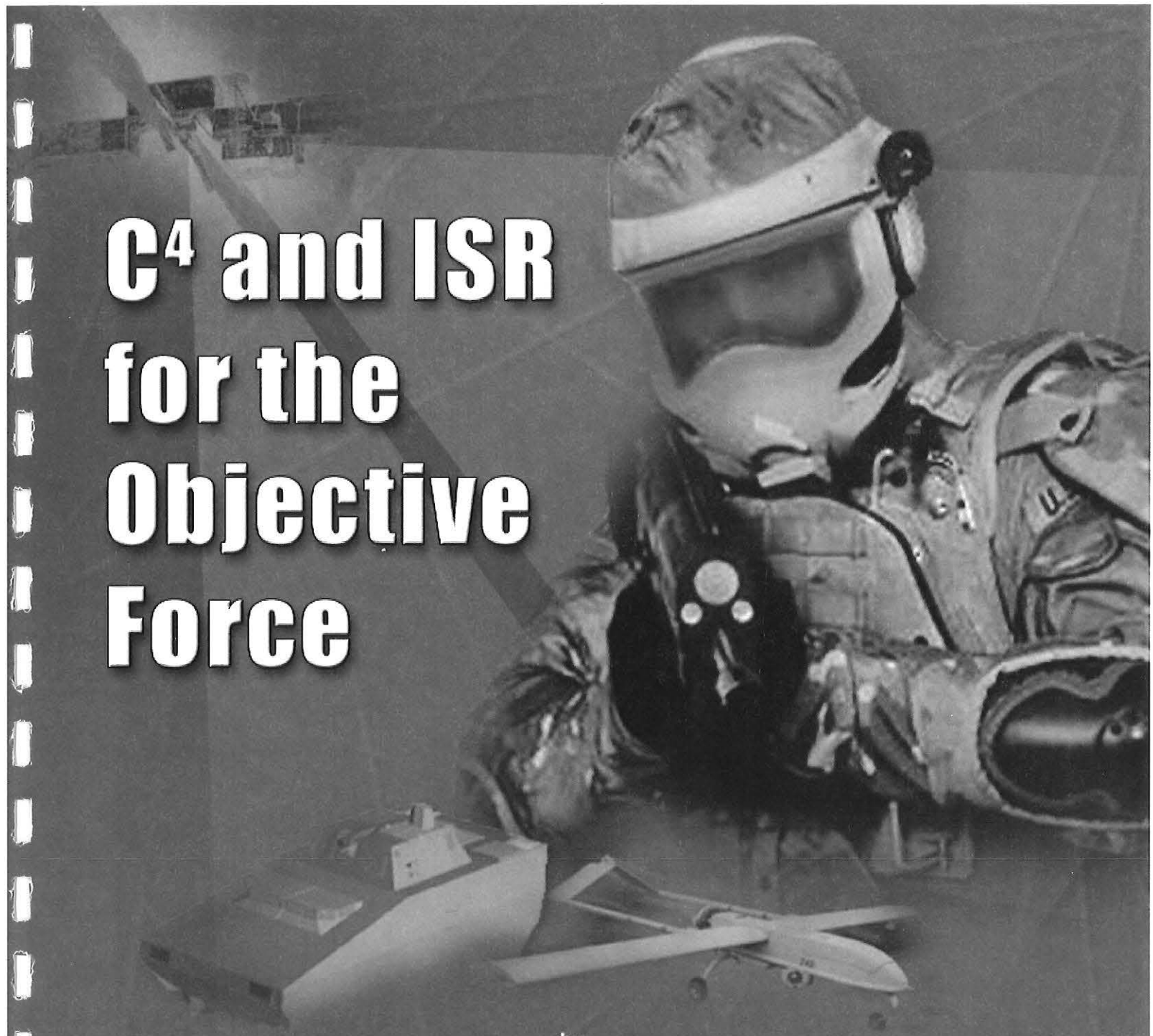

C4 and ISR for the Objective Force

by

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C^4 and ISR for the Objective Force

Operational success for future Army commanders[1] is inextricably tied to superior knowledge that enables commander understanding and decisive action. Noted systems theorist Stafford Beer writes:

The wise see knowledge and action as one.[2]

This paper focuses on the fundamental underpinnings for the Army's transformation from information-based to knowledge-based warfare. Knowledge—its creation, management and presentation---enables commanders to make rapid decisions and take decisive actions across the full spectrum of operations. To that end, this paper is developed in two parts. The first part is a discussion of the relationship between knowledge development and decision-making. The second part lays out a vision of how Command, Control, Communication, and Computers (C^4) and Intelligence, Surveillance and Reconnaissance (ISR) will enable commander decision dominance, a cornerstone of Objective Force effects-based operations. Our primary focus is on C^4 and ISR functional imperatives. A secondary focus is on the leadership and cultural environments in which Army C^4 and ISR transformation must occur.

Background – Army Transformation

To establish a common reader baseline, the following Army Transformation principles are provided:

- The environment in which the Army will operate has fundamentally changed.
- The Army's mission of defending our nation, values and ideals will not change.
- Army Transformation is integral to and aligned with Department of Defense (DoD) Transformation.
- The Army clearly understands that it will operate as a key and integrated member of a joint, combined and interagency team, each member of which possesses fundamental capabilities upon which all will rely.
- Army Transformation trades off near-absolute combat systems overmatch based on "inches of armor" to achieve the qualities of rapid deployability, responsiveness and agility.
- The Objective Force ensures mission success and force survivability by achieving dominant battlespace awareness—an awareness of self, enemy and battlespace that is unprecedented and near perfect.

