TRADOC Pamphlet 525-2-1

The United States Army Functional Concept for

See

2015-2024

Version 1.0

30 April 2007

Foreword

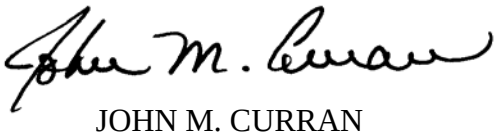
From the Director
U.S. Army Capabilities Integration Center

This concept provides amplification to the Army's capstone and operating concepts in the see functional area. It focuses on the acquisition of data, transformation of data into information and knowledge, and providing knowledge to the future Modular Force during the 2015-2024 timeframe. The concept describes how the continuous acquisition and analysis of data and information from Army, joint, interagency, multi-national, and non-traditional sources allows for an accurate understanding of complex operational environments. It also identifies required capabilities for the further examination of potential doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) solutions.

As this concept demonstrates, the Army has a well-developed body of ideas regarding how we can better support joint force commanders (JFCs) to conduct successful campaigns in the future. However, it is equally clear that the Army cannot achieve its conceptual goals for improvement without an array of capabilities that must be developed by other Services and the larger joint community, particularly in the areas of Battlespace Awareness and Joint Command and Control. I strongly encourage the use of the *See* concept in our interactions with other Services and joint organizations, in the spirit of joint interdependence.

This concept is the outcome of a collaborative effort involving subject matter experts from throughout the Army, and the product of a detailed study of strategic guidance, current doctrine, and lessons learned. It assumes a future that includes complex situational environments; thinking, adaptive, and highly-capable enemies; and Army operations that must be fully integrated into a joint, interagency, and multi-national framework. From these efforts, the concept offers new ideas for further examination so that the future Modular Force will be able to defeat any adversary or control any situation across the full range of military operations.

As with all concepts, the *See* concept is in continuous evolution. It will be refined and updated as new learning emerges from research, operational experience, joint and Army wargaming, experimentation, and combat development.



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Executive Summary

Introduction

a. United States Army Training and Doctrine Command Pamphlet 525-2-1, *The United States Army Functional Concept for See 2015 – 2024*, focuses on the contribution of acquiring data, exploiting data, transforming acquired data into information and knowledge, and providing that knowledge to the future Modular Force. The see function is the first and most fundamental component of the "Quality of Firsts." [1]

b. The requirement to "see first, understand first, act first, finish decisively, and re-engage at will"[2] depends on more than the ability of the commander to "see," and therefore, acquire data and information from the operational environment. It demands the ability to transform what is seen as useful information and knowledge/intelligence, and provide it in a form that permits commanders to combine the knowledge with their judgment and intuition to decide and act effectively.

Operational Problem

a. The projected operational environment of 2015-2024 is likely to be more complex than the one faced by U.S. forces today. U.S. military technical, organizational, and doctrinal advances will bring both improved capabilities and increased complexity. Economic, political, diplomatic, and social factors will influence tactical and operational actions to a far greater extent, and at lower organizational levels, than previously experienced. Potential enemies will adapt technologically, organizationally and doctrinally to offset perceived U.S. advantages, while taking advantage of their improved access to technology and information. The combined impact of more complex operations, environments and opponents will challenge commanders' ability to achieve situational understanding.

b. Precision strike requires precision knowledge of self, opponent and environment. Distributed and simultaneous operations demand the right knowledge at the right time, and comprehension of more aspects and surface area in the operational environment, rather than only the military aspects of designated objectives. Difficult environments and adaptive enemy operations dictate highly granular intelligence and may hinder anticipation of future events. Large amounts of intelligence and other types of information demand rapid and accurate processing, analysis, and distribution capacity.

Solution Synopsis

a. The *See* concept describes the acquisition and development of data, information, knowledge, and intelligence to facilitate the future Modular Force's decisionmaking and execution from the operational level to the lowest tactical levels. The force will have access to vast amounts of data and information relevant to the complex environments and problems it will face. Knowledge of friendly forces and the environment permits proper employment of all capabilities. Knowledge of the enemy or "intelligence," provides commanders the ability to plan and execute operations.

[1] TRADOC PAM 525-3-2, The United States Army Concept for Tactical Maneuver, p. ii, dated 2 October 2006.
[2] Ibid

b. Every aspect of future Modular Force operations will derive increased effectiveness through the ability to see and know, and from the ability to anticipate the following areas-

- Comprehensive knowledge of friendly force mission, location, activity, and capabilities. Tenets, such as speed, agility, and continuous operations depend on reliable, accurate, and timely self-knowledge.
- Integrated knowledge of the theater environment, such as terrain, weather, infrastructure, culture, demographics, and neutral entities. Understanding the environment in which the future Modular Force finds itself, in particular, understanding the perceptions of partners and the other human elements of the environment, is a key determinant of success.
- Detailed knowledge of the enemy's intelligence,[3] that provides insights into their capabilities, organization, and intentions. In many operating environments, intelligence collection analysis will lead future Modular Force operations, as the enemy's location, structure, and methods of operation will be completely unknown and knowledge must be fought for. The future Modular Force will employ integrated and continuous surveillance and reconnaissance, and produce knowledge using all available joint, interagency, and multi-national (JIM) resources, across all echelons and domains.[4]

Key Ideas. The future Modular Force is knowledge-based and will progressively and continuously assign meaning to data, information, and knowledge across the cognitive hierarchy-

- *Acquire*. The future Modular Force will obtain data about itself, the environment, and the enemy in order to support development of relevant information, knowledge and ultimately, support understanding.
- *Transform*. The future Modular Force will convert vast amounts of data into knowledge, which the force can employ operationally. The fusion and analysis needed to accomplish this is the most important element of the see function and the most difficult.
- *Provide*. In order for decisionmakers and other users, for example, staffs and cells to employ knowledge, the future Modular Force will present data, information, and knowledge at the right time and place, in the right form.
- Data *Exploitation.*[5] The data available to the future Modular Force will be too extensive and varied for humans alone to find and organize. This is particularly true when dealing with situations where analysis of a greater amount of raw data covering a much wider number of subjects is required; environmental clutter is much higher, and enemy observables are more ambiguous. To cope with this, the future Modular Force will employ data exploitation to create conditions for analysts to find and use data more effectively.

[3] The See Function is not the Intelligence Warfighting Function. While among the most critical warfighting functions, intelligence is one of several categories of knowledge contributing to situational awareness and understanding. In the context of this concept, intelligence constitutes one of the three elements of awareness and understanding - *knowledge of the enemy* in an operationally and environmentally relevant context.
[4] TRADOC PAM 525-3-2 (Tactical Maneuver for the future Modular Force) delineates three domains - physical, human, and informational.
[5] The extraction of implicit, previously unknown, and potentially useful knowledge from data, and includes not only the actual extraction of data (data mining), but the preparation of data, and the assessment and optimization of the data preparation and mining processes.

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Military Operations

THE UNITED STATES ARMY FUNCTIONAL CONCEPT FOR SEE 2015–2024

History. This publication is a new United States Army Training and Doctrine Command (TRADOC) Pamphlet developed as part of the Army Concept Strategy for the future Modular Force.

Summary. TRADOC Pamphlet (Pam) 525-2-1, *The United States Army Functional Concept for See 2015-2024*, is the overarching visualization of how the Army future Modular Force will acquire, transform, provide and exploit data, information, intelligence and knowledge within joint operations in the period 2015-2024 to achieve decision superiority across the range of military operations. The ideas presented here are fully integrated within the evolving contest of the future operating environment, joint and Army strategic guidance, and the joint framework.

Applicability. This pamphlet applies to all TRADOC, Department of the Army (DA) services, agencies, and activities involved in the future Modular Force. It functions as the conceptual basis for developing required solution sets related to the future Modular Force see functions within the domains of doctrine, organizations, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) requirements.

Proponent and exception authority. The proponent of this pamphlet is the TRADOC Headquarters, Director, Army Capabilities Integration Center (ARCIC). The proponent has the authority to approve exceptions or waivers to this pamphlet that are consistent with controlling law and regulations.

Suggested improvements. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commander, TRADOC (ATFC-ED), Fort Monroe, VA 23651-1046. Suggested improvements may also be submitted using DA Form 1045 (Army Ideas for Excellence Program Proposal).

Distribution. This publication is only available on the TRADOC Homepage at http://www.tradoc.army.mil/tpubs/pamndx.htm.

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Chapter 1
Introduction

1-1. Purpose

The purpose of this concept is to describe how the future Modular Force will acquire and generate knowledge of itself, its opponents, and the operating environment. Developing knowledge of the operating environment is essential to a knowledge-based, net-enabled force capable of seeing first, understanding first, acting first, and finishing decisively.

1-2. Scope

a. The *See* concept focuses on data acquisition, transformation of data into information, intelligence, and knowledge, providing knowledge, information and data, and the exploitation of extremely large data sets across the joint, interagency, and multi-national (JIM) team. The *See* concept is not synonymous with any warfighting function, but rather describes how the future Modular Force develops knowledge about the environment, friendly forces, and the enemy as the foundation for the command tasks of understanding and decisionmaking.

b. The *See* concept is integral to every aspect of military operations, every level of organization and activity, and is crucial to success in every phase of operation. Although major combat operations demand accurate and rapid intelligence, other environments and opponents may be still more challenging. Irregular warfare demands greater quantities of detailed data, usually resulting in a higher level of analytical effort to produce actionable intelligence. Catastrophic attack may be more difficult to predict and indicators more ambiguous. Stability operations and peacetime engagement often demand a high level of knowledge of the environment for force protection and cultural interaction.

c. For the purposes of this concept, *data* is the lowest level of information on the cognitive hierarchy and consists of unprocessed signals or sensings from the environment. *Information* is data that has been processed to provide further meaning. *Knowledge* is information analyzed to provide meaning with respect to implications for the operation. Finally, *understanding* is knowledge that has been synthesized and judgment applied to it in a specific situation to comprehend the situation's inner relationships per (FM 6-0). Understanding in military operations is typically exercised in the decisionmaking function. Although individual data is transformed into understanding using this process, in practice it is iterative and non-linear.

1-3. Conceptual Foundation

a. The *See* concept is one of six functional concepts, that describe in more detail how the future Modular Force will achieve the tenets outlined in the Army capstone, operational maneuver, and tactical maneuver concepts. The *See* concept is also inexorably interrelated with the functional concepts of *Battle Command, Strike*, *Sustain*, *Protect*, and *Move*. The *See* concept underpins each of the five functional concepts, which depend on a significantly improved ability to understand the future Modular Force, the enemy and the environment, and share knowledge in near real-time.

b. This concept is closely related to the joint functional concept of *Battlespace Awareness*, which includes joint collection and sharing of joint data, information and knowledge.

c. Army Transformation Roadmaps. The Army Transformation Roadmaps assist in areas applicable to the *See* concept. This concept articulates fundamental aspects of seeing and understanding the operational environment required for future Modular Force brigades, divisions, and corps. Seeing and knowing on the battlefield will include a wide variety of capabilities, for example, the distributed common ground system-Army.

d. The concept can assist in describing potential Army contributions to Department of Defense's (DOD) emerging concepts and experimentation programs.

e. The ability to "see" and "know" is the basis for commander to form situational understanding that underpins the Army's *Battle Command* concept. To achieve the vision of information and decision superiority over future opponents, the future Modular Force must possess the following attributes-

- Near-real-time visualization in the common operational picture (COP) and an embedded ability to conduct mission rehearsal en route.
- Rapid, collaborative decisionmaking support.
- Accurate and timely adversary and environmental information including precise geo-location, rapid understanding of environmental constraints, and cultural knowledge; all of which will be integrated through analysis conducted with reliable network access, data sharing, and collaboration.
- Synchronized intelligence, surveillance, and reconnaissance (ISR) to reduce unnecessary redundancy, expedite operational decisions, maximize coverage, and facilitate situational awareness and understanding.
- Exploitation at all levels of the constellation of military and civilian space capabilities that support surveillance, reconnaissance, communications, positioning, navigation, weather, and missile defense.

1-4. Limitations

a. There are numerous factors that may limit the future Modular Force's ability to access and exploit knowledge in the future. No matter what technical advances are made in acquiring data and displaying the situation, units in contact with the enemy and environment will continue to have the best "ground truth" understanding of the situation. Commanders and staff not present forward will lack the intuitive or tacit appreciation of the situation useful in decisionmaking.

b. The availability of an accessible network for all future Modular Forces may be a limiting factor. Regardless of design, the same battlefield friction and chaos that impact other capabilities will influence the future Modular Force network. This may occur as a result of the operating environment, error, system failures, or deliberate enemy action. Based on the situation and physical limitations, it is probable that not all levels of network tools, processes, and capability will be adequate for all uses and users at all times, and will demand the same level of prioritization and synchronization as forces, fires, and logistics do today.

c. Information sharing protocols, laws, and policies will regulate, and at times prevent, data and information sharing between agencies, organizations, and nations thereby reducing, to some degree, knowledge development. Essential classified and sensitive information may preclude effective sharing with lower tactical formations, other agencies, and coalition partners. Although the design and implementation of this and other concepts will account for these constraints, some limitations are inevitable.

d. The large number of points where fusion and analysis take place on the battlefield, from individual Soldiers and Future Combat Systems (FCS) vehicles to the multiple headquarters, will lead to multiple, conflicting interpretations of the data and information. While there is an advantage of developing alternative views for consideration, it may complicate achieving a common view of the enemy or environment.

e. Joint and interagency dependencies increase effectiveness, but can introduce risk if nodes or links suffer disruption. For example, cooperative employment of ISR or full-spectrum protection are critical elements in joint concepts, and their disruption will create vulnerabilities to the force as a whole. Also, adversaries will almost always find niche capabilities that mitigate joint force (JF) technological advantages.

f. The complete use of data, information, and knowledge will be limited to what commanders and other individuals are capable of employing, based on cognitive, temporal, and organizational limitations.

Chapter 2
The Joint Operational Environment

2-1. Overview

a. Emerging cultural, religious, ethnic, political, and economic realities will greatly complicate the future geopolitical environment (see fig 2-1). The resulting mix of global strategic, operational, and tactical issues transcends borders and involves opponents with worldwide connections that will present a demanding combination of challenges and dilemmas for the U.S. Security challenges will be more varied and unpredictable and the range of operational settings within the spectrum of conflict considerably more complex, driving an expectation that U.S. military assistance in civil support operations and stability operations will continue to rise. The future Modular Force will encounter unprecedented complexities in physical terrain (especially urban areas), demographics, and informational environments. The allegiances of many entities within the operational environment will be difficult to determine. While some of those entities may clearly be neutral, others will be “gray” opposing certain U.S. efforts while supporting others. Strategic deployments to areas of conflict will involve long logistical trails and the need to operate in regions with poor infrastructures. U.S. resources could be extended beyond the historic bounds of the task, and the range of military operations in those settings will be much wider than in the recent past.

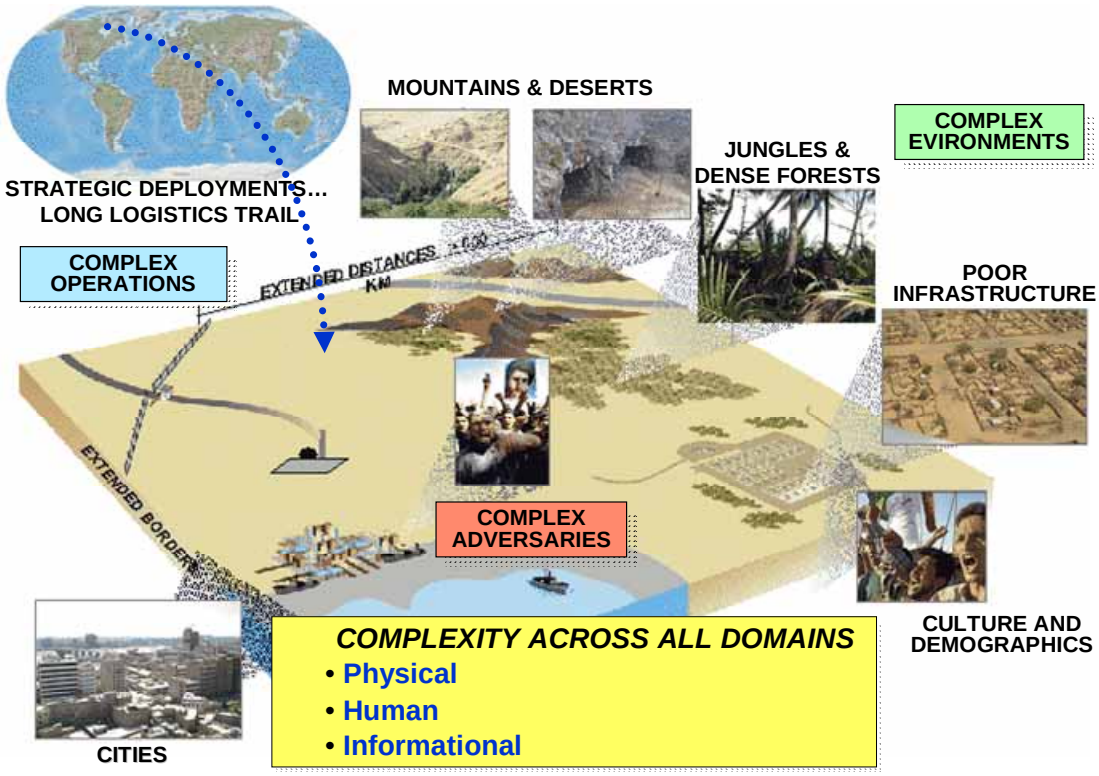

Figure 2-1. The Joint Operational Environment

b. The National Defense Strategy[6] and the Capstone Concept for Joint Operations (CCJO) postulate four primary security challenges for the future: traditional, irregular, catastrophic, and disruptive. *Traditional* (conventional) operations conducted within a state-on-state framework will continue to be relevant in the future environment. Regional aggressors will continue to modernize conventional forces and invest in capabilities that will enable them to dominate their neighbors. *Irregular* (unconventional) warfare may be conducted as the principle choice of adversaries who are overmatched in size or military technologies, or these kinds of operations may be combined with conventional capabilities to present an even more complex threat. *Catastrophic* challenges involve the acquisition, possession, and use of weapons of mass destruction. Adversaries seek such capabilities to dominate their regions, deter external intervention, or both. *Disruptive* challenges may occur through the employment of breakthrough technologies to negate existing U.S. advantages in key operational domains.

c. The most dangerous future adversary would be one that combines capabilities in all four challenges in creative ways, adapting them before and during the course of a conflict to frustrate U.S. military action. Opponents will attempt to use these capabilities to exploit perceived vulnerabilities, especially our dependence on networked command and ISR. Opponents will also attack America's relationships with host and supporting nations, the media, commercial interests, and multi-national or interagency partners. U.S. development of the intellectual capital that will power a culture of innovation and adaptability potentially represents the most effective response to combinations of threats that cannot be predicted.

