, requiring you to adjust your information management process.

Appendix B

Information Filtering and Integration Checklist

a. Treat all information as a strategic advantage by establishing its relevance. If it is not relevant, treat it as non-essential and guard against using it in the decision-making process.

b. Consult a subject matter expert to assess the value of information and assign it a priority. Establish its relationship to other pieces of information.

c. Determine where the information fits in the decision-making chain of events. Define it as actionable or non-actionable information. Establish a category for actionable information and one for non-actionable information. Prioritize each group.

d. Immediately establish relationships between pieces of actionable information and analyze their impact. Prioritize the impact of actionable knowledge.

e. Present the information impact to the commander, or other decision-makers. Note the results as 1) the commander took action, 2) the commander held the information in abeyance, or 3) the information was re-inserted into the filtering and integration process and the information filtering and integration checklist will be repeated.

Glossary

3-D	Three-dimensional
ACSC	Air Command and Staff College
ALLIED FORCE	Code name for NATO combat operations conducted in Serbia and Kosovo
ATO	Air Tasking Order
AU	Air University
BDA	Bomb Damage Assessment
C2	Command and Control
C4	Command, Control, Communications, and Computer
CTAPS	Contingency Theater Automated Planning System
DOD	Department of Defense
DSS	Decision Support System
GHz	Gigahertz
GPS	Global Positioning System
ISR	Intelligence, Surveillance, and Reconnaissance
JFC	Joint Force Commander
JSTARS	Joint Surveillance Target Attack Radar System
NATO	North American Treaty Organization
NIMA-in-a-box	National Imagery and Mapping Agency-in-a-box
PIR	Priority Intelligence Requirement
RJ	Rivet Joint
TBMCS	Theater Battle Management Core Systems
TCS	Terascale Computing System
UAV	Unmanned Aerial Vehicle
US	United States
USAF	United States Air Force
USAFE	United States Air Forces in Europe

Definitions:

architecture. A framework or structure that portrays relationships among all the elements of the subject force, system, or activity (Joint Publication 1-02: referenced in Joint Publication 6-0)

bandwidth. The difference between the highest and lowest frequencies available for network signals. The term is also used to describe the rated throughput capacity of a given medium or protocol. (Cisco Certified Network Associate Study Guide, SYBEX, Network Press; 1999 SYBEX, Incorporated)

command and control. The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission (Joint Publication 1-02: referenced in Joint Publication 6-0)

command, control, communications, and computer (C4) systems. Integrated systems of doctrine, procedures, organizational structures, personnel, equipment, facilities, and communications designed to support a commander's exercise of command and control across a range of military operations. (Joint Publication 6-0)

gigahertz. Approximately one billion cycles per second. For example, a Pentium computer processing unit may have a speed of 1.4 gigahertz. (*A+,* Certification Insider and Course Technology, 1999 by Course Technology)

information environment. The aggregate of individuals, organizations, and systems that collect, process, or disseminate information, including the information itself. (Joint Publication 1-02: referenced in Joint Vision 2020)

information superiority. The capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same. (Joint Publication 3-0)

intelligence. The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas. (Joint Publication 1-02: referenced in Joint Publication 2-0)

joint operations. A general term to describe military actions conducted by joint forces, or service forces in relationships (e.g., support, coordinating authority), which, of themselves, do not create joint forces. (Joint Publication 1-02: referenced in Joint Publication 3-0)

knowledge management. Creating knowledge assets by selecting or filtering knowledge in order to make it relevant. (Godbout)

priority intelligence requirements. Those intelligence requirements for which a commander has an anticipated and stated priority in the task of planning and decision-making. (Joint Publication 2-0)

processing. A system of operations designed to convert raw data into useful information. (Joint Publication 2-0)

reachback. The electronic ability to exploit organic and non-organic resources, capabilities and expertise, which by design are not located in-theater. It enhances the

operational agility of the deployed unit by improving its access to timely and relevant information. (Neal)

reconnaissance. The transitory mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an adversary, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. (Joint Publication 1-02)

surveillance. The sustained systematic observation of aerospace, surface or subsurface areas, places, persons, or things by visual, aural, electronic, photographic, or other means. (Joint Publication 1-02)

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