Dominant Battlespace Awareness is critically dependent on the ability to create, manage, and present expert knowledge to commanders at every echelon from the foxhole to the White House. Shared battlespace awareness enables superior understanding leading to precise and decisive actions.

Commander's Understanding

The essential precursor for Objective Force operational success is the commander's perfect or near perfect understanding of the battlespace. However, achieving perfect or near perfect understanding is extremely difficult. So we must ensure that in every case the commander's understanding of the battlespace is superior to the opponent's so that he[3] can make better and faster decisions, or understand first and act first. Admiral Chris Barrie, Chief of Defence Force, Australia, states:

> It has always been the case that the commander or manager making the better tactical and strategic decisions will triumph in the long run.[4]

Figure 1, *Achieving Commander's Understanding,* illustrates the contribution of data, information and knowledge to achieving commander's understanding. The basic element of the chain is data, which can be envisioned as an individual dot. Each dot is important to build the true picture. Some are more critical than others, but dots provide little or no meaning. Connecting multiple dots begins to paint a picture or provide information, the second step on our hierarchy of understanding. Information begins to answer the questions "What is it?" and "What do we know?" Knowledge is the interpretation of the picture that results from connecting the dots. Knowledge gets to the answer of "What it all means." For ISR, knowledge is expressed in terms of the opponent's capabilities, vulnerabilities and intentions. It is both anticipatory and predictive to allow the commander to operate inside the opponent's decision cycle, that is, to take action before the opponent can react. The commander receives and interprets available knowledge based upon his training, skills and

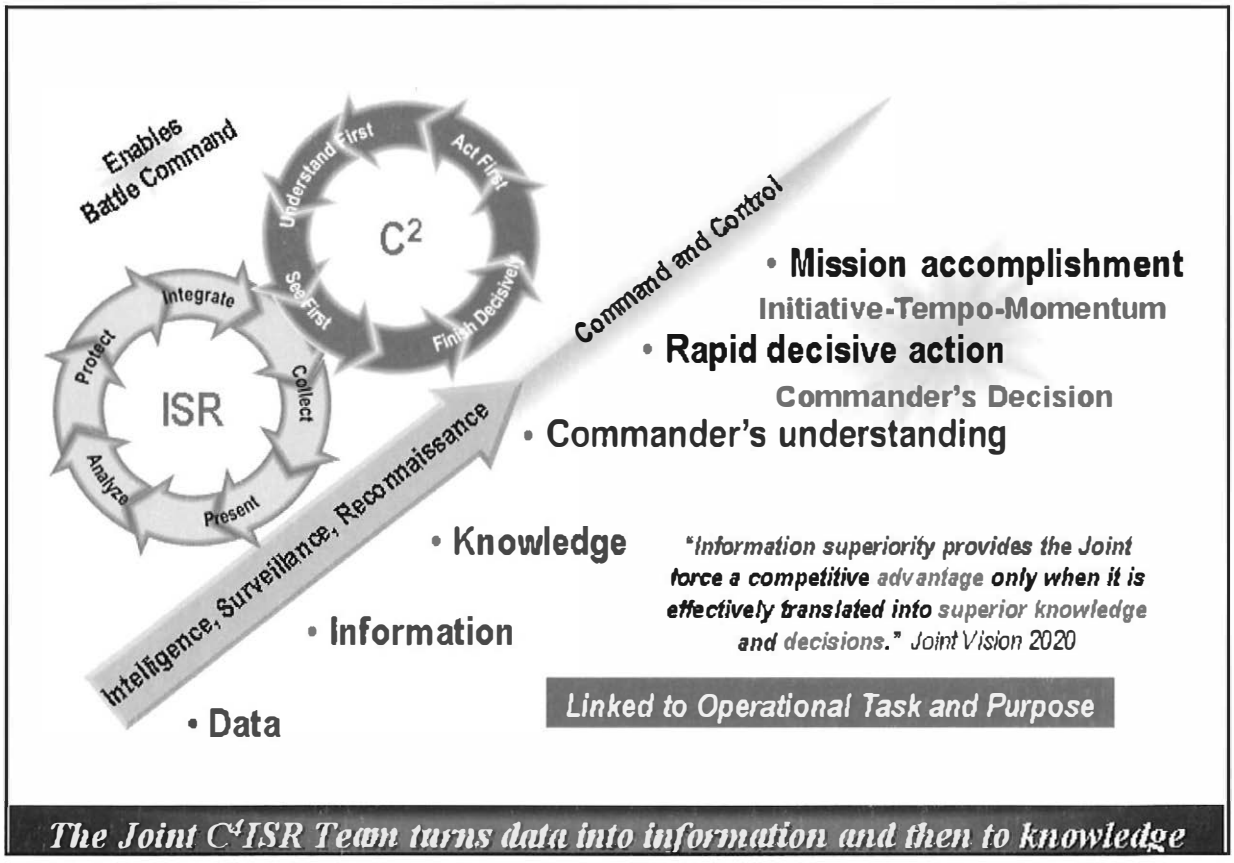

Fig. 1. Achieving Commander's Understanding

experience to achieve understanding. From this understanding, the commander makes decisions. The goal is to provide timely, accurate, complete and relevant knowledge rather than vast quantities of data and incomplete information. The objective is to speed and improve the commander's understanding and decisionmaking. The result is faster and better decisions. The endstate is an enemy that is always reacting to us.**The Whole is Greater Than the Sum of Its Parts**

To achieve this capability we must address the roles of technology and humans. On one side are the technocrats who are fascinated by the speed with which data and information can be moved from node to node. They laud the concepts of machine-to-machine exchange and the consistent handling of data. On the other side are the humanists who focus on the need to know what it all means and stress the limitations of machines to infer. This is the classic question of "art or science?" We are committed to focusing on how technology and humans complement each other. We seek the optimum balance.