[6] The National Defense Strategy of the United States, March 2005.

d. Additionally, the future Modular Force will face increasing complexity in its own operations. Given the expectations outlined above, strategic and joint guidance unequivocally establishes full spectrum dominance, the defeat of any adversary or control of any situation across the full range of military operations, as the overarching goal of joint transformation and JF development. Thus, it is imperative that the future JF and the Army are fully prepared to be effective across the spectrum of conflict and in the conduct of full spectrum operations throughout the course of a future campaign. The future Modular Force will fight as a part of a networked JF, integrated at every level, and interdependent in the joint areas of battle command, force projection, air and missile defense, sustainment, and fires.

e. Exploiting the full potential of tomorrow's technical capabilities will require an unprecedented breadth and depth of technical and tactical skill, individual and organizational flexibility, and personal initiative and creativity pitted against thinking, adapting adversaries. Speed, simultaneity, distribution, and the ability to conduct multidimensional operations over extended distances will be mandatory to gain the initiative and allow for ultimate success. As future adversaries gain additional capabilities to directly threaten U.S. territory, U.S. military forces will become increasingly involved in homeland security in addition to executing challenging missions abroad. The future Modular Force must also fully integrate its operations with its interagency and multi-national partners, exploiting the strengths that those partners provide, while minimizing any limitations and vulnerabilities.

2-2. Future Modular Force Operational Complexity

a. Future Force and joint operating concepts will result in greater military capability, but will also add complexity in its ability to see and understand more interactions through collaboration, more capabilities available for employment, higher levels of autonomy and distribution, higher tempo for deciding and acting, and a greater range of assigned missions to the same force[7] (see fig 2-2).

[7]See also discussion in Army's Capstone Concept, chap 2, "Implications of the Future Strategic Context" and CCJO, sec 4(e), "Characteristics of the Joint Force."

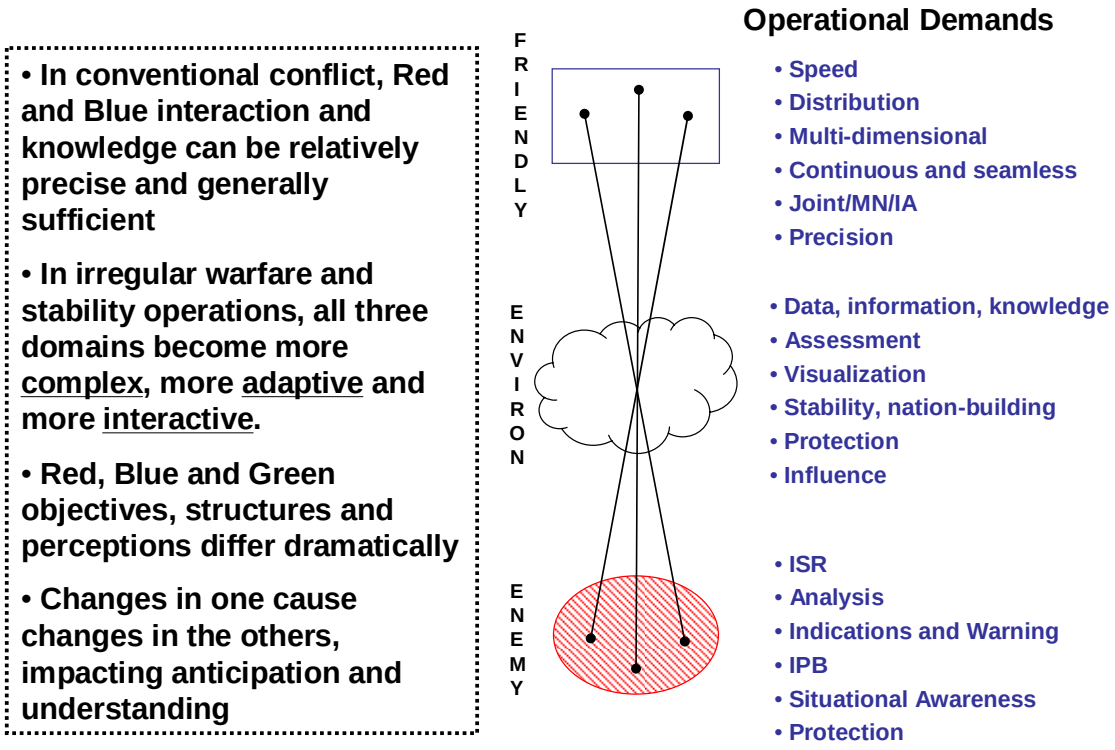

Figure 2-2. Complexity in the Future Operational Environment

b. The challenges posed by the overall operating environment include those described below.

(1) *Tempo.* High operating tempo requires knowledge acquired, transformed, provided, and exploited at a much faster pace than today's force is capable of. Intelligence, environmental knowledge, and self-knowledge must be available to future Modular Force commanders rapidly, accurately, and with nearly complete assurance to enable them to understand and act more quickly. The future Modular Force acquisition and processing capabilities must have the endurance for multiple rotations and be able to respond to ever-changing operating environments. Operations should be based on the commander's operational design, rather than by limitations in knowledge development.

(2) *Distributed operations.* Distribution will have the effect of increasing the amount and type of knowledge needed to accomplish the mission; a larger number of future Modular Force elements with differing missions; a greater variety of environments; and more and varied intelligence requirements. The knowledge must be local, specific, and actionable in order to support distributed operations.

(3) *Simultaneous operations.* Simultaneity complicates the ability of the commander and the organization to comprehend the entire operational environment. Acquisition and transformation of data, information and knowledge no longer lend themselves to sequencing and

prioritization for efficiency. Each echelon and organization will require unique data, information and knowledge at the same time in order to succeed.

(4) *Homeland Security*. While future Modular Forces are engaged in forward deployed locations, the conflict may take place on multiple fronts, including U.S. forward bases and in the homeland. Impacts will be multiple, ranging from degrading needed capabilities to creating informational or psychological effects. For example, much of the data acquisition and transformation will be coordinated from within the U.S. Attacking those facilities will not only disrupt transformation activities, but will cause the U.S. to divert leadership attention, security forces, and intelligence activities to prevent further attacks.

(5) *Multidimensionality*. Similar to the challenge presented by simultaneity, future Modular Force operations will orchestrate a much wider set of capabilities across all domains of conflict, all requiring specific and often difficult-to-acquire knowledge. This expands the breadth of domains commanders must understand, and the number of decisions they must make.

(6) *Joint, Interagency, and Multi-national Operations*. As a part of a larger networked team, the future Modular Force must plan and execute in complete concert with other services, nations, and agencies. As each element of the force collaboratively accomplishes critical joint and coalition missions, rapid teaming and self-synchronized operations will require a more complete understanding of the operational environment.

(7) *Concurrent, Seamless Operations*. The future Modular Force must be capable of developing knowledge both sequentially and simultaneously, without pausing for transitions.

(8) *Precision*. Precision effects demand accurate and near-instantaneous knowledge of friendly forces and highly granular intelligence about the opponent and environment. The increased knowledge requirements place enormous demands on the future Modular Force's ability to acquire, transform, and provide geospatial intelligence.

(9) *Net-enabled Knowledge Proliferation and Human Comprehension*. The future Modular Force will acquire enormous amounts of data, information, intelligence, and knowledge from both organic and networked sources. One of the key challenges will be to use this information rapidly and fully to solve complex problems in all three domains. Collaborative planning, cooperative employment of capabilities, and rapid joint, multi-national and interagency teaming will all introduce significantly greater and more varied information into future Modular Force organizations. While technology will assist in data processing and fusion, intelligence analysis, in particular, will remain a human cognitive function, subject to the same time and comprehension limitations we have today.

2-3. Environmental Complexity

a. The future environment will be more complex than the one today, based on population changes, changing geographic and political centers of threat environments, increased mobility, global connectivity, and evolving technological advances leveraged by potential opponents.

b. Urban and complex terrain. Opponents will continually seek complex terrain, such as urban or mountainous, to protect their organizations and capabilities, while increasing the risk to U.S. forces. In these environments, the opportunity for tactical surprise rises, increasing the need for detailed and rapidly transformed intelligence and other knowledge. The level of "clutter;" unrelated, confusing observables in the environment, will make collection of enemy signatures, and the identification of enemy elements and activities, difficult, and opponents will exploit these limitations.

c. Austerity. The future Modular Force will often contend with poor or non-existent infrastructure, placing a premium on knowledge of the environment. And with limited or disrupted information infrastructure to take advantage of, the future Modular Force will often be required to operate in a degraded mode until Army and Joint information enablers, such as communications, networks, are in place.

d. Human Dimension and Culture. As opponents employ adaptive tactics, the population will often become the battle ground, with success and failure determined primary by the popular perception of security and stability rather than metrics of military aspects of the campaign. In these situations, victory for either side of the conflict will hinge on maintaining or restoring security, garnering the support of the population, and stabilizing infrastructure and institutions. Understanding the population, language, culture, and physical environment of the theater of operations will convey a significant operational advantage.

e. Information Age Challenges. The operating environment will be characterized by global information transparency and near-instantaneous knowledge of actions in theater. The impact will range from near-instant public and political reaction to events, to security risks to U.S. forces, adversaries, and often the local population. Both the means; for example, satellite use and internet access; and the message, propaganda, proselytizing, and deception; will bring greater international presence and impact into every conflict.

f. Globalization. Globalization will broaden the impact of interests and actions. What in the past might have been a local or regional issue, will increasingly become regional and global. Similarly, the more rapid movement of resources, humans, and ideas across borders and boundaries will shape and re-shape conflicts as they occur.

2-4. Adversary Complexity

a. Asymmetries of Organization and Operation. Our adversaries are less defined by traditional capabilities and organizations, adding to the challenges faced by our forces. The U.S. will most often possess a technology advantage over opponents. Adversaries, however, will organize and operate in ways designed to avoid these future Modular Force strengths and take advantage of any identified weaknesses.

(1) *Strategic Organization: State, Trans- and Non-state Entities*. Adversaries will often work in combination with a variety of partners joined by shared interests, for example, criminal organizations, terror groups, and third-party nations. In many cases there will be a complex and

sometimes conflicting set of enemy objectives, tactics, and capabilities, and the connections between elements will often remain difficult to discern.

(2) *Operational/Tactical Organization*. Adversaries may operate in a highly distributed fashion, and use a wide variety of tactics available to shield themselves from detection, identification and interdiction; this includes, using cellular structures under local command, blending with or shielding themselves among civilians, and exploiting protected structures.

(3) *Tactics/Doctrine*

(a) Opponents will often adopt asynchronous[8] and asymmetric tactics, techniques and organizations in order to counter U.S. conventional capabilities. The future Modular Force will face enemy intentions and operations that are more difficult to detect, understand, and with which to deal. And as opponents continuously adapt, knowledge will become more perishable, increasing the amount of collection and the level of effort for analysis. Threat functions such as command and sustainment will be low-signature to avoid detection, and operations will disguise intent and location until as close as possible to the moment of execution. Opponents will seek engagement ranges, times, and locations where terrain and weather conditions least favor employment of future Modular Force sensors and strike capabilities, thus creating the opportunity for tactical surprise, and deflecting future Modular Force advantages in standoff and precision fires.

(b) Adversary operations will often focus on the future Modular Force itself, avoiding a more predictable and exploitable terrain-orientation, and often relying instead on both asymmetric and asynchronous operations. Adversaries will choose when and where to strike without the need for holding ground and achieving decision, or varying the frequency and patterns of activities to keep U.S. forces at high states of readiness and induce exhaustion or carelessness. The enemy will often organize in autonomous or loosely-related elements with widely varying degrees of training and standards for operating, all of which will make patterns and behaviors far more difficult to discern or predict.

(4) *Combined Traditional, Irregular, Disruptive, Catastrophic Approaches*. Opponents will combine the widest possible variety of approaches to counter and defeat future Modular Force tactical advantages. These approaches include combining conventional, paramilitary, terrorist and criminal actions; use of globally acquired technologies that counters key U.S. capabilities; and catastrophic attack, such as using weapons of mass destruction against the U.S. homeland.

b. Access to Knowledge. Opponents will be able to access a large amount of information through their own means, third-parties, non-state entities, and commercial information systems. This access will include knowledge of U.S. forces employment, organization and capabilities; knowledge of the environment, ranging from weather predictions to U.S. popular opinion; and even knowledge of their own forces. These trends will threaten the future Modular Force's presumed informational advantages while creating opportunities for tactical, operational, and strategic surprise.

[8] Not operating at the same time as, or having the same tempo or phasing as U.S. forces.

c. Access to Technology, Systems and Capabilities. Opponents will no longer require advanced industrial capacity or high-technology infrastructure, and often not even the direct financial resources, to acquire and field sophisticated weapons and systems. The future Modular Force will often face adversaries who can compete in specialized areas of technology. Many capabilities will come from third-party states and non-state actors, making anticipation of their use difficult or impossible. Opponents will harden communications through arms market and commercial encryption access, low-probability-of-intercept means, satellite capabilities, fiber optics, and courier operations in order to reduce the effectiveness of U.S. technical collection means. Opponents will employ deception means, such as radar absorbing and reflecting materials, obscurants, and decoys with electro-magnetic, acoustic and thermal signatures to hinder multi-disciplined intelligence collection. Low-signature weapons will neutralize friendly detection capabilities, while systems, such as hyper-kinetic or thermobaric weapons, employed at close range or remotely from shielded positions will attempt to defeat the future Modular Force active protection.

2-5. Joint Organization

a. The ability of the future Modular Force to "see" itself, the operating environment, and the enemy is not only a critical Army enabler, but a joint requirement as well. All JFs will rely on DOD satellite communications architectures to meet bandwidth requirements. Ground forces interact more closely with the operating environment and adversary, than other elements of the JF, providing the JFC a unique ability to gather and develop intelligence on the enemy and provide knowledge of the environment. At the same time, ground forces have unique information requirements; friendly force tracking must function at the individual level, requiring reliable knowledge of tens or hundreds of thousands of entities on a timely and continuous basis. Ground forces have far more complex interactions with the environment in terms of terrain, population, and culture. Opponents in the ground environment will often be asymmetrically organized and highly distributed, seeking to avoid detection and multiplying the demands on the intelligence system. Neither centralization, nor decentralization of data acquisition or analysis will solve the challenges of operating in the ground environment.

b. The future Modular Force will require a combination of approaches, and full integration with JIM capabilities to be fully effective. Data acquisition will be a blend of organic and shared resources; transformation of data and information, through analysis will occur both separately and collaboratively between echelons; and all elements of the force will be able to share data, information, and knowledge, allowing the future modular force and JF to take full advantage of all acquisition and transformation efforts.

Chapter 3
The Central Idea

3-1. Overview

This concept focuses on the contribution of acquiring, exploiting, and transforming data into information and knowledge, and subsequently, providing that knowledge to the future Modular Force. The see function is the first and most fundamental component of the "Quality of Firsts." The requirement to "see first, understand first, act first, finish decisively, and re-engage at will"

depends on more than the ability of the commander to "see" or obtain information about the operational environment. It also demands the ability to translate what is seen and intuitively understand the operational environment in order to decide and act effectively.

3-2. Operational Problem

a. The projected operational environment of 2015-2024 is likely to be more complex than the one faced by U.S. forces today. U.S. military technical, organizational, and doctrinal advances will bring both improved capabilities and increased complexity. Economic, political, diplomatic, and social factors will influence tactical and operational actions to a far greater extent, and at lower organizational levels, than previously experienced. Potential enemies will adapt technologically, organizationally, and doctrinally to offset U.S. capabilities, while taking advantage of their own access to technology and information.

b. The combined impact of more complex operations, environments, and opponents will challenge the commanders' ability to achieve situational understanding. Precision strike demands precision knowledge of self, opponent, and environment. Distributed and simultaneous operations demand the right knowledge at the right time, and comprehension of more aspects and surface area in the operational environment, rather than only the military aspects of designated objectives. Difficult environments and adaptive enemy operations dictate highly granular intelligence and may hinder anticipation of future events. Large amounts of intelligence and other types of information demand rapid and accurate processing, analysis, and distribution capacity.

3-3. Solution Synopsis

a. The *See* concept describes the acquisition and development of data, information, knowledge, and intelligence to facilitate the future Modular Force's decisionmaking and execution from the operational level to the lowest tactical levels. The force will have access to vast amounts of data and information relevant to the complex environments and problems it will face. Knowledge of friendly forces and the environment permits proper employment of all capabilities. Knowledge of the enemy "intelligence" provides commanders the ability to plan and execute operations. Every aspect of future Modular Force operations will derive increased effectiveness through the ability to "see" and "know," and from that the ability to anticipate, in the following areas-

- Comprehensive knowledge of friendly force mission, location, activity, and capabilities, based both on both reporting and the commanders' personal presence in the operational environment. Tenets, such as speed, agility, and continuous operations depend on reliable, accurate, and timely self-knowledge.
- Integrated knowledge of the theater environment, for example, terrain, weather, infrastructure, culture, demographics, and neutral entities. Understanding the environment in which the future Modular Force finds itself, in particular, the human element of the environment is one of the key determinants of success.

- Detailed knowledge of the enemy or "intelligence,[9]" provides insights into their capabilities, organization, and intentions. In many operating environments, intelligence collection and analysis will lead future Modular Force operations, as the enemy's location, structure, and methods of operation will be completely unknown and knowledge must be sought. The future Modular Force will employ integrated and continuous employment of surveillance and reconnaissance to produce knowledge using all available JIM resources, across all echelons and domains.[10]

b. Key Ideas. The future Modular Force is knowledge-based and will progressively and continuously assign meaning to data, information, and knowledge across the cognitive hierarchy, focused on the discrete knowledge requirements that support rapid and accurate decisionmaking-

- *Acquire*. The future Modular Force will obtain data about itself, the environment, and the enemy in order to support development of relevant information, knowledge and ultimately, support understanding.
- *Transform*. The future Modular Force will convert vast amounts of data into knowledge that the force can employ operationally. The fusion and analysis needed to accomplish this is the most important element of the see function, and the most difficult.
- *Provide*. In order for decisionmakers and other users, for example, staffs and cells, to employ knowledge the future Modular Force will present data, information, and knowledge at the right time and place, and in the right form.
- *Data Exploitation*. The data available to the future Modular Force will be too extensive and varied for humans alone to find and organize. This is particularly true when dealing with a great amount of raw data, covering a wide number of subjects; environmental clutter is high and enemy observables are more ambiguous. To cope with this, the future Modular Force will employ data exploitation to create conditions for analysts to find and use data more effectively.