Warfare is a human endeavor. Humans initiate conflicts and define successful outcomes. They devise campaign strategies and plans, define the rules of acceptable behavior and, most important, suffer the physical, psychological and emotional consequences of war. And, because humans are involved, there is inevitably a degree of unpredictability in war. There is no certainty that a commander will perform in a given manner when faced with a particular situation. And while it is possible to develop a profile for a specific commander, it is the commander's ability to skillfully perform the unexpected that often separates the great commander from the pack. So human analysis must play the prominent role in confirming what the opponent is doing now, predicting what he will do next, and anticipating what will follow. It is a human developing and understanding of the actions of humans.

The preeminence of human analysis in the analytical process does not denigrate the importance of science and technology (S&T). Science and technology must also assist in reducing the uncertainty of military operations and can help to reduce the performance differential among commanders of different experience and skill levels. The rising tide of automated processes and artificial intelligence raises the performance potential of all commanders. We are in the midst of revolutionary developments in our abilities to sense the battlespace, see our opponent, and "know" the friendly-force situation in real and near-real time. A complementary revolution in our abilities to store, manipulate, move and manage data, information and knowledge holds out unlimited potential for real and near-real time awareness and understanding.

Over time, science will continue to push the enabling technologies to envelope and automate much of what humans do, but it will not automate understanding and it will not automate the initiation of rapid decisive action based on that understanding. Therefore, the critical decision is not whether "science" or "art," but how much science can ultimately be brought to the artistic endeavor of war or military engagement, and to what end? The whole is surely greater than the sum of the parts.

The Objective Force

Future military operations will be conducted in a fundamentally different and dynamically changing operational environment (OE). It is an environment characterized by the need for rapid response and preemption to dominate unstable situations. Qualities of speed, responsiveness, deployability, agility, lethality, sustainability, maintainability and full-spectrum capability are critical hallmarks of the Objective Force. Units of Action and Units of Employment will manifest a mastery of transitioning between conflict and humanitarian support as they seamlessly move up and down the spectrum of conflict. In a like manner, Units of Employment will often be required to conduct combat and support and stability operations simultaneously. Army Transformation is specifically

designed to address the changed circumstances of this new OE. As the Army Chief of Staff (CSA) notes:

> Army Objective Force units will dominate land operations, providing the decisive complement to air, sea and space operations. They will create synergy within the Joint Task Forces by controlling the ground, where people and political authorities reside, and by defeating our opponents in their protective sanctuaries or forcing them into the open where they can be destroyed with joint fires. The psychological effects produced by the power and precision of Objective Force units will serve to deter hostile acts, both prior to deployment and during the stability phases of operations. The presence of Objective Force leaders and Soldiers, disposed across the battlespace yet operationally integrated through an information network, provides the Joint Force Commander situational dominance in applying lethal and non-lethal effects with unprecedented precision across the spectrum of military operations.[5]

Army Transformation changes the force from a discipline-specific, stovepiped, platform-centric organization designed for the linear fight to a network-centric, knowledge-enabled force optimized for full-spectrum operations. The Objective Force is fully integrated vertically and horizontally with joint and coalition forces, and with interagency teams. This will allow unfettered movement of large and, most important, relevant volumes of data, information and knowledge between the commander's critical decision nodes. The clear purpose of the knowledge support schemata is to enable commanders to achieve dominant battlespace understanding as a precondition for rapid, decisive action. It will enable Objective Force Commanders to

See First, Understand First, Act First, and Finish Decisively.

Decision Superiority and Knowledge Management are important concepts for achieving Objective Force capabilities. These terms are used throughout this paper, and while in common usage, they are not commonly understood. It is important that the reader understand what they mean, within the context of this paper. This is key to understanding the roles of C^4 and ISR in Army Transformation.

What is Decision Superiority?

Decision superiority is the commander's ability to (1) make better and faster decisions than an opponent based on a superior understanding of the battlespace and (2) clearly and rapidly communicate those decisions. The results are faster, more precise and more consistent mission execution; the ability to operate inside the opponent's decision cycle; the ability to control the operating tempo; and the ability to aggressively seize the initiative. Success almost invariably goes to the force manifesting such characteristics.

The commander's search for decision superiority is not something new. In the past, a commander might have employed a marginally superior information network, but most often success was determined solely by the skill of a commander and his staff to extrapolate the situation from a limited amount of information of dubious quality. The new dynamic is the underlying technology that significantly increases the probability that any commander, not just a Napoleon or Patton, can achieve dominant battlespace understanding and execute decisive action. The exponential increase in our ability to effectively handle data, project knowledge, and improve the commander's understanding levels the playing field. The technological revolution mitigates the intuition gap between the gifted and less talented commanders at all levels. But commanders must still apply their training, judgment, experience and intuition to the decisionmaking process. So war will remain a human endeavor. Science will assist significantly, but the human will understand, decide and act.

Operationally relevant knowledge can be broken down into three categories:

- Knowledge of Self: Friendly forces knowledge to include allies and other members of future coalitions across all domains (ground, sea, air, space, information, cyber and others), i.e., BLUE or PURPLE KNOWLEDGE;
- Knowledge of Opponent: Knowledge of opposition or enemy forces across all domains (ground, sea, air, space, information, cyber and others), i.e., RED KNOWLEDGE; and
- Knowledge of the Battlespace: Knowledge of the characteristics of the battlespace (environmental, geographical, weather, culture, populations, etc.), referred to as GRAY KNOWLEDGE.

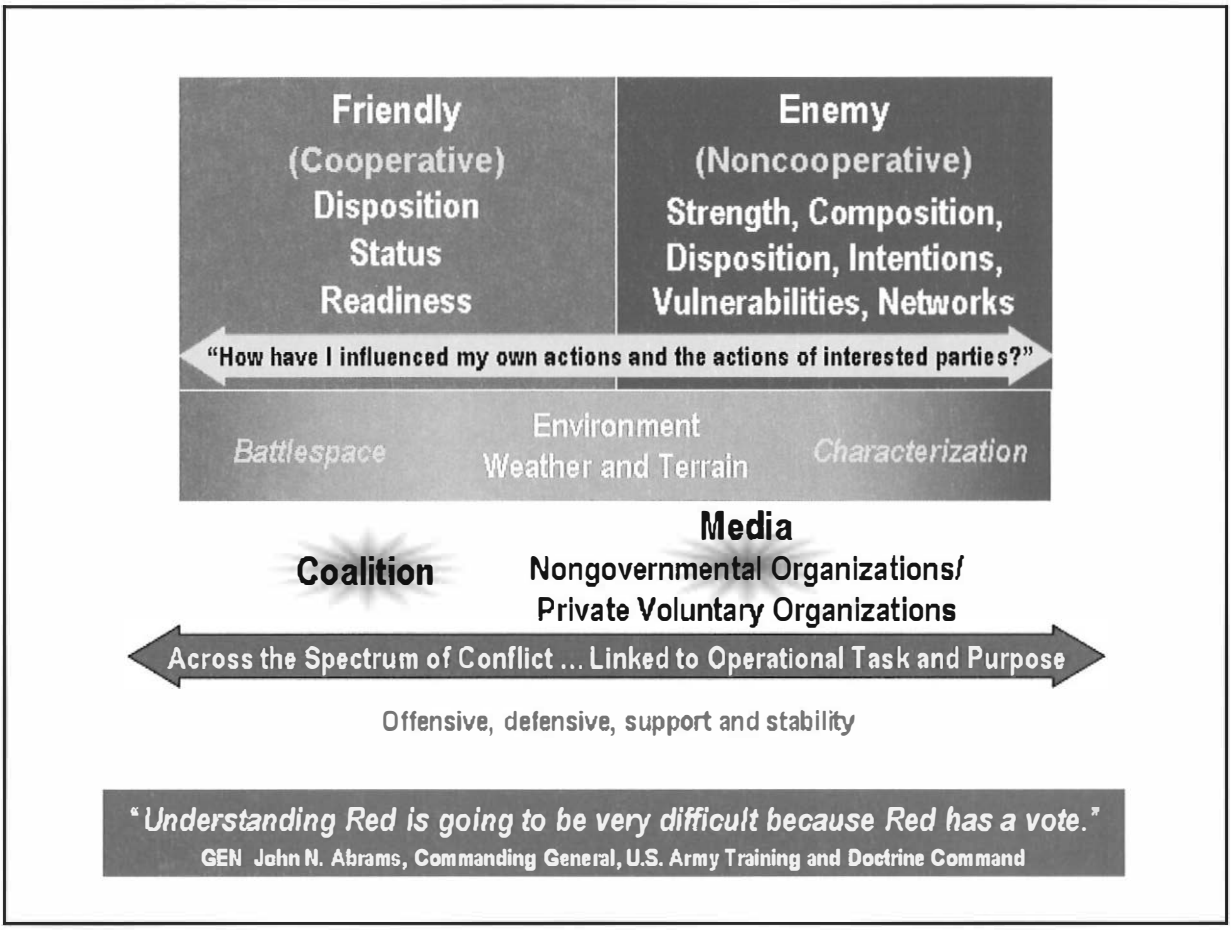

Fig. 2. Basics of Commander's Understanding

BLUE/PURPLE, or friendly forces data and information, are absolutely attainable. Admittedly, there are policy and technology challenges related to the generation, management and display of friendly data and information, but at the end of the day, Blue Forces information is attainable with increased clarity. In most cases, the information is gathered in a cooperative environment through active and passive means. In the future, much of the information will be generated automatically by sensing and reporting systems embedded in friendly-force systems. Since there is no intent to deny or deceive the recipient, the essential challenge is to gather information and present it to the decisionmaker in a timely, relevant, and easily understood manner. Analysis of this friendly data is important, but it is fundamentally analysis of what is already known and can therefore be largely automated.