[9] The See Function is not the Intelligence Warfighting Function. While among the most critical warfighting functions, intelligence is one of several categories of knowledge contributing to situational awareness and understanding. In the context of this concept, intelligence constitutes one of the three elements of awareness and understanding, *knowledge of the enemy* in an operationally and environmentally relevant context.
[10] TRADOC PAM 525-3-2 (Tactical Maneuver for the future Modular Force) delineates three domains: physical, human, and informational.

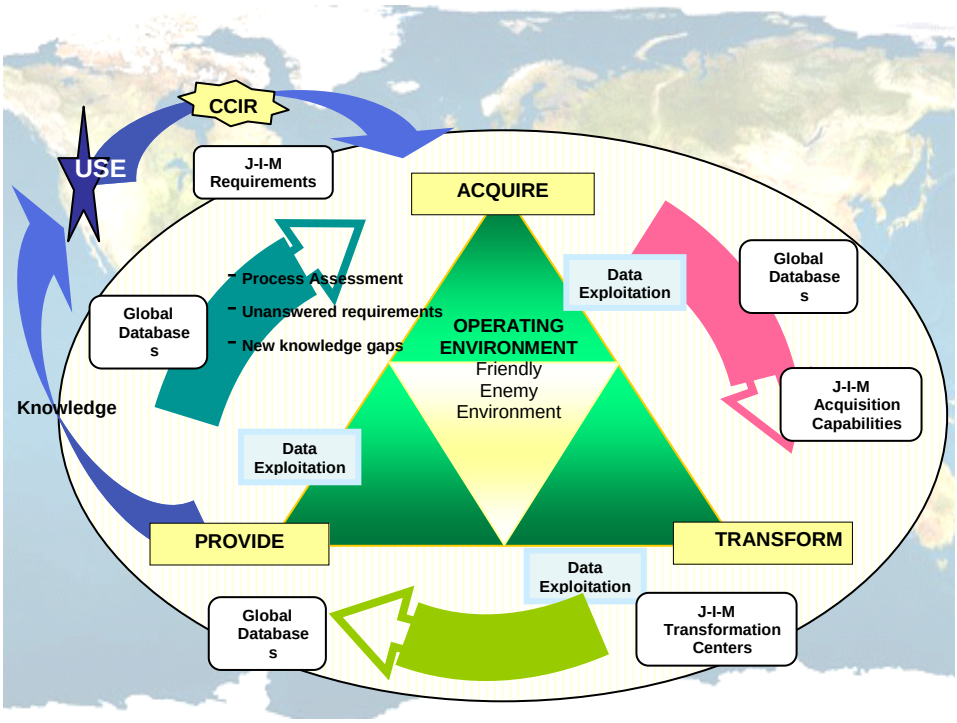

Figure 3-1. The See Process

c. Applications by Modular Force. The future Modular Force will access and contribute to a wide range of data, information, and knowledge, from all echelons and elements of the joint, multi-national and interagency capabilities, as well as non-traditional sources, such as academia and industry. Data and information will be processed and compared continuously against existing knowledge to provide tailored knowledge for each user's requirements. Most significantly, the commander's critical information requirements (CCIR)[11] will be the primary driver of the see process by setting detailed enemy, friendly, and environmental knowledge requirements needed to facilitate effective decisionmaking (see fig 3-1).

(1) Whether developed through focused acquisition, such as ISR collection to satisfy a stated requirement, or through connecting disparate data elements to develop new information, only the application of human cognition[12] can develop knowledge from data and information by providing interpretation, context, and operational relevance. The cognitive hierarchy (see fig 3-2) represents the progressive synthesis of data and information into knowledge, and from knowledge into awareness and understanding. Data is the lowest level of fusion on the hierarchy, while understanding is the highest level. While terms, such as "data" and "information" may seem to imply a technical approach, it will be humans and their organizations that conduct the preponderance of acquisition and transformation. Similarly understanding, the ultimate result of knowledge development, is purely a human endeavor.[13]

[11] Elements of information required by commanders that directly affect decisionmaking and dictate the successful execution of military operations. (FM 3-0) (Marine Corps) Information regarding the enemy and friendly activities, and the environment identified by the commander are critical to maintaining situational awareness, planning future activities, and facilitating timely decisionmaking.
[12] Cognition is the act of learning from and integrating information.
[13] FMI 2-19.1, paragraph 3-34.

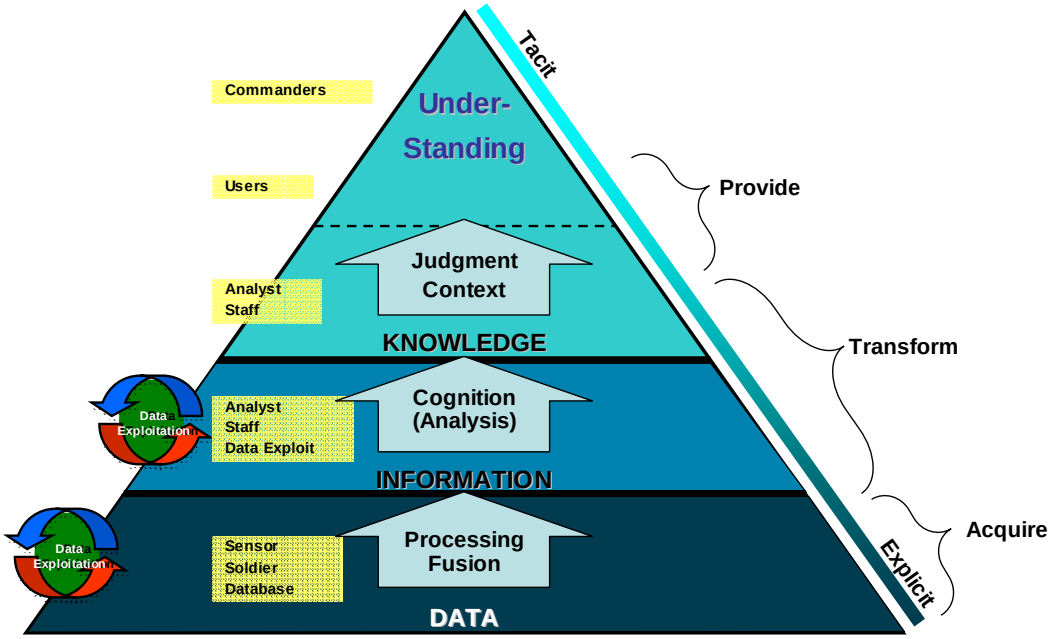

Figure 3-2. See and the Cognitive Hierarchy

(2) The sum of all this knowledge; knowledge of friendly forces, the environment, and accurate and timely intelligence on the enemy, tailored to user's requirements, provides *situational awareness*. Situational awareness is the result of combining knowledge of the mission-specific situation and accurate assessments of near-term future friendly, enemy, and environmental states. One of the challenges of the future Modular Force will be reconciling "ground truth" of units in contact with contextual data and information compiled at higher levels of command. This fusion takes place largely in the person of the commander, who has the data and information, "explicit knowledge," represented in the COP, but also the intuitive, experience-based feel, "tacit knowledge"[14] for the situation. The commander translates the combined knowledge of the present situation from various areas of expertise with their judgment and decisionmaking skill into situational understanding.[15]

[14] Tacit knowledge is knowledge that is implied or inferred, and is not generally understood by all. Explicit information and knowledge are facts and actions that can be described and captured (electronically or otherwise) for use by others. For example, the location of a unit in relation to the terrain is explicit information. That the unit has the needed morale and skill to defend the terrain may be tacit knowledge. Commanders apply both explicit and tacit knowledge to achieve situational understanding. (Rand Study: Collecting the Dots - Problem Formulation and Solution Elements, Martin C. Libicki, Shari Lawrence Pfleeger, OP-103-Reserve Component, January 2004).

[15] There is a difference between situational awareness and situational understanding. Situational understanding is more than knowledge of the factors of METT-TC. It includes understanding the present relationships among them and forecasting them into the future. (FM 5-0.1)

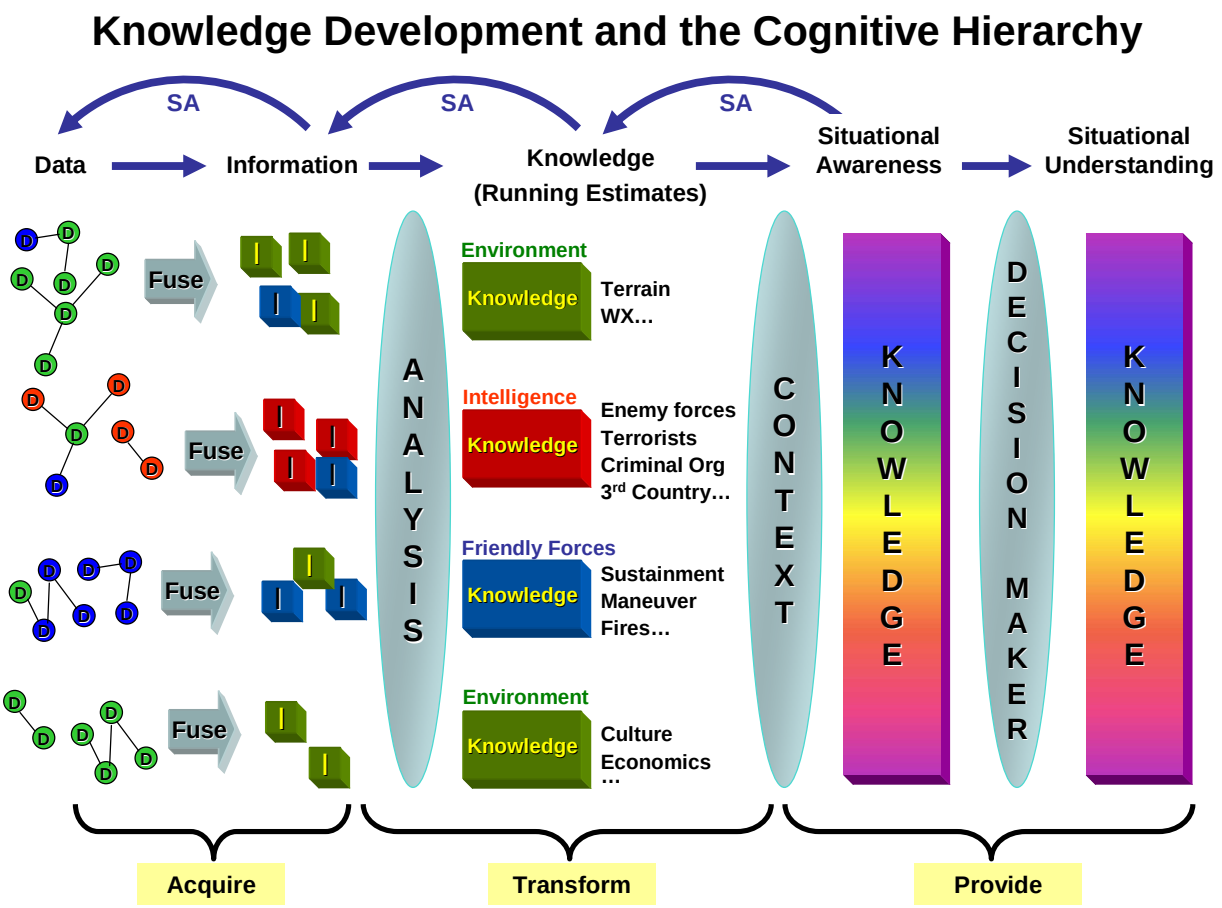

Figure 3-3. The Knowledge Development Process

(3) Although this process is presented in steps (see fig 3-3), in practice it is recursive, with constant feedback of data, information, and knowledge from one step to another. For example, analysts and staffs use situational awareness as the start point for acquiring new data, and commanders adjust their CCIR as the situation or decision criteria change. As the enemy and the JF continuously contend for the advantage in the knowledge domain, the future Modular Force must be capable of meeting its knowledge requirements with degraded technical capabilities.

d. The future Modular Force will plan knowledge requirements for decisions that can be anticipated, as well as the flexibility to answer unexpected requirements arising from operations. Commanders plan against likely courses of action, relationships and linkages, and use the results to drive data acquisition priorities. The future Modular Force must account for unexpected requirements, specifically those resulting from operations or developments as the force fights specifically for knowledge.

(1) Commanders anticipate potential decisions and develop information requirements to be answered as decision criteria in the form of CCIR. Analysts and staff produce information and knowledge designed to answer stated requirements and use estimates to fill information gaps

and to forecast future conditions, while directing further acquisition efforts as needed. Technological advancement will significantly improve the ability of the future Modular Force to acquire and transform data and information based on deliberate planning, specific questions driving specific answers, but this process alone will not meet all of the force's needs.

(2) Many future Modular Force requirements will be unforeseen, arising from the execution of operations or from more generalized collection that in turn help produce more definitive requirements. Distributed forces most directly in contact with the enemy and environment will drive larger numbers of dynamic, unique, and localized knowledge requirements, while the proximity to an unpredictable enemy will demand highly detailed, immediate knowledge that may not be relatable to CCIR. The future Modular Force will often conduct operations for the sole purpose of gathering intelligence, including reconnaissance; raids; enemy network exploitation; operations intended to stimulate enemy responses; and data exploitation. The force must be capable of supporting execution-based requirements where time, resources, and the expertise needed to formulate requirements, collect data, and analyze information are more limited.

(3) To address the competing and simultaneous knowledge demands on the force as a whole, the future Modular Force must have-

- Comprehensive knowledge of friendly force mission, location, activity, and capabilities, thoroughly supported by automated aides.
- The commander's intuition, based not only on judgment and experience, but on his presence where units are in contact.
- Detailed knowledge of the theater environment, for example, terrain, weather, infrastructure, culture, influencers, key government or tribal leaders, and nonhostile entities.
- Detailed intelligence (knowledge of adversaries), using integrated and persistent ISR to provide awareness, assessment, and anticipation.
- Exploitation of all available data, information, and knowledge that provide the capability to deal with vast amounts of data, understand more ambiguous targets, and conduct successful system-of-systems analysis.[16]
- At the lowest organizational levels, the future Modular Force must have the ability to: access data; develop knowledge requirements in near-real-time; employ reconnaissance, organic sensors and analytical capabilities; and share a common operational picture laterally and vertically.
- Constructive challenging of friendly, environmental, and enemy estimates through techniques, such as red teaming, seeking alternatives views and identifying errors in fact and assumptions, and other analytical faults.

e. While the requirement for commanders to understand their operating environment has not changed over the history of warfare, evolving elements of the future operational environment,

[16]System-of-systems analysis does not constitute a new form of acquiring, transforming or providing knowledge, but is rather is one way that data, information and knowledge can be used. System-of-systems analysis is one of elements used to develop a range of options for JF employment. It is designed to integrate knowledge of multiple aspects of the enemy into one view. (JWFC Doctrine Pam 3, 16 June 2003)

such as precision, distribution and high tempo, coupled with adversarial and environmental challenges, will significantly elevate complexity for commanders and their organizations. Commanders in the future Modular Force must understand the situation with sufficient clarity and speed to decide and act effectively. The ability to do so better than one's opponent is the essence of decision superiority. The knowledge development process must assist commanders in-

- Shortening their decision cycle when required.
- Improving the accuracy of their estimates and forecasts.
- Sharing information and knowledge more rapidly and universally.
- Expanding the scope of their understanding to encompass culture, economics, politics, and social structure as required by the situation.
- Avoiding many of the errors in human cognition by the use of rigorous analytical techniques in red teaming.
- Questioning assumptions through the application of experience and tacit knowledge.

f. Acquire. The future Modular Force will acquire data from organic and non-organic sources, including collaborative and cooperative access from and contribution to joint, interagency, and when possible, coalition databases. Acquiring consists of actions to *gather*, *collect*, and *fuse* data using ground, air, and space-based capabilities. *Gathering* is the non-competitive acquisition of data and information, normally relating to information about friendly forces, the environment, and some facets of the enemy. Gathering can include most elements of open-source intelligence (OSINT), but also comprises access to military, public, and government databases; terrain and infrastructure data; friendly forces information; weather; some imagery; subject matter expertise; field research; and other techniques for acquiring information. *Collecting* is the focused and competitive acquisition of data and information, normally engaged against the enemy, as well as some aspects of the environment, and includes in some cases friendly forces.

(1) There are important implications in the distinction between *collection* and *gathering* (see fig 3-4). Collection is fought for, constituting an operation against the enemy in both the physical and information domains. Reconnaissance and surveillance involve directed action against the enemy for the purpose of collecting intelligence, and units at every level of command must have the capacity to contend for knowledge against the enemy. In uncertain situations, the force will frequently conduct maneuver for the sole purpose of intelligence collection.

(2) Gathering is generally uncontested by the subject, and primarily involves readily available data, although subject to friction in terms of misunderstandings, human behavior, and the complexity of interactions in the environment. The data, information, and knowledge resulting from collection involve greater levels of “fog;” limited certainty and the requirement to employ more human analysis. Much of the data gathered in support of the future Modular Force, (for example, friendly forces information, economic and cultural data, terrain, and some elements of enemy information), has a much higher confidence level, and requires less human intervention and analysis. Collected data will normally have a lower level of assurance than gathered data, consequently requiring more analysis. Gathering will tend to require less reassessment.