Quite a different picture emerges when we look at the generation of data and information on an opposing force. RED information is obtained through sources and methods that include intelligence collection and production efforts[6] coincident to military operations, informants, expatriates, members of non-governmental organizations, academia and open-source information. It is normally gathered in a noncooperative environment. Our opponents understand our reliance on knowledge to enable rapid, decisive operations. They will consistently seek to deny and deceive our sensing and awareness capabilities while they concurrently work to gain the "battlespace understanding high ground." They will conduct asymmetric and asynchronous, counterintuitive operations to confuse and unbalance our awareness and understanding. The essential challenge for Army ISR, operating seamlessly with joint, national, coalition and interagency capabilities, is to overcome the enemy's actions to deny and deceive. Unlike collecting friendly data and information that can be passive or active, collection of information on opposing forces is virtually always active. You have to go and get what you need. To be confident that what you have gotten is truth, you must analyze, synthesize and fuse data and information within the context of what is known about the opponent's patterns of operation, what is happening, and, equally important, what is not happening. So "ground truth" for some of the opposing force may never be precisely known. That is why the trained analyst's expertise at confirming what is really occurring and anticipating what will happen next is so critical.

The Objective Force's requirement for precise environmental data and information, i.e., GRAY data, will be much more important in the future than in the past. Environment characterization is a much larger concept than just providing weather, terrain and geographical data. A sensing of its relevance to Objective Force operations is best captured when we consider the crucial importance of "geospatial information." For the Objective Force, geospatial information provides the common references in time and space on which the network-centric force relies for synchronization and fusion. Without this common reference, data transmitted from dispersed forces conducting distributed operations cannot be combined into a coherent Common Relevant Operating Picture (CROP) or "running estimate" of the battlespace. Without precise geospatial information, the use of geographically referenced precision munitions will be ineffective.

To conclude the discussion on knowledge generation, in theory it is assumed that, at the initiation of planning for deployment to a crisis situation, the level of knowledge for ourselves and our opponent is equal. Therefore, we are thought to be on a level "Decision Superiority" and knowledge playing field. In fact, most often we start at a disadvantage because until the tragedy of the 11 September 2001 attacks on the United States we rarely had to play a "home game," i.e., we have deployed to the opponent's area to accomplish our mission. So we have initiated planning for most conflicts with less than superior battlespace knowledge and have been required to quickly ramp up to achieve dominant understanding. Ideally this has been accomplished during the planning and predeployment phases. But on occasion we have entered the operational area with less than optimal understanding. This is a liability we can no longer afford. We cannot afford actual or near "cold starts." Elevation of the "knowledge condition" of our forces to an optimum operational level depends on both the human endeavor of intelligence analysis and technology. Technology and automation must help focus the analytic effort through the assimilation, correlation and presentation of data, pointing to patterns, etc. Modeling techniques such as assisted target recognition (ATR) are an example. Technology can also assist by sounding alarms when data and information achieve established benchmarks for quality and confidence gates. But rapid decisive action is fundamentally underpinned by "human in the loop" intelligence analysis. This is critical because it is one of the deciding factors in achieving the operational flexibility required to execute operations such as sensor-to-shooter, sensor-to-decider, and sensor-to-analyst.

Decision superiority is also vitally dependent upon the orderly handling of data. This is achieved today through common rules for handling federated databases such as setting common standards and

protocols that enable information sharing across systems, echelons, services, agencies and coalitions. In the past, establishing these rules and standards may have been sufficient to manage the data. For the Objective Force, the requirements for data and information management go beyond applying these rules. In the future, data management must consider not only the data, but also the syntax and behavior associated with that data. Objective Force-era data management tools and systems must allow us to "reason" beyond the syntax to understand the data within the context of the relevant domain. One way of achieving this is to develop a "belief system," i.e., a model that helps us determine when something is other than expected based upon confidence in the data and the data management system. Another way of achieving this is to insist that data or information have a semantical alignment such that when you enter "Gettysburg" into a query, you return with the battle in 1863 and not "Welcome to Gettysburg, South Dakota."

Yet another key element in the decision superiority concept is a robust communications capability that ensures unimpeded transmission of the data and information needed to present a dynamic, continuously updated "running estimate" of what is occurring throughout the battlespace. This capability encompasses not only the transport layer, but also the protocols for knowledge presentation at the point of decision. Huge challenges remain associated with seamless connectivity; self-healing systems; automatic fault detection and repair; dynamic bandwidth adjustment to meet any and all operational demands; and flexible presentation at the point of decision. The presentation scheme, energized by visionary challenges in the art of the possible, will drive technology to move beyond visualization to perceptualization, the multisensory approach to "presentation." Close integration of the knowledge generation, transport, manipulation and presentation capabilities with a robust modeling and simulation capability will optimally enable Objective Force operations. A feel for the possibilities of the art will drive the science. And all of this must be focused on committed commanders and their distinctive knowledge requirements. Operationally focused and relevant C^4 and ISR are the goals and should never be compromised to the "gee-whiz" nature of technology.

The final and most important factor is the commander. He will interpret the knowledge provided based upon his personal style of operations, previous experience, etc. For this reason, the presentation of knowledge becomes critically important and must be pursued as an art form vice a technical process that presents data in a uniform manner for all commanders, a "one-size-fits-all" approach.

What Is Knowledge Management?