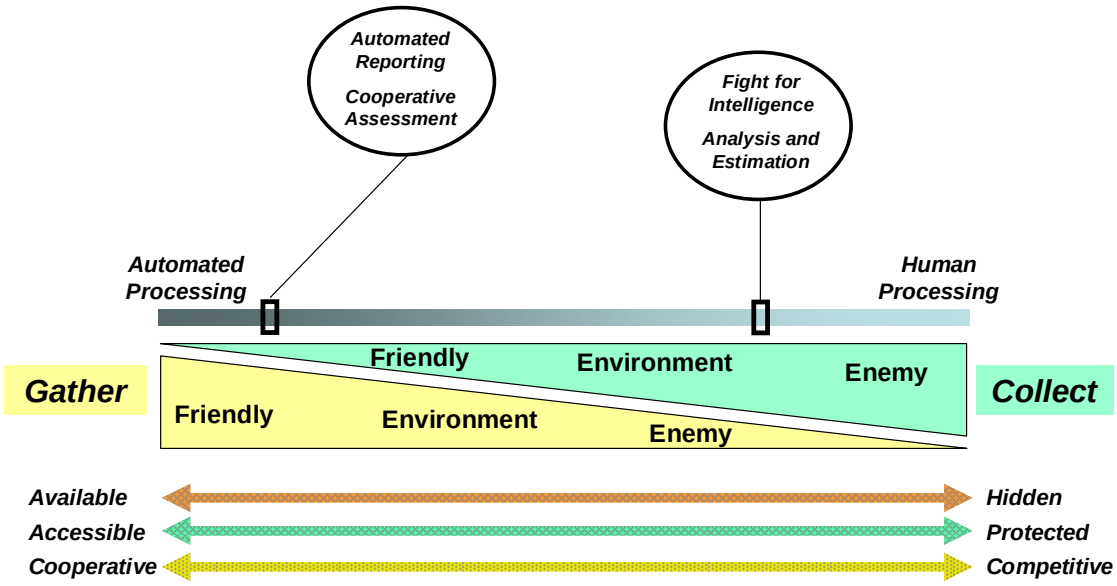

Figure 3-4. Gathering versus Collecting

(3) As technology improves, the gap between collection and gathering will widen. Asymmetric opponents, countering technologies, and complex environments will tend to make collected data increasingly more ambiguous, while gathered data will lend itself to automation, with smaller requirements for human involvement. The net effect will likely be more processes, operations, and leader attention dedicated to collection, and less human effort spent on tracking and assessing things like the location and activities of subordinate elements, JFs, and coalition partners.

g. Transform. The future Modular Force will continuously fuse data and analyze information, employing the steps of *access*, *fusing*, *analysis*, and *assessment* to accomplish the transformation into knowledge. A critical product of transformation is the prediction of future states, conditions and behaviors that serves as the basis for planning and executing future Modular Force operations. While technology can and must assist the processes of acquiring and transforming data and information, human cognition will remain the most important facet of knowledge development, including the use of a red team to assist in developing accurate predictions of future states, conditions, and behaviors.

h. Provide. The results of acquisition and transformation are provided as timely, geospatially precise, accurate, assured, and tailored knowledge to the commander and other leaders for decisionmaking, force application, movement, protection, and sustainment. The process of providing data, information, and knowledge must be both effective and efficient to enable decisionmaking and execution. Providing data, information, and knowledge consists of transporting, providing access, using access, combining, and delivering.

i. Data Exploitation. As the future Modular Force produces data, information, and knowledge, they compare them to other data across the entire network through *data exploitation.* Data exploitation extracts previously unknown and potentially useful knowledge from

exceptionally large data sets, as well as, performing the functions of preparing data, and assessing and optimizing the exploitation processes. For example, data exploitation encompasses developing data standards, structuring databases, tagging data, and developing data architectures, as well as using modeling, lessons learned, measures of performance, and measures of effectiveness to detect and correct data exploitation shortfalls. The use of databases and the development of patterns and linkages are not new analytical tools, but the combination of *improved processing capability*, *networks*, and *data mining technologies* will radically advance data exploration, pattern development and analysis, and discovery of links and relationships normally hidden in vast quantities of data scattered throughout multiple, global databases.

(1) One of the key elements of data exploitation is data mining.[17] Data mining does not *conduct* analysis, but rather assists analysts in finding, managing, and making fuller use of data. It goes well beyond standard methods of submitting queries within databases by fully exploiting databases and by recursively finding linkages and patterns in large data sets. The future Modular Force will be able to link data it planned and executed collection against, and to find and employ a far wider variety and amount of data throughout the network. While most often associated with developing adversary information, data mining can also provide much greater depth to friendly forces information and contribute significantly to understanding environmental factors, such as economics, infrastructure, culture, and religion. For example, logistics analysts will be able to find and connect a variety of factors, such as unit demands and future missions, raw material supplies, industrial forecasts, materiel movements, and weather patterns across interdependent supply chains to assess the likelihood of sustainment issues.

(2) Analysts will employ data exploitation to improve their ability to acquire and transform relevant data and information, as well as, discern data patterns and potential relationships, and make more sense of information, events, and behaviors. The ability to employ intelligent and focused data mining will present significant training challenges to commanders, staffs and even analysts, but achievement of the capability will dramatically advance the development of knowledge.

Chapter 4
Future Modular Force See Concept in the Joint Campaign

4-1. Introduction
The JFC, employing defeat mechanisms, will seek to defeat the enemy as rapidly as possible to achieve early decision. While the enemy may avoid decision across the entire campaign through various strategic designs, the use of engagements and battles in concert with nonlethal effects can offer the JF the ability to decisively defeat the enemy at the tactical and often operational level.

[17] Derived from Data and Analysis Center for Software (A DOD Information Analysis Center) "The non-trivial extraction of implicit, previously unknown, and potentially useful knowledge from data. Another definition is data mining is a variety of techniques used to identify nuggets of information or decisionmaking knowledge in bodies of data, and extracting these in such a way, that they can be put to use in areas, such as, decision support, prediction, forecasting, and estimation. The data is often voluminous, but, as it stands, of low value as no direct use can be made of it; it is the hidden information in the data that is useful."

4-2. Achieve Decision

a. JFCs will employ three defeat mechanisms; destruction, dislocation, and disintegration,[18] throughout the course of a campaign. While these functions are most often associated with conventional warfare, the principles found apply equally to any operations where U.S. and coalition forces face adversaries.

b. Specific see contributions to each include the following.

(1) *Destruction*

(a) Defeat by destruction emphasizes the physical dimension of conflict and the application of lethal combat power to "destroy enemy capabilities."[19] The success of future Modular Force strike will depend most heavily on its ability to detect, locate, identify, track, and assess targets. See enables strike operations through-

- Shared situational awareness in near-real-time that distinguish friendly and neutral elements from the enemy.
- Precise and timely intelligence on potential targets.
- Largely automated knowledge of friendly and allied forces.
- Space and air based multi- and hyper-spectral imagery that enhances observation capabilities.
- Routine and dynamic ISR synchronization.
- Integration of ISR with all operations.
- Accurate assessment of effects on targets.
- Continuous and accurate knowledge of environmental factors; such as culture, weather, and terrain.
- Rapid, precise effects assessments.

(b) Against irregular forces, the future Modular Force will rely even more heavily on the see function to provide in-depth knowledge of the enemy and environment before planning operations. This includes the ability to identify and track individuals as opposed to units or distinctive military systems. Intelligence will be required to detect, locate, and track adversaries inside urban clutter or hidden among the population. Commanders will require detailed environmental knowledge to build their understanding to take into consideration a much wider range of factors, such as the population and use of infrastructure, when making decisions regarding destruction.

(2) *Dislocation*

(a) "Defeat by dislocation emphasizes the use of combined arms maneuver to obtain significant positional advantage" over adversaries "in a manner that renders the enemy's dispositions less valuable."[20] The intelligence process supports dislocation of the enemy by

[18] Army's Capstone Concept, p. 12.
[19] Ibid.
[20] Ibid.

providing awareness of likely enemy dispositions and intentions, as well as prediction of enemy actions and reactions. Knowledge of the environment assists commander in anticipating the impact of friendly and enemy operations on the population, and political and economic factors.

(b) Knowledge of friendly forces' missions, status, and readiness permits effective decisionmaking and self-synchronization, facilitating rapid and precise maneuver. Dislocation not only functions against conventional militaries in the physical domain, but can be effective against insurgents or terrorist groups in the physical, moral, and information domains as well.

(3) *Disintegration*

(a) Disintegration focuses on the "integration of dislocating and destructive effects to shatter the coherence of the enemy's dispositions."[21] The see function will assist commanders in identifying enemy critical capabilities, decisive points, and centers of gravity; modeling and assessing friendly and enemy courses of action; and detecting and assessing the enemy's ability to reconstitute from disintegrating effects.

(b) Disintegration is as relevant to irregular forces as it as against conventionally organized militaries, but the understanding necessary will be far more difficult to achieve. Additionally, the human environment, such as culture, population, and social systems, will play a much greater role not only in conducting operations, but in anticipating their effects.

4-3. Joint Campaign

a. The joint campaign framework consists of six phases: *shape, deter, seize the initiative, dominate, stabilize, and enable civil authority*.[22] While presented in order of normal employment, these phases do not begin and end in sequence. For example, shaping efforts will continue throughout a campaign.[1]

b. It should be noted that Joint Publication (JP) 3-0, *Joint Operations*, 17 September 2006, specifies six phases: *shape*, *deter*, *seize the initiative, dominate*, *stabilize*, and *enable civil authority*. The Army Capstone predates this new joint phase titling and uses the following four phases: prepare and posture, shape and enter, conduct decisive operations, and transition. For concept purposes, the *prepare and posture* phase encompasses the two distinct joint phases of *shape* and *deter*. Similarly, the Army *shape and enter* phase includes elements of the joint s*hape* and s*eize the initiative* phases. The Army *conduct decisive operations* phase includes the joint s*eize the initiative* phase and parts of *dominate*, s*tabilize*, and e*nable civil authority*. *Transition* as used in the Army capstone overlaps the joint phases of *dominate, stabilize,* and *enable civil authority.*

c. The discussion of joint phasing does not imply that those phases are sequential in planning or in execution. In fact, many phases will be concurrent while some phases may actually be omitted from a particular campaign or major operation. For example, though JP 3-0 labels *shape*

[21] Ibid.
[22] Joint Publication 3-0, "Joint Operations," 17 September, 2006, Chapter IV.

as phase-0, it is actually a continuous effort that only begins in Phase 0. In some instances, Phase I, *deter*, may not occur at all, the JFC may go directly from *shape* to *seize the initiative*.

(1) *Shape*. Shaping has always been the most challenging operations for knowledge development. Fewer assets may be present for acquiring data and information; the force has not developed the situation and is less aware, and known aspects can change dynamically and rapidly. Knowledge of the human aspects of the environment will determine what shaping actions are likely to be effective, how well they are working, and when others must be employed. National capabilities, peacetime engagement forces, and air and space-based stand-off sensing systems will enhance intelligence collection. Analysis will focus on assessing the effects of shaping, potential threats to friendly forces, and prediction of future behaviors, states and actions.

(2) *Deter*. The ability to understand the operating environment is critical to deterrence. The JFC will require accurate and timely knowledge of what the potential enemy values and a range of possible deterrent options and the methods for carrying them out. Acquisition and transformation capabilities will estimate the probability of success against potential adversaries. Finally, commanders will require knowledge of when and why deterrence has succeeded or failed.

(3) *Seize the Initiative*. Prior to the commitment of forces, the future Modular Force will have access to knowledge developed across the joint, interagency, and coalition domains. For example, national and space-based capabilities provide responsive and accurate data about the enemy and environment before forces arrive in theater, while contributing to the networking and status of friendly en route elements. This knowledge will permit effective peacetime engagement activities, as well as, planning and preparation for crisis. The responsible JF headquarters will lay the knowledge foundations for the campaign, beginning in the pre-conflict phase and refine them continuously throughout all the phases. Self-knowledge will revolve around force planning and preparation for potential commitment. Knowledge of the environment will drive planning for the preparation and commitment of forces. Knowledge of the opponent will predict future states and behaviors that will enable commanders to orchestrate deterrence, shaping, and entry operations. As forces are employed, self-knowledge is essential for commanders to properly meter force flow, prevent fratricide, and effectively employ JF capabilities in a dynamic and potentially chaotic situation.

(4) *Dominate*. Dominant military operations succeed by attacking both the enemy's will and means to resist. Conversely, many opponents will attempt to deny decisive operations by protracting conflict with the U.S. in an effort to attack political resolve. The ability of the future Modular Force to accurately and rapidly understand the situation is critical to being able to attack the enemy in the physical and moral domains, as well as, to assess effects across the entire environment. Self-knowledge allows the future Modular Force to support and receive support from key capabilities, such as sustainment, joint fires, and protection without loss of tempo to build information, or de-conflict operations and positioning. Accurate route status and knowledge of the physical environment will facilitate rapid maneuver, while assessment of the social and cultural situation will enable the future Modular Force to move, strike, sustain, and protect more effectively. Knowledge of the enemy allows the future Modular Force to anticipate likely courses of action, apply force, protect forces, and assess effects in support of the

campaign. In situations, such as stability and reconstruction, or during counter-insurgency operations, the future Modular Force may not achieve decision rapidly, and when achieved, may not be sufficiently aware of it to permit exploitation. Intelligence collection and analysis will comprise a much wider variety and amount of data, such as culture, popular attitudes, economics, and governance. This integrated view of the operational environment will improve situational awareness and commanders' ability to make timely and informed decisions.

(5) *Stabilize.* As the campaign proceeds and the enemy's ability to control terrain or populations and move freely diminishes, the complexion of the operational environment changes. The JFC orchestrates a wide variety of operations, often requiring the future Modular Forces to engage the enemy while at the same time controlling civilian movement, protecting the populace, and safeguarding or restoring critical infrastructure. This will significantly multiply the amount and type of data, information, and knowledge the future Modular Force will require in order to conduct its portion of the campaign.

(6) *Enable Civil Authority*. With forces engaged in everything from combat to humanitarian assistance, and where the population and enemy may be intermingled or in close proximity, understanding the situation and the effects of operations will be the primary means for achieving success. Opponents will attempt to take advantage of the force's and the population's inherent vulnerabilities during this phase. The future Modular Force must be capable of acquiring and transforming information that goes well beyond standard military expertise, and this agility must reside in all operating units in order to succeed. Environmentally, commanders must be capable of acquiring and transforming information relating to civil governance, economic activities and structures, physical infrastructure, and sociological aspects. While some of these can be met through reach to experts, some level of organic capability must also be present, and at lower tactical levels than in the past.

4-4. Synchronization and Exploitation of Joint Interdependence

a. The future Modular Force will conduct operations interdependently with the JF and interoperability with coalition forces. It will take advantage of knowledge acquisition and processing capabilities from across the force, and employ its own unique capabilities to develop situational understanding. *Joint interdependence* requires a blend of organic capabilities and the cooperative sharing of acquisition and transformation means.

b. Joint Interdependence includes, but is not limited to those listed below.

(1) *Joint Battle Space Awareness.*[23] Joint Battlespace Awareness calls for sharing of detailed, timely information and knowledge between joint, interagency, and multi-national elements. Joint collection of intelligence will take place across organizational, Service, and even national lines, ensuring full use of intelligence collection capabilities. Similarly, the joint, interagency, and multi-national elements will cooperatively analyze data and information. Joint battlespace awareness will be heavily reliant on space-based capabilities, ranging from intelligence collection to communications.

[23] Army's Capstone Concept, p. 13, lists five key interdependencies: Joint Battle Command, Joint Force Projection, Joint Air and Missile Defense, Joint Sustainment and Joint Fires and Effects. Joint Battle Space Awareness is added to this list of "key interdependencies," because of its significant correlation with the See Concept.

(2) *Joint Battle Command*. The assured and near real-time sharing of data on all the friendly, environmental, and enemy situations is essential to the ability of the future Modular Force to operate synergistically within the JF.

(3) *JF Projection*. "Advanced strategic and operational lift capabilities" will "facilitate strategic responsiveness and operational agility within the"[24] operational environment. Knowledge of self, the environment, and the adversary will permit the future Modular Force to project forces with more precision through timely assessment of the theater of operations, the environment, and anti-access limitations.

(4) *Joint Air and Missile Defense*. Defeating diverse anti-access threats requires in-depth and real-time knowledge of enemy organization and capabilities; as well as, an accurate assessment of the effects of strikes in order to limit the risk to non-combatants, infrastructure, and deployed forces.

(5) *Joint Sustainment*. Integrated joint sustainment requires exceptionally accurate and up to date force knowledge, world-wide visibility of logistical items, knowledge of the environment, and situational awareness.

(6) *Joint Fires and Effects*. Integration of joint fires will demand highly assured self-knowledge to prevent fratricide and reduce engagement times. The environment, particularly the human element, will often dictate how and where the force can apply effects. Planning and applying effects against opponents will demand much higher quality of knowledge in terms of granularity, timeliness, accuracy, and assessment. Additionally, adversaries operating asymmetrically will drive a disproportionately higher level of effort to acquire, transform, provide, and exploit data and information, as analysts are forced to focus on individuals hidden in high-clutter environments and employing low-signature capabilities.

4-5. See and the Seven Key Operating Concepts

a. The seven key operational concepts introduced in the Army's capstone[25]outline how the Army will support joint operations. These are: shaping and entry operations; operational maneuver from strategic distances; intratheater operational maneuver; concurrent and subsequent stability operations; distributed maneuver support and sustainment; and network-enabled battle command. Within each of these key operational ideas, there are many opportunities to explore, develop, and leverage see capabilities to enable campaign success.

b. Shaping and Entry

(1) *Shaping*. The future Modular Force will develop knowledge before and during shaping, allowing full use of its capabilities, as well as those of the joint, coalition, and interagency elements. Knowledge of the environment will enable commanders to operate using a better understanding of terrain effects, weather and atmospheric effects, infrastructure, culture, and social systems, such as economics and governances.

[24] Ibid.
[25] Army's Capstone Concept, Chapter 5.

(2) Knowledge of the opponent will assist commanders in understanding the enemy as a system, exploiting weaknesses, manipulating perceptions, and deceiving him as to the location and nature of friendly operations. Intelligence will be critical to-

- Defeating or degrading enemy anti-access strategies.
- Detecting and identifying key enemy nodes or capabilities and assessing effects on the nodes.
- Developing and maintaining self-synchronization.
- Providing timely information to planning, executing, and assessing information operations.
- Planning, employing, and assessing effects across the full range of diplomatic, informational, military, and economic spectrum to deny the enemy support and impact their will to fight.

(3) A greater level of access to knowledge and persistency of surveillance allows the future Modular Force to avoid pausing to develop more intelligence before continuing operations. Persistence will provide-

- More data, which in turn offers a greater probability that critical data has been collected and identified through data exploitation, which may lead to improved analytical effectiveness in developing knowledge.
- More effective pattern and link development to assist analysis.
- The ability to identify less predictable enemy operations and activities, for example, in forensically reviewing actions that led to an attack.
- The ability to develop knowledge of key environmental aspects (both physical and human) and facilities to support force flow.

(4) The future Modular Force must be capable of employing JF collection capabilities and drawing from all intelligence disciplines. This is particularly critical in overcoming enemy anti-access measures**.** Direct action of maneuver and strike forces will constitute key components of joint efforts to destroy and degrade anti-access elements, such as the enemy's long-range precision engagement system, offensive and defensive air capabilities, unconventional forces, surveillance and targeting systems, and battle command systems. Most of the available collection and network capabilities will be interagency, joint and multi-national, and future Modular Forces must be able to seamlessly employ or even direct those capabilities as required by the mission and situation.

(5) Shaping and entry involve significant fluidity and uncertainty of situation, and multiple, competing demands for knowledge. The future Modular Force must be capable of transforming large amounts of data and information into knowledge that supports precise maneuver, strike, and protection planning. As units will not be in contact with enemy forces, commanders will be less capable of developing the situation through maneuver and will rely on robust see capabilities to-

- Develop “targets” for a variety of lethal and nonlethal effects.
- Resolve ambiguity.
- Direct movement.

- Self-synchronize within the future Modular Force, and as a part of the larger joint and multi-national force.
- Locate, track, and orchestrate the defeat of enemy anti-access efforts.
- Support information operations to gain and maintain information superiority.
- Assess the success of shaping actions in achieving entry conditions.

(6) Equally demanding in shaping and entry is the requirement to share knowledge among joint, multi-national, and future Modular Force elements. The unpredictable nature of the situation and the need for maintaining the initiative require the ability to operate rapidly and in close coordination. This will demand a future Modular Force to-

- Share and employ information and knowledge throughout deployment and employment.
- Track friendly forces down to the individual in real-time.
- Plan and collaborate.
- Rapidly form and dissolve joint and multi-national teams.
- Rapidly coordinate forces and effects without pausing to stage or reset.

(7) *Entry*. Future Modular Force commanders introduce combined arms force packages via multiple lift platforms into numerous entry points, building quickly from battalions to larger formations. Future Modular Force entry forces must be capable of employing joint data acquisition capabilities, including networks, databases, collection capabilities, and friendly force information, in order to act in coordination with the larger force, while protecting rapidly established joint and Army capabilities. Deployed corps and division command posts ensure effective command capabilities are in place to control these complex operations and data acquisition and transformation capabilities are essential to providing knowledge to employed forces. As most of data *gathering* will be automated, the most critical knowledge infrastructure will be the early establishment of intelligence collection and analysis capabilities.

(a) Forcible entry operations will use strategic assets, such as air and sea lift, joint precision fires, and theater and space-based intelligence collection and network capabilities. Accomplishing this mission requires the ability to-

- Access in near real-time the location, missions, and status of joint and multi-national forces.
- Employ or coordinate strategic, joint, interagency, and selected multi-national capabilities using organic command and knowledge architectures, particularly in the areas of intelligence and strike.
- Connect to and collaborate with Army, joint, and national elements without time consuming coordination or engineering.
- Rapidly establish the required data and information infrastructure.
- Rapidly downlink, process, and analyze national and commercial imagery from archives and databases in theater.

(b) Subordinate maneuver forces will seize and defend entry points to facilitate follow-on force flow, set conditions for future maneuver to multiple points in the theater, and

enable earlier transition to offensive operations. The non-contiguous and fluid nature of these operations implies-

- The ability to collaborate with or directly employ joint and selected strategic capabilities.
- Organic collection and transformation capabilities at lower tactical levels.
- Sufficient network access to mine data from a wide variety of organizations and sources.
- Real-time knowledge of friendly forces, particularly those not organic to maneuvering units.
- Real-time tailored knowledge of the environment, such as human, weather, terrain, and infrastructure, specific to each organization's operating environment.

(c) Early entry forces must be able to draw on support from air and naval forces, as well as, from multi-national partners already engaged in theater. The ability to share information and knowledge will be critical to tactical and operational success, and includes-

- Exchanging sustainment information with joint and multi-national elements, in and out of theater.
- Seamless sharing of intelligence collection and analysis capabilities.
- Continuous visibility of sustainment capabilities and materiel.
- Collaborative planning and execution across the joint, multi-national, and interagency team.
- Assured access to joint sustainment, strike, and protection capabilities.

(d) Once entry occurs, the JFC orchestrates the force flow to build combat capability quickly and evenly in order to prevent gaps between early arriving forces and counter-offensive, counter-decisive operations forces. This orchestration will demand a continuous and current flow of data and information, as well as, estimates of future conditions, including requirements to-

- Continuously transform friendly data and information.
- Apply organic and non-organic collection means to detect, locate, identify, and track enemy elements.
- Perform data mining and intelligence analysis to develop additional information and detect patterns and relationships.
- Predict likely enemy actions and patterns that assist commanders in denying the enemy the ability to reinforce, re-synchronize, or exercise initiative.
- Develop knowledge necessary to protect subordinate maneuver forces from enemy action and environmental hazards.
- Provide subordinate maneuver forces access to standoff strike assets through connection to joint and multi-national capabilities.

- Ensure continuous sustainment and high operational tempo by developing and providing friendly force, threat, and environmental data across the force.

c. Operational Maneuver from Strategic Distances

(1) Commanders may execute operational maneuver from strategic distances. This capability is highly dependent on the commander's ability to continuously understand the enemy and friendly situation, and make effective decisions at every phase of maneuver, particularly given the tempo and distribution of friendly forces. This will call for significant improvements in the collection, the network, and the ability to access and process knowledge from all sources.

(2) Persistent surveillance to gain understanding of the opponent and the operational environment continuously and in near real-time is essential to the ability to maneuver across strategic distances. In the time it takes to move forces, the situation anticipated during initial planning will have changed. Without the ability to conduct near-continuous surveillance of selected critical areas, persons, or capabilities, the future Modular Force would be forced to stage and build awareness as it developed the situation. Persistent surveillance will also enable the future Modular Force to produce greater amounts of data to enable more effective data mining, and pattern and relationship development, helping analysts to develop knowledge of more ambiguous targets while out of contact. While persistent surveillance is only achievable for specific periods of time against extremely critical targets, it is an essential capability for the future Modular Force.

(3) Knowledge readiness demands continuous surveillance and access to theater databases, allowing operations to begin with less uncertainty for employed forces. The force achieves this through focused preparation on key contingency areas or employment possibilities, development of collection and analysis architectures, linking the standing JFs headquarters to the future Modular Force, and rapid acquisition and transformation of information as the situation progresses.

(4) Rapid and en route situational awareness permits continuous development of knowledge of the opponent, the environment, and the future Modular Force throughout deployment and employment. The force will have access to and the ability to direct sensors and information gathering capabilities through its networked integration with the JF. This will permit organic and collaborative collection and analysis to support the knowledge demands of the future Modular Force commander while deploying. It also enables future Modular Forces to conduct distributed, en route mission rehearsal, essential to immediate employment in theater.

(5) Continuous and assured connectivity to joint and interagency capabilities allow the future Modular Force to begin influencing and participating in operations to achieve decision superiority prior to first contact in theater. This demands both technology and processes to assure access in virtually any location and situation en route to the point of commitment.

(6) "Knowledge reach" allows knowledge centers, early entry forces, and follow-on forces to be connected and focused on the same challenges. This capability is essential to planning and execution, and also to reducing operational transitions and orchestrating force flow, sustainment, and force protection.

d. Intratheater Operational Maneuver

(1) Operational maneuver in theater can occur as purely ground maneuver, as vertical maneuver, or more likely, a combination of ground and vertical maneuver. Vertical maneuver operations, in independent actions or as complementary maneuver in support of committed ground forces, will be among the most demanding in terms of knowledge of terrain, enemy, and friendly forces. Operational maneuver requires the near–simultaneous movement and support of multiple tactical formations by ground, air, and sea from separate staging areas to locations in-depth, from which they focus their combat power against critical enemy forces and facilities.

(2) In accomplishing these operations, the future Modular Force will employ significant knowledge generation capabilities. The future Modular Force will collect very detailed data and information simultaneously across a large geographic area. This requires not only access to joint and national intelligence collection capabilities, but possession of organic sensors they can employ in close concert with maneuver forces. Organic collection capabilities must be able to support maneuver forces to identify enemy elements and targets, determine optimal routes of movement, and protect forces, allowing the future Modular Force to dictate the tempo and maintain momentum. In order to make sense of collected data and predict future conditions, units must possess a corresponding level of analytical capacity.

(3) Non-contiguous friendly forces will employ automated force awareness, and fusion of friendly force data and information to ensure that self-knowledge keeps pace with the commander's decisionmaking and execution requirements. This capability is essential to self-synchronization, full use of organic and joint strike capabilities, and exploitation of opportunities

(4) Sustainment and protection of forces maneuvering vertically and by ground will demand real-time data about the status of forces, operational environment conditions, and estimates of future activities in order to continue momentum and maximize support to the force. Especially critical is protection of sustainment capabilities from environmental hazards and enemy action, employment of shared ISR and strike capabilities to maintain situational awareness and respond to threats, and reliable connectivity with supported forces throughout the area of operations.

e. Decisive Maneuver

(1) Assured knowledge of friendly forces will allow commanders to make decisions without extensive de-confliction and information gathering in order to synchronize operations and direct combat power. The future Modular Force will orchestrate its development of knowledge, from organic to cooperative, to conduct the strike, movement, protection, and sustainment that contribute to decisive maneuver. In irregular warfare, decisive maneuver can be

far more complicated. Enemy targets are more difficult to discern in the environment, and decisive points that might cause collapse of an organization are difficult to predict and find, if they exist at all. Finally, success or failure in decisive maneuver against irregular opponents is difficult at best to discern. The result is a much greater demand on intelligence collection and analysis, and more extensive awareness of the operational environment. Decisive maneuver requires-

- Detailed knowledge of opponent organizations and relationships.
- The ability to discern adversaries from the civilian population, and between various enemy factions, while operating in complex physical environments.
- The ability to track friendly forces, including multi-national and interagency presence, particularly while highly distributed.
- Distributed, collaborative mission rehearsal on the move and across operational distances.
- Collection against ambiguous and low signature systems to counter adaptive threat capabilities.
- Air, ground, and space-based collection capabilities for high-clutter environments, such as jungles or built-up areas.
- Extensive use of the knowledge built by other elements in- and outside the operational environment through access to JIM organizations.

(2) *Simultaneous, Distributed Operations.* Designed for decentralized, non-contiguous operations, future Modular Force divisions and corps will conduct simultaneous operations distributed across the entire joint operations area (JOA). To accomplish this, the future Modular Force must possess-

- Superior situational understanding enabling ground commanders to, operate non-linearly, bypass what is less important or non-threatening, and focus operations against the forces and capabilities that are most critical to the enemy.
- Advanced air and ground multi-capable ISR and command capabilities to enable the force to mass effects, as well as, access to space and other assets to expand operational reach significantly beyond the constraints of organic sensors and strike capabilities.
- The capacity to develop knowledge with sufficient accuracy and timeliness to permit simultaneous engagement by air and ground maneuver elements, joint fires, and suppression of enemy air defenses, allowing forces to transit the operational environment on its terms in any terrain.

(3) The force will be capable of conducting defensive operations at the same time the operational offensive is occurring. For example, the joint support structure, long-range fires, air operations, and often segments of the population and infrastructure, will require ground defense. Defensive operations can comprise much of stabilization or peacekeeping operations. Success will depend on many of the same capabilities as in the offense, to include-

- Highly detailed knowledge of enemy forces to allow the force to anticipate, detect, and defeat enemy attacks in all forms and domains.
- Information superiority, particularly in irregular warfare where perceptions play a greater role in operational success.
- Detailed knowledge of the population, including relationships, culture and social structure, that support both defensive operations and information operations.
- Employment of precision tactical engagement to destroy enemy elements, enabled by shared, assured knowledge of friendly forces.
- Employment of effects from JIM means.
- Deception processes and means.
- Force protection systems.

(4) *Direct Attack of Enemy Decisive Points and Centers of Gravity*. The future Modular Force will employ strike, lethal and nonlethal effects, supported by joint capabilities and operational maneuver to directly attack enemy decisive points. One of the essential enablers of direct attack is the ability of joint and future Modular Force commanders to understand and share knowledge on potential decisive points and centers of gravity in order to link them to concrete military objectives and activities. Decisive points may be difficult to discern and attack in irregular forces, and more difficult to assess after attack, often leading to operations being conducted for the purpose of intelligence, and intelligence becoming a precursor to determining what may be enemy centers of gravity and decisive points.

(5) When possible, the future Modular Force will employ information operations, fires and maneuver to directly attack enemy decisive points and centers of gravity developed through-

- Intensive collection operations against enemy observables to provide situational awareness and targeting information.
- Transformation of data and information from across JIM capabilities.
- Use of data exploitation to help analysts develop information about low signature activities, and enemy patterns, linkages and organizations, enhancing awareness and force protection.
- Assessment of effects on the enemy, including red teaming to estimate possible behaviors and outcomes.

(6) Similarly, the future Modular Force will use knowledge to apply pressure on the enemy through nonlethal means, such as depriving them of popular support and interdicting key intelligence or support means. This includes the future Modular Force's ability to-

- Gather cultural data and information in the JOA to plan and execute operations.
- Develop measures of effectiveness to assess the impact of friendly and enemy operations on the population.
- Employ reach to gain access to cultural knowledge globally from military and civilian experts.
- Use human intelligence, other disciplines, and data mining to determine enemy support structure.

(7) *Continuous Operations and Controlled Operational Tempo.* Continuous operations create and control an operational tempo designed to apply continuous pressure and overwhelm the enemy's capability to respond effectively. High operational tempo and continuous pressure will seriously hinder the enemy's ability to adapt, regroup, reconstitute capabilities, or reconfigure forces to support new operations. In order to accomplish this, the force must be able to-

- Share information about the enemy, environment, and friendly mission between all forces, committed and uncommitted, to provide seamless transitions.
- Use systems and processes to continuously self-synchronize the force, avoiding unnecessary delays for decisionmaking and staging.
- Use a high degree of automated tracking of friendly forces to free commanders and staffs to focus on understanding the enemy and environment, and planning for future commitments, engagements, and actions.
- Track detailed sustainment demands in order to support the continuity of operations.

(8) Commanders may also avoid undesirable operational pauses through inter-component cooperation. This will require-

- Shared knowledge of friendly and enemy situations between all elements of the JIM force.
- The ability to rapidly team without extensive pre-coordination.
- Collaboration with engaged forces to prepare follow-on elements for immediate commitment.
- Access to multiple types of data from various databases, including threat information, cultural data, and details on infrastructure.

f. Subsequent and Concurrent Stability Operations

(1) The future Modular Force will conduct subsequent and concurrent stability operations that will present a broad range of risk, intensity, tempo, and complexity, varied over time and region."[26] Future Modular Force units must be able to secure or destroy remnant forces and hostile factions, secure border regions, protect civilian and friendly military elements, and support demilitarization and reconstruction initiatives.

(2) In non-contiguous operations, the future Modular Force commander may execute combat operations at the same time and in the same area of responsibility as stability operations. To accomplish this, the future Modular Force will have the ability to-

- Employ analysts, systems, and processes to develop knowledge, including in non-traditional areas, such as infrastructure, commercial and economic data, tribal and other social boundaries, property ownership information, and key leaders' biographical data. Most important, and difficult, will be developing skills in these widely varied fields.

[26] Ibid. p. 27.

- Discriminate between enemy elements and non-combatants using advanced collection and analysis capabilities.
- Detect low-signature enemy systems, such as improvised explosive devices (IED) and commercially available encrypted communications.
- Gather evidentiary data for dealing with enemy fighters acting from within the population, as well as, criminals taking advantage of the absence of local law enforcement.
- Conduct pattern analysis for both the enemy and elements of the environment, such as economics and the population.
- Develop knowledge of the population, culture and social structure using linguists, intelligence personnel, cultural awareness teams, and other elements of the force.
- Model potential impacts of friendly and enemy operations on the population to enhance planning and preparation.
- Assess intended and unintended effects on the population from friendly and enemy activities.
- Tap into military and civilian experts from across a variety of disciplines, from linguistics and culture, to civil engineering and economics.
- Red team potential courses of action for consequences, including enemy and non-combatant outcomes and risks.

(3) The future Modular Force must be able to rapidly transition into and out of combat or between missions against an adaptive enemy without loss of operational momentum. Implied in this is the capability to-

- Maintain situational awareness of multi-national military or security forces operating near or within areas of responsibility.
- Provide information and knowledge to non-U.S. forces and organizations as needed.
- Coordinate friendly activities with non-military and non-governmental organizations.
- Draw from situational awareness from across the theater, particularly in areas, such as sustainment and political developments.
- Share and present knowledge to the lowest tactical levels.

(4) Campaign priorities in irregular warfare will normally focus on diplomatic, informational, and economic objectives, with military operations used in a supporting role. For example, centers of gravity may include public support and confidence for the newly established government, the economic viability of the state, and adversary physical and informational efforts to influence public opinion and destabilize the emerging government.

(5) Commanders and their units will develop knowledge, however, the sources and nature of the data and information will vary considerably from conventional operations, including requirements to-

- Understand borders and boundaries (physical, ideological, religious, cultural, and organizational) between elements and interests.

- Identify sources and means of external and internal support, including money, supplies, and manpower.
- Identify cultural, economic, and political leverage points.
- Understand effects of the conflict on the population.
- Identify which regions or areas are stable, and which are or will likely become unstable, and the causes driving change.
- Identify enemy means to communicate internally or with the population, and what alternate means are likely if primary means are interrupted.
- Understand enemy intelligence capabilities, leadership, and organizations.
- Possess the ability to identify and track designated individuals.

(6) Operations in irregular warfare will generally demand a disproportionate level of resources and effort relative to the number of forces involved. The future Modular Force will require greater situational awareness to-

- Understand local social, cultural, or religious customs.
- Discern the enemy from the population.
- Assess the impact of programs and initiatives.
- Track friendly and neutral entities to protect them from strike operations.
- Predict analysis that allows planning kinetic and information operations against enemy elements.
- Assess red team outcomes and risks accurately.
- Collect and analyze data to develop enemy patterns of operation and organizational linkages.
- Protect widely dispersed forces engaged in non-combat operations.
- Acquire environmental knowledge to protect infrastructure vital to stability and popular support.
- Exchange knowledge to effectively integrate with multi-national forces, including processes and procedures for sharing classified and sensitive information.

(7) Tactically, operations will be more distributed and the enemy will attempt to take advantage of isolated elements. The future Modular Force will use its superior mobility to rapidly reposition forces throughout the theater in order to maintain pressure and deny the enemy freedom of movement. Similarly, it will adjust frequently to social and political developments and changing rules of engagement, transition between peace enforcement and combat operations, and acknowledge and act on modifications in enemy methods or popular perceptions. The future Modular Force will achieve greater effectiveness in irregular warfare through-

- High levels of situational understanding, based in part on greater exploitation of intelligence, data mining and expert analysis, and an increased level of social and cultural awareness embedded in the force.
- Improved ability to discriminate between combatants and non-combatants.
- Effective integration of multi-national forces' capabilities and situational awareness.
- Sufficient automated knowledge of friendly forces to permit expanded span of control and span of command.

- The self-knowledge to conduct rapid mission-tailoring.
- The environmental knowledge and intelligence to orchestrate nation-building activities and combat operations.

(8) The urban environment will present some of the most difficult challenges for commanders; it is dense, complex, confining, and lethal. Data acquisition capabilities will remain an essential component of urban operations, but may suffer from increased constraints imposed by terrain, law, and the population, while demanding significantly greater effort, precision and timeliness. Detecting and identifying the enemy will be the most important factor in securing the population and defeating enemy forces. The future Modular Force will act to acquire-

(a) Friendly forces information:

- Track and maintain status not only on all friendly forces, but key civilian elements, such as police or local leadership.
- Access to JIM capabilities to direct precise effects in near-real-time.
- Near-instantaneous access to knowledge from diverse world-wide experts in order to deal with subjects outside normal analyst or staff expertise.