We understand that knowledge, transport and presentation are essential elements of decision superiority. For our purposes we consider them constants, in the sense that to varying degrees they must always be there. The metrics for measuring their contribution to decision superiority are the availability, accuracy or data confidence, relevance and compatibility of the data or knowledge; the timeliness, capacity, assuredness and security of the transport layer; and the clarity and adaptability of the presentation. Management of these variables to achieve optimum capability is the principle task of knowledge management. Simply stated, for Army Transformation, knowledge management is getting the right knowledge to the right person at the right time, to enable rapid decisive operations and mission success. To achieve decision superiority, both content and transport count.

In the pursuit of knowledge, many managers have sunk billions of dollars into information technology ventures that have yielded marginal results, while others have sought to marginalize the contributions of computers by insisting their utility is diminished by their limited interpretive capability. To reiterate, achieving decision superiority mandates that we avoid focusing on the inherent tension between technology and human endeavor. Within the modern battlefield's C^4 and ISR constructs, the sheer volume of data dictates that automation is a necessity. And just as the speed and precision of decisionmaking is rewarded by profit in the business world, it is rewarded by

mission success and survival on the modern battlefield. We need to concentrate on the complementary nature of man and machine. What can reasonably be automated ought to be automated, thereby freeing our soldiers to realize their optimal contribution free of the data management and manipulation processes that have taken so much of their time in the past.

What is Our Plan of Action?

The Army's Transformation objective is to achieve a force that is strategically responsive and dominant at every point on the operational spectrum. The Army Transformation Campaign Plan (ATCP) is the Senior Leader management tool used to both implement the vision and assess progress toward meeting the specific benchmarks of Transformation. The C^4 and ISR Transformation objectives parallel the Army objective. The G-2 has developed a companion plan—the Army Intelligence Transformation Campaign Plan (AITCP)—to outline a vision and broadly coordinate and synchronize Army Intelligence transformational activities. The Army Chief Information Officer (CIO)/G-6 has done likewise with the Army Knowledge Management (AKM) Strategic Plan and its supporting Army Knowledge Enterprise (AKE) framework. Knowledge is a central focus of both the G-2 and CIO/G-6 plans.

Achieving the C^4 and ISR Transformation objectives calls for reengineering the processes currently used to manage knowledge. At its core, reengineering requires a fundamental rethinking and radical redesign of current business processes to bring about dramatic improvements in performance. It is not about making marginal improvements of what already exists. It mandates new ways of doing business. It requires not only changes in accepted processes, but also overcoming the organization culture that is often captured by an inertia resistant to change. In some cases it will require throwing away what is currently in place and starting over, beginning with a clean slate. At this point, we are not advocating that we throw away everything that has been accomplished over the past several years. For some time, the C^4 and ISR communities have been undergoing transformation, albeit under different names.[7] But, we acknowledge that we must be prepared to go to that extreme as we continue to explore and better understand requirements for the Objective Force.

Reengineering requires an orderly plan of attack. The first and most important aspect of that plan is leadership from the top. For C^4 and ISR, that leadership is in place. From a C^4 perspective, the Army CIO/G-6 is the Army's strategic change agent for implementing the Army Knowledge Management Vision, "A transformed Army, with agile capabilities and adaptive processes, powered by world class, network-centric access to knowledge, systems, and services, interoperable with the Joint environment." The AKM Strategic Plan establishes strategic goals, objectives, and milestones for transforming the Army from "islands of automation" into one "Army Knowledge Enterprise." From the perspective of intelligence, surveillance and reconnaissance, the G-2 is the Army ISR Integrator and is responsible for coordinating and integrating ISR capabilities across battlefield functional areas and within the joint, DoD and national communities. In coordination with the G-3,[8] CIO/G-6, G-8, Training and Doctrine Command (TRADOC), Information and Security Command (INSCOM), Network Enterprise Technology Command (NETCOM), Space and Missile Defense Command (SMDC), representatives of the Army Acquisition Community, and the national intelligence community, the G-2 is responsible for overseeing the implementation of a coherent "Space to Mud" ISR architecture.

A second element of the plan is the framework for evaluating where we are and where we must go. The Doctrine, Training, Leader Development, Organization, Materiel, Facilities and People (DTLOM-FP) framework is the template that guides our efforts. The ATCP and the complementary AITCP and AKM Strategic Plan provide the roadmap that guide and measure our progress. Within the ATCP, Lines of Operation[9] (LOs) have been identified that serve to focus attention on the broad areas of Army Transformation activity. The Army G-2 and CIO/G-6 serve as joint proponents for the

C^4ISR LO. Within the LO, the G-2 and CIO/G-6 have identified the major actions, decision points and events required to achieve C^4 and ISR Transformation. These actions have been coordinated and synchronized with major actions in each of the other LOs, and linkages and dependencies have been identified and are being tracked. All this has been accomplished in coordination with the larger ISR and C^4 communities, to include agencies at the national and joint levels. On a monthly basis, the G-2 and CIO/G-6 report on their progress to the Vice Chief of Staff of the Army (VCSA). The CSA receives monthly updates and chairs detailed quarterly reviews.

As an adjunct of these plans, the G-2 and CIO/G-6 have identified major imperatives for support to the Objective Force. These imperatives are complementary and point to the guiding principle mentioned before that the whole is greater than the sum of its parts. Additionally, many of these imperatives are common to both the C^4 and ISR communities.