(b) Sensing technologies to allow:

- The ability to "see" through hardened structures to find weapons and enemy personnel.
- Capabilities to allow Soldiers to pinpoint snipers and explosive events.
- Sensors to identify mines and IED, for example, X-band radar and hyper-spectral sensors capable of detecting minute changes to soil or ground cover.
- Biometrics to identify potential enemies from the general population.
- Knowledge of weather capabilities and strategies to allow Soldiers and commanders complete, real-time situational awareness of the operating environment, and timely local weather observation input to Army short-term and Air Force longer-term computer modeling.
- Every Soldier a Sensor (ES2). Soldiers will continue to play the most critical role, reporting data and information, and will be aided by improved optics and reliable communications links.

(c) The urban environment is effective for the enemy as it is able to employ the population for protection, intelligence, sustainment, and psychological operations. Although technical capabilities are crucial to the success of the intelligence warfighting function, human understanding, knowledge, judgment, and cognition are the critical enablers to mission success. The Modular Force will employ the following capabilities:

- Human intelligence (HUMINT) collection by dedicated teams.
- ES2 collection by patrols, civil affairs teams, special operations teams, and other organizations capable of acquiring and reporting information incidental to their missions, enabled by their connection to the network.
- Cultural data and information gathering.
- Force Protection knowledge and warning across the entire force.

(d) Data and information transformation capabilities including:

- Dedicated analysts connected through the network to tactical leaders.
- On-demand access to intelligence data, such as imagery or HUMINT reports at the lowest levels.
- Multi-intelligence analysis.
- Advanced automated fusion support tools.
- Cultural analysis.

g. Distributed Maneuver Support and Sustainment

(1) In order for the future Modular Force to cope with complex environments, create and control operational tempo, and apply continuous pressure, sustainment and maneuver support must be applied with equal continuity and precision. The combined impact on support activities of environmental difficulties and challenging operational conditions will require-

- Shared information about the enemy, environment, and friendly mission between all forces and supporting elements to permit anticipation of demands and greater certainty in planning.
- Systems and processes to continuously support widely distributed forces and elements.
- A high degree of automated tracking of friendly forces to more rapidly and accurately provide a picture of the status of forces throughout the operational environment.
- Tracking of detailed sustainment and other maneuver support demands for continuity of operations.
- Highly detailed force protection knowledge to enhance survivability of non-combat forces and elements.

(2) Commanders may avoid undesirable operational pauses for supporting activities through inter-component cooperation. This will require-

- Accurate and timely shared situational awareness between all elements of the JIM team.
- The ability to rapidly form teams without extensive and time consuming coordination.
- Collaboration with engaged forces to integrate supporting activities into on-going operations.

- Access to threat information, cultural data, and details on infrastructure necessary for planning and conducting support activities.

h. Network-enabled Battle Command

(1) Battle command, enhanced through the network, constitutes the single most important contribution of the *See* concept, support in decisionmaking through developing and providing knowledge. Commanders and the battle command processes drive the acquisition and exploitation of data, and the transformation of data and information into knowledge. Battle command demands-

- The ability to drive data acquisition in support of decisionmaking and execution.
- The ability to dynamically prioritize data acquisition in response to unexpected or emerging requirements from a cross the force.
- A highly reliable and accurate knowledge of friendly forces and non-combatants throughout the operational environment.
- The ability to track and understand maneuver support demands for every element of the force.

(2) Commanders require timely and accurate transformation of data into information and knowledge. This will require-

- Access to databases, and skilled analysts and experts to assist commanders and staffs in interpreting data and information.
- Systems and processes for matching stated requirements to transformed information, enabling rapid gap analysis and re-tasking of acquisition.
- The ability to collaborate with experts globally from across disciplines and areas of knowledge.
- Presentation systems that effectively convey the situation, tailored to the commander's decisionmaking style.

i. Additional Considerations in Exploring, Developing, and Leveraging See Capabilities

(1) *Self-synchronization and Cooperative Engagement.* The future Modular Force will conduct tactical maneuver empowered by higher levels of situational understanding and characterized by increasing simultaneity, high operational tempo, relentless pressure on the enemy, improved air and ground mobility, precision movements, expanded operational reach, routine application of joint capabilities, retention of freedom of action, and the combination of precision, speed, and momentum to produce shock and disintegrating effects. The combination of these operational characteristics both demands improvements in self-synchronization and cooperative engagement. The ability to adjust or re-synchronize tactical activities dynamically directly supports the employment of forces to accomplish assigned missions, and will be accomplished using-

- Intuitively presented yet highly detailed knowledge of friendly forces locations, activities, missions, and planned maneuver of all elements in the area of operations to all levels of command in real-time.
- En route mission planning and rehearsal.

- Rapid update of current and projected enemy situation.
- Accurate and highly detailed environmental data, such as weather, physical terrain, urban terrain data, and population information.

(2) Self-synchronization enables more effective *cooperative engagement* between elements of the tactical force. Cooperative engagement is the collective capability of forces in combat to provide mutual support to other friendly forces or to benefit from the support of other units and joint assets, including fires, ISR, and sustainment. This capability is made possible by the future Modular Force's ability to-

- Expand operational reach to the tactical level to increase the number of available capabilities.
- Share situational understanding.
- Communicate reliably.
- Interoperate with battle command systems from across the force, JIM to facilitate rapid teaming.
- Accurately and in real-time locate all friendly units with a high degree of confidence.
- Share planned maneuver and movement in real-time.
- Share intelligence and provide assessment of effects after engagement.

(3) *Employing Joint Capabilities at the Tactical Level*. The ability to connect and share awareness with a wide variety of joint assets and capabilities is a key component of joint and future Modular Force operations. The ability of the future Modular Force is based on-

- Reliable, shared awareness across a wide variety of joint and Modular Force elements.
- Unhindered collaboration between elements to coordinate and optimize the employment supporting assets.
- The ability of supporting elements to access local force protection means, joint fires, and knowledge of the threat and local population.
- Self-synchronization within the force and between elements of the JIM team.

Chapter 5
Future Capabilities and DOTMLPF Implications

5-1. Introduction
To fully realize and leverage the function of see in the future, ideas need to be considered systematically and to a more precise level of detail. This section groups possible future capabilities for the see function by applying the four key ideas of acquire, transform, provide, and exploit. Capabilities are then analyzed for possible solutions to their implementation through likely changes required in DOTMLPF.

5-2. Acquire Capabilities

a. The ability to acquire data and information will permit commanders to track and understand their own organizations, the enemy and environment. Acquisition of data and information includes access to friendly systems and activity, data and information about the human and physical aspects of the environment, and detailed collection of intelligence on the enemy.

b. Potential Solution Sets

(1) *Blue Force Tracking and Awareness*

(a) The ability to gather and present the location, status, and missions of all elements of the force, including joint and coalition partners, is fundamental to the ability of the future Modular Force to operate. Blue force awareness includes status for combat, sustainment, and protection, and permits visualization of planned actions and locations in order to provide a running estimate of future conditions and portray the force as it will look in time and space. Self-knowledge has multiple implications for future Modular Force operations.

(b) Friendly force knowledge will enable better and more rapid decisionmaking by dramatically reducing the time and human effort required to gather, process and update detailed information on friendly units and cooperating elements, and then employ that knowledge to de-conflict and synchronize them. Units will be far more capable of self-organizing, driven by mission and intent, and enabled by detailed knowledge of all other forces. The future Modular Force will be able to conduct operations without pausing to transition from one phase to another, conduct operations from strategic or operational distances, and form and dissolve joint and combined teams rapidly to accomplish specific missions. Decisionmakers at all levels can quickly estimate the impact of rapid changes of mission, organization, and physical position on the overall operation, improving their ability to decide and act. This level of agility is dependent on assured self-knowledge in all of its dimensions.

(c) Self-knowledge is also essential for the application of precise future Modular Force and joint strike capabilities. Given distributed and simultaneous operations, asymmetric threats, and complex physical environments, strike cannot depend on today's painstaking and sometimes inaccurate processes for identifying and clearing friendly units and non-combatant locations. The future Modular Force must be capable of real-time and near real-time knowledge of all non-adversary elements, as well as their planned future activities in the operational environment, in order to make rapid and accurate strike decisions.

(d) Other functions, such as sustain, move, and protect will depend on early knowledge of the projected status of combat forces and their missions in order to provide the right capability at the right time and location. In an unforgiving and unpredictable environment, and in support of highly mobile and distributed forces, these functions will depend on exceptionally precise and timely information, and an intimate understanding of the mission, environment, and threat in order to succeed.

(e) Self-knowledge is one of the chief enablers of the future Modular Force. Through it, commanders can create "virtual mass," the effective employment of movement and strike without compromising cohesion and protection. Without assured self-knowledge, the future Modular Force often will often resort to physical proximity and manual de-confliction, and in doing so, reduce tempo and the ability to develop combined arms, and joint and combined synergy.

(f) Blue Force tracking and knowledge could, if compromised, intercepted, or disrupted, form a significant risk to future Modular Forces. Systems must be robust, assured, and secure to prevent the system from revealing locations and intentions, and presenting potential vulnerabilities to the enemy.

(2) *Environmental Data and Information Gathering*

(a) The ability for commanders to understand their forces and the enemy in an accurate environmental context will allow units to self-synchronize for reassembly and eliminate or reduce the time spent today orienting to the operational environment. This area has enormous implications for warfighting today and will increase in significance for operations in the future.

(b) Geospatial intelligence (GEOINT) will permit the future Modular Force to exploit and analyze imagery and geospatial information in order to describe, assess, and visually depict physical features and geographically referenced activities on the Earth. Success for the future Modular Force will depend in large part on taking away the opponent's "home field advantage," their superior knowledge and use of the environment.

(c) Weather will remain a significant operational factor. The future Modular Force will employ large numbers of systems that are impacted by weather; opponents will be impacted as well, yet will be capable of exploiting opportunities provided by the weather; and terrain, economics, populations and other environmental factors. Additionally, to the extent that the future Modular Force attains information superiority over its opponent, it may be able to exploit the adversary's relative inferior weather knowledge.

(d) The future Modular Force will require comprehensive knowledge of the operational environment's infrastructure. Maneuver and sustainment operations will use as much of the infrastructure as possible to avoid creating its own. Combat forces will deny opponents key resources. The force will conduct strike with more detailed knowledge about potential targets, collateral damage, and protected sites. The electromagnetic environment will have a significant effect on future Modular force operations. Successful exploitation of the electromagnetic spectrum will be dependent on adequate characterization of this environment (earth/soil properties, line-of-sight, and related factors affecting electromagnetic propagation).

(e) Just as important as the physical operational environment are the human and social systems aspects, or cultural knowledge. Particularly as an opponent attempts to draw U.S. forces into urban combat and more complex environments, or as a country requires stabilization support, the human environment factors often will be the most decisive. In many cases, the key aspect of the environment will be its human rather than physical features.

(3) *Managing Collection Activities*

(a) ISR Synchronization. Because the future Modular Force is knowledge-based and opponents will exploit clutter and ambiguity to hinder the ability to *See First* and *Understand First*, intelligence will often drive operational planning and execution.

(b) Joint Cooperative Employment of Sensors. Emerging joint concepts, such as battlespace awareness, describe a future intelligence collection environment in which sensors are inherent parts of warfighting organizations, but capable of supporting the information needs of any element of the force based on operational opportunities. The ideas of cooperative employment of capabilities and networked access will be essential to future Modular Force success.

(c) Integrated Collection Management. The requirement for the future modular and JF to conduct collection as dynamically as it conducts operations demands an integrated collection management capability. It must permit universal real-time knowledge of all joint and agency collection activities, planned and current, in the operating environment, and facilitated on-line collaboration and employment planning between organizations.

(4) *Advanced Collection Capabilities to Generate and Share Data in Near Real-time*

(a) This includes interfaces with JIM, and non-traditional assets, and coupled with our capability to deny the adversary information, will help create future Modular Force.

(b) Information Superiority. All operational environment activities, including asymmetric and asynchronous behaviors, produce “observables” or phenomena that can be perceived and measured, such as electromagnetic signature, temperature, chemical composition, orientation, movement, and a number of entities. It is the observable that sensors detect, and data about which fusion and analysis processes and interprets to provide information.

(c) Future Modular Force organizations will continue to employ their own organic sensors. As seeing and knowing have become integral components of all future Modular Force activities, the need for a greater number and more capable collection assets will likely emerge. Commanders employ their own sensing capabilities as an integral part of the combined arms team to accomplish all critical functions, such as move, strike, protect, and sustain. For example, chemical, biological, radiological, and nuclear (CBRN) sensors will comprise an integrated detection network crucial to protecting the force. Sensors and other collection capabilities must permit rapid reconfiguration to accommodate new observables.

(d) The process for new capabilities “spiraled” into on-going operations must be capable of being integrated into the force’s architecture quickly and without disrupting operational activity.

(e) The future Modular Force will leverage two key advantages to develop knowledge of the adversary. First, it will have continuous access to data, information, and knowledge across the joint, coalition, and interagency enterprise that will permit it to develop

and refine relevant knowledge. This advantage is dependent on the day-to-day collection and analysis of potential opponent's capabilities during peacetime, and the ability to refocus rapidly on new situations.

(f) The second advantage is the ability to employ its sensors, as well as leveraging those of others, to develop continuous time collection against enemy observables. The future Modular Force will require the ability to collect data on how its adversaries are organized, how individual elements are related to one another, how they make and communicate decisions, and their methods of operating and adapting, for example, by viewing the opponent (including their interaction with the environment) as a system. This includes non-military means, such as use of television, radio, satellites, and the internet.

(g) The opponent's doctrine or patterns of operation, tactics and adaptive capacity coupled with acquired knowledge of the opponent's capabilities and system-of-systems will shape how the future Modular Force fights. The acquired data will permit the future Modular Force some insight into how the enemy intends to operate and through analysis, predict when, where, and how enemy actions might occur. As the opponent adapts and adjusts their operations, the future Modular Force will require the operational and mental agility to anticipate, detect, understand, and adapt its operations to the opponent's new behaviors. While knowledge of current operations and patterns will have value, it will be transitory in nature and demand constant application of automated mining and human analysis to remain relevant.

(h) The enemy's current locations and operations provide the future Modular Force tactical advantage, and are required for immediate actions, such as strike and protect. The key requirement for the future Modular Force to be effective against adaptive opponents will be its ability to discern their ambiguous signatures in the operating environment.

(i) From current data and information on the enemy, the future Modular Force can more accurately predict future enemy intentions and plans. The future Modular Force will gain its greatest advantage over opponents when it is able to tie what it collects to what is collected elsewhere, and use developed knowledge and pattern analysis to properly anticipate opponent's activities well enough and early enough to plan, decide, maneuver, strike, protect, and sustain the force.

(5) *Fusion at the Point of Acquisition.* As the force acquires data and information, it must be capable of processing, tagging, and comparing it to locally held data and information. For example, signals that have a known origin will be identified as such. This capability not only speeds the data transformation process, but assists the element acquiring the data in determining whether requirements are being met or need additional effort.

(6) *Acquisition at Strategic, Operational and Tactical Levels*

(a) In theory, the ability to share and access data across the strategic, operational, and tactical levels would make "ownership" of acquisition capabilities irrelevant. In practice, however, organic resources will remain important. The requirements for acquiring data, information, and knowledge will exist at every echelon, but each will have very distinct needs.

While acquired data will gain greater value through analysis and dissemination, the complexity of friendly operations, the environment and potential opponents will drive acquisition toward incredibly detailed and discrete requirements. This has several implications for the future Modular Force.

(b) Many future Modular Force platforms specifically designed for other operational missions will collect, fuse, and provide data. In non-linear environments and against asymmetric enemies, this collection strategy becomes an essential feature of the future Modular Force. First, opponents' observables will not always be readily distinguishable from background clutter, nor will they be predictable in space or time to allow for effective positioning of limited numbers of ISR-specific platforms. Second, ground combat and support systems will often be in the closest proximity to enemy signatures, permitting more collection opportunities and greater geographical coverage, with the net effect of greater persistency and acquisition of more data elements for mining and analysis. Third, placing collection capabilities on combat and other non-ISR systems in the environment in a non-linear operational environment can reduce the force protection challenges to securing low-density ISR systems.

(c) Finally, a greater base of collection capabilities reduces a future Modular Force vulnerability posed by losing collection systems. This is not to imply that all data acquisition can be accomplished from non-ISR platforms, but rather that this capability can significantly add to the quantity and quality of future Modular Force collection.

(d) Acquisition capabilities cannot be "pooled" for efficiency, that is, non-executing organizations cannot centrally acquire data and information without reference to specific requirements. While national/strategic and operational echelons will contribute to developing knowledge, the increasingly distributed nature of the battlefield means that each level must possess the ability to acquire its own mission, and situation-specific data. Organic acquisition capabilities must at a minimum support each organization's inherent knowledge requirements for battle command, strike, move, sustain, and protect functions.

(e) Highly distributed future Modular Force operations will create highly distributed and unique data requirements, placing greater demands on individual organizations to develop knowledge for their specific geographic and mission needs.

(f) Operations in complex terrain will increase the requirement for high-fidelity data. For example, urban terrain will demand data about individual persons, infrastructure, buildings, and even individual rooms that will often differ entirely from the individuals, infrastructure, buildings, and rooms only meters away.

(g) Opponents operating adaptively deny the future Modular Force and JFs the efficiency of being able to collect across wide areas, against large formations, or to take advantage of obvious patterns to estimate those things that they do not collect. In irregular warfare, collection targets are often individual persons or very small groups intentionally blending into the environment, and operating over an undefined and widely distributed area. Not only will detection be far more difficult, but identification and assessment will as well. Data collection will demand more sensors, employed more continuously, and covering a much larger

geographical space. Enemy distribution will cause the future Modular Force to collect its highly refined data in more locations across the operational environment, making consolidation of collection assets ineffective.

c. Future Capabilities

(1) *Doctrine*

(a) The future Modular Force requires the capability at all echelons to track and understand the activities of friendly, enemy, and non-combatants, as small entities and individual personnel in the context of complex opponents and environments, particularly urban, in order to discern hostile from friendly, apply precise effects, and stabilize the population.

(b) The future Modular Force requires the capability at the BCT and below levels to use knowledge built by other elements in the context of a JIM environment, in order to make full use of all acquisition capabilities, as well as, take better advantage of data and information already available.

(c) The future Modular Force requires the capability at all echelons to display knowledge in multiple domains, such as human, informational, and moral throughout various functions, for example, sustainment, movement, and protection, in order to provide common awareness across the force.

(d) The future Modular Force requires the capability at BCT level to estimate and model friendly force status, activity, and location in all operational environments, in order to permit effective execution planning.

(e) The future Modular Force requires the capability at all echelons to possess collaborative sensor awareness and conduct collaborative collection management in a JIM environment, in order to most effectively employ acquisition capabilities.

(f) The future Modular Force requires the capability at BCT and below levels to conduct environmental data gathering in all operational environments, in order to effectively plan and execute operations.