Fig. 3. C^4 and ISR Imperatives for Enabling the Objective Force

As an example, of how this process works, the Army Transformation Campaign Plan establishes the requirement for the Objective Force to be able to deploy a Unit of Action (UA) in 96 hours after liftoff, a division in 120 hours, and five divisions in 30 days anywhere in the world. Upon arrival in the area of operations, that initial UA must be capable of transitioning immediately into combat operations, i.e., "fight off the ramp." To achieve this, the UA must have a thorough understanding of the operational environment prior to departure and must be continually updated while en route. There are several critical capabilities required to make this happen.

From an ISR perspective, it is critical that we posture ourselves so that there are "no cold starts." This mandates that we anticipate requirements and become directly involved in the identification of the commander's critical and priority intelligence requirements (CCIR/PIR). As the crisis begins to develop, we must be able to form a team of intelligence professionals focused on the tasks at hand. This will require us to link experts and form collaborative teams to identify and acquire existing data, information and knowledge to support the commander's planning process. After this initial

foundation knowledge is provided for planning, the follow-on tasks are to (1) identify knowledge gaps, which results in the identification of anticipatory collection and production requirements, and (2) provide refined answers to the unit's requirement for more specific knowledge as the planning process matures and the questions become more detailed. From an ISR perspective, the key is anticipating future intelligence requirements. In support of this effort, ISR soldiers are involved in information source identification, collection management, and production management. This will require the synchronization of national and joint assets to support anticipatory and predictive analysis. These functions must all occur before the unit is deployed. Once the deployment phase begins, the ISR community provides real-time updates while the unit is en route, projecting knowledge in synchronization with the operation and supporting the commander's deliberate planning process through modeling and simulation for decisionmaking and mission rehearsals. Within the ISR community, a second challenge is recommending a tailored force package of expert personnel and, as required, special purpose equipment for forward support. The objective is to reduce the ISR footprint forward. Integral to this planning process must be the links to enable "reach and project" operations.

From a C^4 perspective, achieving a network-centric, knowledge-based, enterprise architecture is essential. The Army will achieve this by merging Legacy, Interim, and Objective Force C^4 architectures to one Army Knowledge Enterprise Architecture (AKEA) as the Army's extension of the DoD Global Information Grid Architecture. The AKEA is the blueprint for reducing the deployed C^4 footprint and creating ubiquitous access to knowledge, systems, and services. For the ISR community, as a major customer of the Army's information infrastructures, C^4 is critical. The fundamental ISR requirements include assured communications, range extension, communications-on-the-move, multilevel security, timeliness, interoperability, information assurance, and bandwidth-intensive communications. Without a robust, assured and secure information infrastructure, the goal of a seamless integrated ISR "Space to Mud" system is not achievable. Transformed Army ISR is a knowledge-projection force that relies on a robust transport layer to enable reach and project operations.

"Where are we today?" We are not currently organized, trained and equipped to consistently and systematically perform these functions. Today, support to contingency operations often requires Herculean efforts on the part of our soldiers. Fortunately, that is the strength of our Army. While we succeed, there is not a deliberate process based on a DTLOM-FP approach to function in this manner.

Today we do not have an enterprise-level infostructure in place that will allow highly mobile commanders to reach to the knowledge centers where the relevant information resides. Similarly, we do not have the policies and procedures in place to support virtual teaming between commanders and subject matter experts. Granted, the Army has made it work, but it has been accomplished ad hoc, which sub-optimizes the tremendous capabilities within the larger C^4 and ISR communities.

Today, our infostructure is circuit-centric. We are trapped in an architecture of mostly point-to-point connections and limited broadcast services, principally restricted to line-of-sight. This is an inefficient use of bandwidth and results in prioritization based on periods of time rather than on need.

Today, we are not able to consistently bring together the results of intelligence, reconnaissance, and surveillance activities from across the Army and within the joint and national intelligence communities. ISR integration within the Army still remains a major challenge, and the challenge will get even larger with the proliferation of sensors on the battlefield, most of which will be embedded in combat vehicles or operated by combat arms soldiers.

"What will it take to achieve our objective?" For the Army to successfully implement knowledge management requires the attainment of several important factors:

- The development of Objective Force doctrine is the starting point. The C^4 and ISR communities have to be actively involved in development of concepts of operations, organizational structures, and tactics, techniques, and procedures (TTP) for the Objective Force. We need to take a leading role in the development of models and simulations that are used to validate Objective Force operational and organization constructs. We must ensure that full recognition is given to C^4 and ISR requirements in the preparation and planning phases of any contingency. We must ensure acknowledgement of C^4 and ISR contributions to shaping the battlespace.
- Our organizations and military occupational skills must be reviewed for applicability to Objective Force operational requirements.
- We need to improve the way we train our military and civilian workforces. We need to improve our ability to teach analysts "how to think" and "how to do" vice "what to think." For our civilian workforce, we need a professional education system similar to our officer and noncommissioned officer programs. We also need to develop certification requirements that are linked to advancement and levels of responsibility.
- We need to reassess our roles in national and joint organizations to determine which positions are critical to infusing Army equities into the normal operating procedures of those organizations.
- The infrastructure must be developed to accommodate faster processing capabilities and dissemination requirements.
- An easily accessible enterprise-wide system requires network-centric processes and services. Portal technology is the chosen means to achieve this capability.
- Information that leads to knowledge must be well organized and structured. This is typically accomplished through content management.
- Knowledge generation requires knowledge transfer. This means sharing knowledge across the enterprise using enabling techniques such as collaborative tools and expertise locators.
- We must develop and sustain an interdisciplinary workforce empowered to share knowledge across functions.