(g) The future Modular Force requires the capability at the BCT level to conduct data exploitation for all forms of operations and in all environments, in order to determine which data and information is available, and which must be acquired.

(h) The future Modular Force requires the capability at all echelons to execute ES2 in all environments, and most particularly in urban environments, in order to acquire more data from its immediate contact with the enemy and environment.

(i) The future Modular Force requires the capability at BCT and below levels to access space-based ISR and communications capabilities in a JIM environment, in order to have fullest access to data, information, and knowledge.

(j) The future Modular Force requires the capability at BCT level to collaboratively plan and execute operations in a JIM environment in order, to most effectively employ the capabilities of the entire enterprise.

(k) The future Modular Force requires the capability at all echelons to rapidly form and dissolve joint and multi-national teams in all forms of operations and in all operational environments, in order to achieve synergy with all JIM elements.

(l) The future Modular Force commander requires the capability at BCT and above levels to rapidly coordinate forces and effects, without pausing to stage or reset in both entry and decisive operations, in order to gain and maintain the initiative and apply continuous pressure on the enemy.

(m) The future Modular Force requires the capability at all echelons to connect to and employ strike assets at every echelon and level of command in a JIM environment, in order to provide responsive effects by all elements more rapidly and precisely.

(n) The future Modular Force requires the capability at all echelons to effectively integrate multi-national forces' situational awareness in a JIM environment, in order to permit employment of joint capabilities, self-synchronize, and develop knowledge more effectively.

(o) The future Modular Force commander requires the capability at all echelons to develop CCIR in a dynamic, complex, and unpredictable environment, in order to support effective knowledge development and decisionmaking.

(p) The future Modular Force requires the capability at all echelons to enter knowledge requirements outside the CCIR and military decisionmaking processes, in order to account for unexpected demands for data and information.

(2) *Organization*

(a) The future Modular Force commander requires the capability at all echelons to fulfill data acquisition responsibilities in all operational environments, in order to meet baseline operating requirements.

(b) The future Modular Force commander requires the capability at all echelons to function as a part of and take advantage of JIM collection capabilities, in all operational environments, in order to fully exploit all sources of data and information.

(c) The future Modular Force commander requires the capability at BCT level to operate acquisition architecture in the JIM environment, in order to assure connectivity with the right sources of data and information at the right times and places.

(d) The future Modular Force commander requires the capability at all echelons to conduct cooperative collection in the context of a JIM environment, in order to employ all acquisition capabilities regardless of level of organization or location.

(e) The future Modular Force commander requires the capability to possess and employ organic collection capability at lowest tactical levels, including reconnaissance and surveillance elements at lower echelons than today, in the context of the JIM environment, in order to support inherent tasks in distributed and simultaneous operations.

(f) The future Modular Force commander requires the capability at all echelons to access data and information at the lowest levels of organization with the JIM context, in order to take full advantage of existing data and information and avoid redundant collection.

(3) *Training*

(a) The future Modular Force commander requires the capability at all echelons to share friendly force knowledge across a JIM environment, in order to provide full situational awareness.

(b) The future Modular Force commander requires the capability down to battalion level to conduct data, information and knowledge searches in all operational environments, in order to make full use of existing data and information.

(c) The future Modular Force commander requires the capability at all echelons for data tagging of acquired data in the JIM environment, in order to permit effective use of data and information by all elements.

(d) The future Modular Force commander requires the capability at BCT level to employ advanced collection and sensor management in the JIM environment, in order to optimize use of all JIM collection capabilities.

(e) The future Modular Force commander requires the capability to conduct data access, fusion and management for all levels of command in a JIM environment, in order to maximize use of available data and information.

(f) The future Modular Force Soldier requires the capability at all echelons to know their role in gathering and fusing friendly force data in all operational environments, in order to effectively function as a part of the larger JIM knowledge enterprise.

(g) The future Modular Force Soldier requires the capability of a working knowledge of space-based ISR and communications at every level in the JIM environment, in order to make full use of all acquisition means.

(h) The future Modular Force commander at every echelon requires the capability to adaptively apply collection and gathering systems in all operational environments, in order to support the force in dynamic situations.

(i) The future Modular Force analyst at the BCT level requires the capability of database search skills at lower tactical levels in the JIM environment, in order to acquire data and information without information specialists in every organization.

(j) The future Modular Force analyst at the BCT level requires the capability of expertise in multiple environmental aspects in any operational environment, in order to accurately assess affects, and support planning and execution, to include culture and mores, religion, crime, demographics, linguistics, neutral/undecided entities, cooperating entities, effects on perception of future Modular Force and adversary actions, economics, information, politics, tribes and families, social structure, organized crime, terrorist entities, and transnational organizations.

(4) *Materiel*

(a) The future Modular Force at all echelons requires the capability to have a "refresh rate" or timeliness of update in all operational environments, in order to support accurate decisionmaking and precise maneuver.

(b) The future Modular Force analyst requires the capability to access non-organic intelligence collection capabilities in the JIM environment, in order to collect required data regardless of system location or command relationship.

(c) The future Modular Force at all echelons requires the capability of sensors able to collect against individual personnel, and ambiguous/low-signature systems in the joint operational environment (JOE), in order to counter adaptive threat capabilities.

(d) The future Modular Force at all echelons requires the capability of air, ground and space-based collection systems capable of operating in high-clutter environments, such as jungles or built-up areas, in order to differentiate friendly, enemy and non-combatants.

(e) The future Modular Force requires the capability at all echelons to track and provide status of key civilian/non-combatant elements, such as police or leadership particularly in stability and unconventional warfare operational environments, in order to understand and support restoring public order and enhancing security.

(f) The future Modular Force analyst at the BCT level requires the capability to possess near-instantaneous access to data, information, and knowledge from diverse experts world-wide in all operational environments, in order to deal with subjects outside normal military analyst or staff expertise.

(g) The future Modular Force at all echelons requires the capability of tools and connectivity to conduct distributed, collaborative mission rehearsal on-the-move and across significant distances in the context of the JIM environment, in order to maintain momentum and reduce pauses.

(h) The future Modular Force requires the capability at all echelons of the collection means to determine optimal routes of friendly movement in all operational environments, in order to enhance more rapid maneuver and reduce risk from enemy or environmental hazards.

(i) The future Modular Force requires the capability at the BCT level of automated aids for dynamically tasking collection assets in both conventional and unconventional operations, in order to meet the demands of distribution and continuous operations.

(j) The future Modular Force requires the capability at all echelons to discern adversaries from the civilian population and between factions, while operating in complex physical environments, in order to support non-combatants and defeat adversaries.

(k) The future Modular Force commander and staff require the capability at all echelons to exchange sustainment data in the JIM environment, in order to plan and execute complex sustainment operations.

(l) The future Modular Force requires the capability at all echelons to connect to and collaborate with Army, joint, and national intelligence analysis elements, in order to develop better situational awareness and employ JIM capabilities more effectively.

(m) The future Modular Force requires the capability at all echelons to collaborate with any JIM element in a JIM context, in order to conduct ground operations without time consuming coordination or engineering.

(n) The future Modular Force requires the capability at the BCT level to rapidly establish the required data and information infrastructure in a forward deployed area, in order to tailor knowledge development capabilities to meet operational requirements.

(o) The future Modular Force requires the capability at all echelons to downlink, process and analyze national and commercial imagery from archives and databases in the context of a JIM environment, in order to make fullest and most rapid use of all sources of data and information.

(p) The future Modular Force requires the capability at the BCT level of sensors that detect, identify and locate enemy anti-access capabilities in the JOE, in order to assure the success of shaping and entry operations.

(q) The future Modular Force requires the capability at the BCT level of sensors that detect, identify and locate key enemy nodes and other physical and informational networks in the context of the JOE, in order to conduct operations against enemy systems.

(r) The future Modular Force requires the capability at all echelons of automated reporting aids in the context of the JOE, in order to develop and maintain self-synchronization.

(s) The future Modular Force requires the capability at all echelons of awareness of friendly force locations and activities down to the individual entity level, and warnings when

reliability is out of tolerance in the context of a JIM environment, in order to plan and execute more precisely and rapidly.

(t) The future Modular Force requires the capability at all echelons of database management and access across the JIM, in order to make effective use of all data and information.

(u) The future Modular Force requires the capability at all echelons to provide essential functions of friendly force knowledge regardless of bandwidth, location, or mission in the JIM context, in order to contribute to Joint Battlespace Awareness.

(v) The future Modular Force requires the capability at all echelons of advanced collection capabilities in sufficient numbers and with the flexibility to adapt to the JOE and the enemy's signatures, in order to acquire precise and timely information, and will include-

- Imagery intelligence.
- Geospatial intelligence (GEOINT).
- Signals intelligence (SIGINT).
- Human intelligence (HUMINT), enhanced by advanced tools and training.
- Technical Intelligence.
- OSINT.
- Counterintelligence.
- Measurement and signatures intelligence.
- Operating environment weather observation and processing.
- ES2.
- Less detectable unmanned sensors that can be hidden in the operating environment.
- Biometric collection capabilities at the lowest tactical levels to permit tagging and tracking of individual persons and systems.
- The ability to adjust to new signatures in the operating environment.

(w) The future Modular Force requires the capability at the BCT level to synchronize all collection, transformation, and providing capabilities in the JIM context, in order to successfully collect data and information and includes-

- Intelligence and operations integration capabilities, including collaborative planning tools.
- Sensor visualization.
- ISR planning tools, including the ability to model collection against potential signatures and collaboration with other units and agencies.
- Tools, processes and training to rapidly shift analytical effort to meet rapidly changing conditions.
- Models and simulation to wargame ISR within operations in order to optimize collection strategies.
- Access at every level to space-based ISR and communications capabilities.

(x) The future Modular Force requires the capability at all echelons of sensors that enable Soldiers to “see” through hardened structures to find weapons and enemy personnel in the JOE context, in order to more rapidly execute operations in urban terrain.

(y) The future Modular Force Soldier requires the capability to pinpoint snipers and explosive events in complex environments, in order to protect themselves and accurately engage opponents.

(z) The future Modular Force requires the capability at all echelons of ground penetrating sensors in the context of the JOE, in order to identify hazards, such as mines and IED, for example, X-band radar and hyper-spectral sensors capable of detecting minute changes to soil or ground cover.

(aa) The future Modular Force requires the capability at all echelons of biometrics in the complex JOE environment, in order to identify potential enemies from the general population.

(ab) The future Modular Force staffs and analysts at all echelons require the capability of automated aids in the context of the JIM environment, in order to assist in rapidly developing detailed information requirements, for example, CCIR or measures of effectiveness for effects.

(ac) The future Modular Force requires the capability at all echelons of advanced visualization for sensors, friendly forces and the environment, tied to planning tools and requirements generation systems in the JIM context, in order to maintain near real-time situational awareness.

(ad) The future Modular Force Soldier requires the capability at all echelons of automated support to human collection, for example, ES2 in the context of the JOE, in order to provide and receive intelligence without hindering operational activity.

(ae) The future Modular Force requires the capability at all echelons of the tools and data storage capacity in the JIM context, in order to find and retrospectively review events against collected data to develop patterns.

(af) The future Modular Force requires the capability at battalion and BCT of fully digitized GEOINT data in the context of the JOE, in order to conduct rapid dissemination and manipulation of data.

(ag) The future Modular Force requires the capability at all echelons to collect GEOINT from a wide variety of systems, including combat systems in the JOE environment, in order to provide data and information that can be exploited for a wider variety of uses.

(ah) The future Modular Force requires the capability at all echelons to manipulate and coordinate GEOINT at every level of command.

(ai) The future Modular Force requires the capability at all echelons to model the physical environment and its interaction with other environmental factors, and to understand highly diverse topography, such as, cities and their key buildings and infrastructure in the complex JOE environment, in order to accurately plan and execute all types of operations.

(aj) The future Modular Force requires the capability at all echelons for forward forces to downlink commercial and civil imagery in addition to defense-related products in the JIM context, in order to make timely use of all joint and interagency capabilities.

(ak) The future Modular Force requires the capability at all echelons of tools and connectivity to accurately report highly localized current weather conditions in the JOE context, in order to more accurately anticipate and account for weather conditions on individual units and Soldiers.

(al) The future Modular Force requires the capability of weather forecasting systems at the lowest tactical levels in the JIM context, in order to permit all elements the ability to predict weather without the presence of forecasters at the lowest echelons.

(am) The future Modular Force requires the capability at all echelons of modeling weather effects and interactions in the JOE context, in order to plan and execute with greater precision.

(an) The future Modular Force requires the capability at all echelons to collect local weather conditions from a wide variety of platforms, not simply on purpose-built weather systems in the JIM environment, in order to have the greatest number of stations without an increase in personnel or tasks assigned to small units.

(ao) The future Modular Force requires the capability at all echelons to employ data collection capabilities available through networked ISR, for example, humans, sensors, and data from collection activities in the JIM context, in order to take full advantage of all sources of data and information.

(ap) The future Modular Force requires the capability at the BCT level of real-time knowledge of sensor locations, missions, and status, as well as, continuous collaboration between all operating elements, in order to effectively benefit from and contribute to Joint Battlespace Awareness.

(aq) The future Modular Force requires the capability at lower tactical levels to search databases in the JIM environment, in order to deliver access to relevant information to all elements of the force.

(ar) The future Modular Force requires the capability at all echelons to conduct collection management in the JIM context, in order to rapidly and precisely collect intelligence, including capabilities that-

- Tie into operational planning tools.
- Assist analysts and collection managers in rapidly translating intelligence requirements into collection tasks.
- Assist analysts in developing observables for each collection requirement.
- Assist in planning sensor employment, including the ability to model collection against friendly, enemy, and environmental considerations.
- Assist in assessing the collection process.

(as) The future Modular Force requires the capability at all echelons of ISR management tools in the JIM context, in order to provide the force-

- Sensor COP.
- Collaborative planning tools.
- Collection assessment tools.
- Weather observation strategy.

(5) *Leadership and Education*

(a) The future Modular Force leaders at all echelons requires the capability of understanding how data gathering and collection takes place within the JIM enterprise, in order to more effectively apply resources and make decisions.

(b) The future Modular Force leaders at all echelons require the capability to cooperatively employ assets in the context of the JIM, in order to apply resource and make decisions.

(c) The future Modular Force leaders at the BCT level require the capability to manage data exploitation processes and capabilities in the context of the JIM, in order to make maximum use of data and information.

(d) The future Modular Force leaders at the BCT level require the capability to understand the provenance of data in the context of the JOE, in order to conduct decisionmaking.

(6) *Personnel*

(a) The future Modular Force requires the capability at all echelons to man gathering, collection and sensor tracking systems in the JIM context, in order to properly plan and execute data acquisition.

(b) The future Modular Force requires the capability at all echelons to have the right personnel to conduct collection management in the JIM environment, in order to ensure that commanders' information requirements are planned for executed.

(c) The future Modular Force requires the capability at all echelons to have the right personnel to conduct data exploitation in the context of the JOE, in order to effectively employ a wide variety of data effectively and rapidly.

(7) *Facilities*

(a) Future Modular Force facilities requires the capability to downlink from sources of data and information from all sources, locally, and globally in the JIM context, in order to make the most effective use of data and information.

(b) Future Modular Force facilities requires the capability to possess and employ networks locally and globally in the JIM context, in order to make the most effective use of data and information.

(c) Future Modular Force facilities requires the capability to possess and employ databases, both distributed and centralized in the JIM context, in order to make the most effective use of data and information.

5-3. Transform Capabilities

a. Data and information have limited or no value without the application of human cognition or analysis. The future Modular Force must have the capability to transform data and information rapidly and accurately into usable knowledge, across a wide range of subjects from military logistics to culture and economics.

b. Potential Solution Sets

(1) *Access*. Universal access to data, information, and knowledge is essential to successful transformation activities. Access includes not only data and information sharing within the future Modular Force, but extends to external sources, such as intelligence agencies, joint, and service organizations, coalition partners, open-source data and less traditional sources, such as, experts in industry or academia. Future Modular Force networks and processes must permit nearly continuous access to internal and external data sources, as well as, the flexibility to link with new or non-traditional partners.

(2) *Fuse*

(a) Data fusion must be aided by advanced digital processing and focused search capabilities. The fusion process will include enemy, environmental, and self-knowledge. Fused data can often provide commanders and other decisionmakers information about the enemy's current situation, and in most cases will form the basis for further information and knowledge development.

(b) Intelligence fusion will be the most rigorous and difficult because it operates in the competitive information environment of collection, where data confidence levels are far

lower, analysis and estimation must fill in knowledge gaps, and collected data is more subject to deception and battlefield "fog."

(c) The fusion model used by the DOD is a functional model and defines six levels of fusion (Levels 0-5 defined below). Levels 1 through 3 add progressively to the cognitive hierarchy and encompass most of the intelligence analysis process. Level 4 is the feedback loop and continuously interacts with levels of fusion while Level 5 provides for presentation and visualization of the fusion processes and their products. Within the context of this concept, this model is applicable equally to data about friendly forces, the environment and the enemy, although how each actually functions will vary considerably.

- Level 0 fusion (source preprocessing) is the initial processing accomplished at or near the sensor that ***organizes*** the collected data into a usable form for the system or person who will receive it. This is where characteristics of the collected objects are standardized and compiled.
- Level 1 fusion (entity refinement) takes new inputs; validates and normalizes the new inputs; ***correlates*** them with an existing entity, and updates the knowledge about that entity. In this way it ***identifies*** what the collector physically detects, and ***resolves*** information conflicts. This fusion level reduces redundancy of reported entities, provides the last known disposition or status of an entity, and makes this information available in a database.
- Level 2 fusion (situation refinement) consists of several separate processes. It ***aggregates*** individual entities or elements into larger entities or forces; ***determines*** how those entities are related and working together; ***interprets*** the actions of the entities; ***determines*** the larger activities and places the smaller actions in that context; and ***hypothesizes*** what the entities may be doing or will do and assesses correctness of those hypotheses. Level 2 is the start point for developing situational awareness.
- Level 3 fusion (threat refinement) ***interprets*** events and actions, ***determines*** objectives and how elements plan to operate and ***predicts*** future actions and their potential effects on operations. Level 3 is primarily cognitive today, although automated processing can assist with some elements.
- Level 4 fusion (process refinement) consists of ***assessing*** the entire fusion process and related activities to improve the timeliness, relevance, and accuracy of information and/or intelligence. Its review includes sensors, collectors, analysts, algorithms, information management systems, and staffs.
- Level 5 fusion (user refinement) consists of a set of processes that connect the user to the rest of the fusion process, so that the user can ***visualize*** the feedback/control interface to enhance or improve these products.