These are but a few examples of the initiatives that must be undertaken to achieve C^4 and ISR Transformation.

While changes in process are the fundamental achievement of C^4 and ISR reengineering and the way reengineering provides value added to the transformed Army, the process is of little or no interest to the commander. The commander is focused on the end result. This begs the question 'What is the value-added to the transformed force?"

- Blue Force commanders will have better definition of friendly locations and operational status than ever before. This will allow commanders to make more informed decisions on the employment of forces and will allow commanders to consistently take advantage of operational opportunities as they appear by employing the right force at the right time for the mission. This is the value-added for Blue Forces.
- Blue Force commanders will have better definition of enemy locations, operational capabilities, vulnerabilities and intentions than ever before. The consistent integration of ISR and non-ISR sensors across Army battlefield functional areas and with joint and national intelligence capabilities will provide persistent surveillance and situational understanding throughout all dimensions of the battlespace. This will allow commanders to identify operational opportunities and take decisive action against opposing forces' centers of gravity and vulnerabilities. This

includes operations across the spectrum of conflict, many of which necessitate the use of persuasion, assistance and diplomacy rather the instruments of lethality.

- Blue Force commanders will have a better understanding of all dimensions of their battlespace than ever before. This is more than geography, weather, and terrain. Battlespace characterization will include knowledge of non-opposing entities operating in the area, such as nongovernmental organizations (NGOs), private voluntary organizations (PVOs), minority groups, etc. Of major importance is the understanding that geospatial information will serve as the common reference for both Blue and Red data. It will support synchronization of all blue forces and is fundamental to shared views of the battlespace.

Summary and Conclusions

Army Transformation is all about transitioning from information-based to knowledge-based warfare to conduct effects-based operations. Systems overmatch based on inches of homogeneous steel and platform-centricity is giving way to network-centric, knowledge-based warfare and the ability to achieve decision superiority and take decisive action across the operational spectrum. In essence, the goal is to make better and faster decisions than the opponent.

C^4 and ISR are the enabling capabilities of knowledge-based warfare. They both represent a dynamic mix of human and automated capabilities. Each is pushing the technology envelope to automate as much as possible of their processes and procedures. However, the "art or science" argument has no merit in this discussion. Automation and technology—the science—are tools humans use to help conserve and focus energy. Computer systems design is an art. The construction of the computer may be a science, but it takes the skill of an artisan to oversee the process. Analysis—the central competency of Army ISR—is, and will remain, a human endeavor. Automation serves to free soldiers from time-consuming repetitive and administrative functions of data and information organization and cataloguing. Automation has already demonstrated its ability to support development of powerful tools to aid analysis but no tool is yet envisioned that can replace the judgment work of an analyst. Art and science, humans and technology, dynamically mixed and interdependent are the foundation for C^4 and ISR in the Objective Force.

Endnotes

[1] The term "commanders" is used throughout this paper to represent leaders in a decision-making position. In most cases the term "decisionmaker" could be substituted.

[2] Quoted from the Hindu scripture *Bhagavad-Gita* (circa 1785) in Stafford Beer, "May the Whole Earth Be Happy: Loka Samastat Sukhino Bhavantu – Lessons from Eastern philosophy for Western managers and Management Scientists," *Interfaces*, 24(4), July-August 1994.

[3] The masculine pronoun "he" is used throughout this paper. It is intended to represent both male and female commanders or decisionmakers.

[4] Admiral Chris Barrie, Chief of Defence Force, Australia, speaking to the Defence Information Management Seminar (DIMS) 2001. 28 June 2001.

[5] United States Army White Paper, *Concepts for the Objective Force,* November 2001, page iv.

[6] For purposes of this discussion, "production efforts" includes the activities of data correlation, fusion, analysis and synthesis. It results in intelligence reporting, predictive analysis, and anticipatory intelligence.

[7] For example, within the ISR community, the intelligence battlefield functional area has undergone several introspective looks to determine how best to restructure to better support the commander. These efforts have resulted in significant changes in the composition of units from a capabilities and size perspective. In the systems area, the number of intelligence systems will be reduced from a total of 19 in the early 1990s to a total of three for the Objective Force. For accuracy, some legacy intelligence systems such as Guardrail Common Sensor (GRCS) and Airborne Reconnaissance Low (ARL) will remain in the force after the first Unit of Action is formed. It is anticipated that all legacy systems will be out of the force by 2015.

[8] The G-3 is the Army's Senior Operations Officer. The G-8 is responsible for Army Programs, Analysis, and Force Development.

[9] "Lines of operation [the management structures for the ATCP] describe similar, closely related activities that link objectives in time and purpose. The lines of operation have been developed to focus responsibility for and cooperation between like activities. Objectives will be linked to one or several lines of operation; to the extent that an objective involves multiple lines of operation, increased coordination and synchronization will be required. Each line of operation has a designated MACOM [Major Army Command]or HQDA [Headquarters, Department of the Army] Staff Directorate as a Proponent, as well as an Army Secretariat Oversight. The TCP will have 12 lines of operations logically aligned with the three transformation axes and two lines of operations that support and are essential to the overall transformation effort." (*Army Transformation Campaign Plan*, 10 April 2001)