(3) *The Fusion Architecture.*[27] This will meet much of the data exploitation requirement for preparing data and databases for data mining. The future Modular Force will design and adapt data architectures to ensure that the right elements and organizations find, relate, and fuse

[27] The Battle Command Concept discusses the fusion architecture as "operating over existing communications networks, must be capable of accepting data from all types of sensors across the force from logistics diagnostics to human observations. This includes sensors on board combat vehicles and Soldiers, multi-national coalition sources, organic purpose-built sensor vehicles and theater, joint, and national sensor constellations."

data from the right sources. This includes estimation tools for determining the probability of data exploitation meeting stated knowledge requirements in a given time frame, as well as, the most effective collection strategy. This architecture must include four modes of operation.

- Manual Operations – Applying human cognition to analyze data without the required use of a computer.
- Computer Assisted Operations – Human initiated, directed, and controlled computer processing of data.
- Semi-Computer Controlled Operations – Human initiated and directed computer processing.
- Total Computer Controlled Operations – Human initiated computer processing of data.

(4) *Analyze.* Human analysis will continue to play the central role in developing knowledge of self, the enemy, and environment, however, significant advancements in tools, networks, processes, and training are needed. Analysts will require access to data from all sources, and the tools to fuse and analyze data, rapidly derive information, and dynamically manipulate and provide knowledge to users across the operational environment. Analysis will demand a far greater range of expertise, for example, irregular forces, terrorism, organized crime, transnational organizations, culture, and social systems, and will often draw assistance from expertise all over the world.

(a) Although future Modular Force tactical organizations will require their own ability to transform data and information into mission-specific knowledge, network-enabled analysis will allow organizations, for example, Knowledge Centers, to assist future Modular Force formations in maintaining situational awareness. This virtual teaming will be especially useful for maintaining awareness during the following instances: the tactical network has been degraded; coordinating data and systems across organizational lines; accomplishing longer-term, complicated analyses, such as understanding threat systems; and assessing the effects of less tangible activities, for example, information operations.

(b) In addition to standard analytical elements and staff, the future Modular Force will require a body of trained and educated Red Team personnel to provide an independent capability to fully explore alternatives in plans and operations in the context of the operational environment and from the perspectives of partners, adversaries, and others.

(5) *Assess*. Knowledge assessment reviews the process of acquiring and transforming data, information and knowledge against users' stated and implied needs; changes to those needs; changes in the operating environment; and changes in the mission or operations of other element of the JIM team. It also sets conditions for delivery, further transformation, or additional acquisition, and often all three simultaneously.

(6) *Transformation at Strategic, Operational and Tactical Levels*. All levels of operation have requirements for knowledge and transform data and information. The ability for each level to meet its demands is not only essential for achieving a common view of the

situation, but it underpins data exploitation. This has several implications for the future Modular Force, which are discussed below.

(a) Transformation that will directly contribute to combined arms operations must be resident at those organizational levels, and provide knowledge at the right time and in the right form to enable decisionmaking. The tempo and complexity of the distributed operational environment will demand responsive and highly tailored knowledge that reach alone cannot satisfy.

(b) Some data and information transformation, for example extremely sensitive SIGINT or HUMINT reporting, may demand centralization at the operational or strategic levels. In these cases, those centers make the data and information available to lower echelons in a timely manner, driving requirements for commanders and other users to be allowed access to the information, the capability to process the data, and analysts with the right skills to interpret and employ the resulting information.

(c) Similarly, some transformation will demand a large amount of fixed communications or computing power, or highly specialized skills. The future Modular Force must have sufficient flexibility built into its structure to conduct its own transformation in some situations, use transformation conducted at higher levels in others, and to collaborate with analysts at any level to solve problems.

(d) The key to effective transformation is the right balance between tactical and operational or strategic capabilities based on the type of operation and the nature of the joint and Service structures. Transformation conducted through reach carries with it risk in terms of timeliness and full knowledge and integration with specific mission requirements, while transformation conducted forward will often suffer from a lack of communications infrastructure and analyst numbers and skills, as well as, situational limitations, such as the need to remain mobile during some phases of operation.

c. Future Capabilities

(1) *Doctrine*

(a) The future Modular Force requires the capability at all echelons to permit data access and sharing for all elements of the future Modular Force and across the JIM, in order to provide for situational awareness and self-synchronization.

(b) The future Modular Force requires at all echelons processes and policies that permit the right information to get the right persons or organizations, regardless of classification or sensitivity within the JIM context, in order to facilitate effective self-synchronization and shared situation awareness.

(c) The future Modular Force requires the capability at all echelons of data transformation processes, for example, architectures, collaboration, access in the JIM context, in order to rapidly and effectively provide knowledge to commanders and other users.

(d) The future Modular Force requires the capability at all echelons to conduct analysis of political, military, economic, sociological, infrastructure and information aspects of the operating environment, in order to allow commanders at all levels deal with the all aspects of their operational responsibilities.

(e) The future Modular Force analysts require at all echelons the capability to conduct collaborative transformation between echelons and across the JIM, in order to share expertise and provide the greatest analytical rigor for commanders.

(f) The future Modular Force commander at the BCT level requires the capability to assess Information Superiority in the JOE context, in order to seize and maintain the initiative.

(g) The future Modular Force at all echelons requires the capability to function within the JIM context by employing classification and security for data, in order to operate effectively.

(h) The future Modular Force requires the capability at the BCT level to apply and modify data standards, particularly regarding raw data from outside the future Modular Force in order to make fullest use of all available data and information.

(2) *Organization*

(a) The future Modular Force requires the capability at all echelons to conduct data transformation at each echelon to account for tempo and distribution, including analytical capacity and lower tactical levels in the context of the JOE, in order to make sense of the information and predict future states.

(b) The future Modular Force requires the capability at the battalion and BCT levels to employ Knowledge Centers in the JIM context, in order to provide knowledge support to deployed future Modular Forces, such as through use of home station operations centers.

(c) The future Modular Force requires the capability to employ a transformation architecture in the context of a JIM enterprise, in order to make complete use of all transformation capabilities.

(d) The future Modular Force requires the capability to apply classification and security standards in the JIM context, in order to provide data, information, and knowledge appropriate to each echelon without delay or loss of precision.

(e) The future Modular Force requires the capability of Red Teams at the BCT level in the context of the JOE, in order to provide commanders with alternate perspectives about friendly, enemy and environmental estimates.

(3) *Training*

(a) The future Modular Force requires the capability of a breadth of knowledge at all echelons in the JIM context, in order to analyze data from across the political, military, economic, social, infrastructure, and information (PMESII).

(b) The future Modular Force requires the capability at all echelons to employ all sources of data, databases and focused search in the JIM environment, in order to support full-spectrum data transformation.

(c) The future Modular Force requires the capability at the battalion and BCT levels to conduct analysis of military data and information across the spectrum of JIM operations, in order to support baseline tactical functions.

(d) The future Modular Force requires the capability at the battalion and BCT levels to conduct fusion processes in the JIM environment, in order to take advantage of all data fusion capabilities at almost all levels of command.

(e) The future Modular Force requires the capability at all echelons of automated transformation aides and tools, to include hardware and software in the JIM context, in order to make full use of all available data and information in support of decisionmaking.

(f) The future Modular Force requires the capability at all echelons to operate the network in the JIM environment, in order to be capable of sharing data, information, and knowledge.

(4) *Materiel*

(a) The future Modular Force analyst at the battalion and BCT levels requires the capability to conduct automated fusion using fusion engines, hardware, and software in the JIM environment, in order to make best use of human cognition in data transformation.

(b) The future Modular Force at the battalion and BCT levels requires the capability of data visualization for sensors, friendly forces, and the environment in the JIM environment, in order to achieve situational awareness and support decisionmaking.

(c) The future Modular Force at all echelons requires the capability of systems for accessing and interpreting non-military PMESII data and information, in the JIM environment in order to successfully accomplish full-spectrum operations.

(d) The future Modular Force at the battalion and BCT levels requires the capability of assessment tools for determining the effectiveness of data acquisition and transformation in the JIM environment, in order to adjust knowledge development as required.

(e) The future Modular Force commander at the BCT level requires the capability of data provenance tools in the context of the JOE, in order to ensure that data and information meets Rules of Engagement and other legal consideration.

(f) The future Modular Force at the battalion and BCT level requires the capability of communications and databasing capacity in the JIM environment, in order to permit en route knowledge development and decisionmaking.

(g) The future Modular Force at all echelons requires the capability of both automated and human language translation capabilities in the context of the JOE, in order to both quantitatively and qualitatively exploit foreign language data and information.

(5) *Leadership and Education*

(a) The future Modular Force leader at all echelons requires the capability to understand transformation processes in the JIM environment, in order to employ capabilities fully and effectively.

(b) The future Modular Force leader at all echelons requires the capability to understand the data exploitation structure and function in the JIM environment, in order to direct and employ the flow of data and information.

(c) The future Modular Force leader at all echelons requires the capability to understand knowledge production processes in the JIM environment, in order to properly apply resources and capabilities.

(d) The future Modular Force leader at the battalion and BCT levels requires the capability of knowledge of PMESII factors impacting potential operating environments within the context of the JOE, in order to accomplish the wide variety of tasks demanded of the force.

(6) *Personnel*

(a) The future Modular Force staff at all echelons requires the capability to conduct data exploitation and fusion at lower tactical levels in the JIM context, in order to successfully support high-tempo, full-spectrum operations.

(b) The future Modular Force at all echelons requires the capability of linguists at lower tactical levels in the JOE context in order to effectively deal with both the environment, for example, population, culture; and data and information.

(c) The future Modular Force requires the capability of specialized analysts for each PMESII element at lower tactical levels to deal with the complexity of joint operations in the JOE context, in order to deal with the wide variety of missions and environments.

(7) *Facilities*

(a) The future Modular Force at the battalion and BCT levels requires the capability of Knowledge Centers in the JIM context, in order to have longer term analysis and studies conducted outside the operating area.

(b) The future Modular Force requires the capability of centers for processing data, information and knowledge, such as command posts, ground stations for sensors, logistics nodes, etc. in the JOE context, in order to cope with the challenges of complexity and distribution.

(c) The future Modular Force requires the capability of large-scale data transformation facilities in the JIM context, in order to support deployed and employed forces.

5-4. Provide Capabilities

a. As knowledge is developed to meet stated and emerging requirements, the future Modular Force must provide and make available knowledge of the friendly, environmental, and enemy situations, and combine those areas into a coherent picture of the situation.

b. Potential Solution Sets

(1) *Transport*

(a) Push-Pull-Data Exploitation. There likely will be multiple methods for transporting data, information, and knowledge. In some cases users will "pull" information, that is, they will actively mine or search out data and information from the network and import those parts that are relevant. Information and knowledge will also be "pushed," that is, provided by other organizations in response to stated or inferred needs. Analysts will also produce knowledge with the aid of data exploitation, which will allow them to find and manipulate extremely large and varied data sets across the network.

(b) Information Management. Orchestration of the flow of data, information and knowledge will become as important to the future Modular Force as the content itself. Not only must the future Modular Force make critical decisions over bandwidth and connectivity, but information management restrictions or priorities will often drive the acquisition and transformation processes, making deliberate choices still more critical.

(c) Focused Search. In order to avoid information overload, analysts in the future Modular Force must have the tools and training to conduct focused search of data to rapidly exploit existing databases for known requirements.

(d) Knowledge Sharing. Knowledge acquired and transferred to coalition partners will be managed by a layered security system that ensures appropriate access to information necessary and appropriately balancing coalition partner needs with security requirements associated with that level of knowledge.

(e) Situational Awareness at the Lowest Tactical Levels. Operating units at every level must be capable of receiving and inputting into the future Modular Force's situational awareness through the COP. While this can involve tens or hundreds of thousands of separate COP capabilities, it is essential to near real-time friendly force knowledge, and makes possible achieving goals, such as self-synchronization and employing joint capabilities at tactical levels.

(2) *Use and Provide Access*

(a) The future Modular Force derives much of its operating capability from how well it is able to generate and employ knowledge. One of the bridges between acquisition of data and employment of the force is network connectivity. To the extent that friction, the enemy or the environment disrupts this connection, the future Modular Force becomes vulnerable. For example, the ability to "self-synchronize," conduct operations around the mission and intent without pausing to orchestrate or reset the force, requires the organization to have a common and near real-time understanding of the enemy, the environment, and friendly forces.

(b) Similarly, the ability to strike effectively in a joint and coalition environment demands the ability not just to know where forces are, but where they will be when the effect is delivered, and with sufficient assurance to prevent fratricide or unintended outcomes.

(3) *Combine.* A wide variety of elements will produce knowledge, but in order to have value, the user must combine them to develop situational awareness. For example, friendly forces knowledge will combine knowledge of operations data (force location, missions, intentions) with sustainment knowledge, force protection knowledge and environmental knowledge. Similarly analysts combine knowledge of the enemy in a framework that relates it to friendly force operations and intentions, as well as, the environment in which both operate.

(4) *Deliver.* As analysts and staffs combine knowledge, they provide it to users. The number and type of user may vary over time, but they populate and support two key processes.

(a) COP. The COP is one of the critical components for a commander to achieve decision superiority, bringing together knowledge developed on the force, the environment, and the enemy in a way that facilitates understanding. While the COP is a command function, it will be one of the key drivers of knowledge generation. The COP will set the parameters for collectors, gatherers, transformers, and providers to develop and provide the right knowledge to users, and especially to commanders. The COP, as a manifestation of the CCIR, will assist in directing the acquisition, and assessing the satisfaction, of those information needs in priority, content, format, and timing.

(b) The Running Estimate. The running estimate provides the commander a continuous, predictive assessment of friendly, environmental, and enemy capabilities and intentions based on knowledge of the current situation and friendly actions. While the COP drives knowledge generation and provides a portrayal of the operational environment, the running estimate provides a continuous estimate of future states to facilitate accurate and timely decisionmaking.

(c) Present. As knowledge is developed, analysts and staff present it in a format that is understandable and tailorable by the commander.

(5) *Strategic, Operational and Tactical Levels.* Every element of the future Modular Force will become an acquisition and transformation capability for the JF. Some implications for the future Modular Force are discussed below.

(a) Various levels of war and a wide variety of users will have vastly different time horizons for acquiring, transforming, and providing knowledge. For example, elements in contact will require that all members of the combined arms team possess useful data, information, and knowledge almost immediately. Higher levels of command conduct more detailed analyses and longer-term studies to support planning and resourcing functions. This disparity in time demands and products imply the need for different structures at each operating level.

(b) All elements in the future Modular Force will acquire data of value to the rest of the force. The ability of these elements to provide the data without disrupting tempo or operations is an essential task for the entire JF. The more automatic the future Modular Force can provide reports, the less the interference with current operations.

(c) The knowledge acquired and transformed at lower levels will be combined with knowledge from higher and adjacent echelons in order to form the most accurate possible view of the operational environment. Often lower tactical organizations, generally brigade and below, will be the most network-constrained element of the joint team, and the future Modular Force must be capable of adjusting resources to meet its scheme of maneuver. At the same time, higher levels providing reach can apply resources to more time consuming studies and products that directly support lower tactical units, for example, trends and patterns.

d. Future Capabilities

(1) *Doctrine*

(a) The future Modular Force at all echelons requires the capability to conduct data access and sharing inside and outside of the future Modular Force within the JIM context, in order to effectively develop and share situational awareness.

(b) The future Modular Force requires the capability at the BCT level of protocols and processes for access to and for providing sensitive data in the JIM context, in order to make fullest use of all sources and forms of data and information.

(c) The future Modular Force requires the capability at the battalion and BCT levels of processes for combining knowledge disciplines in the JIM context, in order to provide data, information, and knowledge in a usable form for situational awareness.

(d) The future Modular Force at the BCT level requires the capability of network operations, including prioritization and permissions in the JIM environment, in order to share data, information, and knowledge at the place and time of its choosing.

(e) The future Modular Force at the battalion and BCT levels requires the capability of information management at each echelon in the JIM environment, in order to manage and make full use of all relevant data and information.

(f) The future Modular Force requires the capability at all echelons to present knowledge to commanders and other users in the JIM context, in order to make developed knowledge understandable and useable.

(g) The future Modular Force requires the capability at the battalion and BCT levels to assess the knowledge development process in the JIM environment, in order to determine effectiveness and adjust its processes.

(h) The future Modular Force requires the capability at the BCT level to reconcile running estimates and knowledge between organizations in the JIM environment, in order to maintain a common view of the situation.

(i) The future Modular Force requires the capability at the battalion and BCT levels of processes and procedures for access to subject matter experts and knowledge centers in the JIM context, in order to extend the capability of commanders, staffs and analysts.

(j) The future Modular Force requires the capability at the BCT level of procedures and architectures for populating external databases in the JIM context, in order to provide knowledge to other organizations.

(2) *Organization*

(a) The future Modular Force requires the capability at all echelons for data and information management organic to each level of command within the context of the JIM environment, in order to effectively manage and make use of data and information.

(b) The future Modular Force requires the capability at all echelons for knowledge development organizations within the future Modular Force structure in a JIM context, in order to provide required expertise and experience.

(3) *Training*

(a) The future Modular Force requires the capability at all echelons for managing information as a key component of combat power in the JIM environment, in order to ensure that commanders have all required knowledge at the right time and place.

(b) The future Modular Force requires the capability at all echelons to present data, information and knowledge, including building and maintaining the components of the COP in the JIM environment, in order to provide near real-time situational awareness.

(c) The future Modular Force requires the capability at the battalion and BCT levels for assessing knowledge against requirements in the JIM context, in order to meet all requirements driven by both CCIR and rapidly changing circumstances.

(d) The future Modular Force requires the capability at the BCT level for assessing Information Superiority in the context of the JOE, in order to provide commanders with a comparative estimate of friendly and enemy knowledge.

(e) The future Modular Force requires the capability at all echelons to access current data from across all JIM elements and functions, in order to build a complete COP.

(f) The future Modular Force requires the capability at the battalion and BCT levels to manipulate and integrate other knowledge in the JIM context, in order to make full use of available data and information.

(4) *Materiel*

(a) The future Modular Force requires the capability at the battalion and BCT levels for push systems, automated and based on stated and implied needs of users, in the context of the JIM enterprise, in order to provide analyzed information rapidly to affected users.

(b) The future Modular Force requires the capability at all echelons for pull systems, the rapid ability to find data, information, and knowledge across the enterprise, in the context of the JIM enterprise, in order to afford access to any users.

(c) The future Modular Force requires the capability at all echelons for presentation systems in the JIM environment, in order to effectively display the combined knowledge of the operational area.

(d) The future Modular Force requires the capability at all echelons for robust network connectivity in the JIM environment, in order to conduct knowledge-based operations without interruption.

(e) The future Modular Force requires the capability at all echelons for software, hardware and connectivity in the JIM and global knowledge environment, in order to gain access to subject matter experts and knowledge centers.

(f) The future Modular Force requires the capability at all echelons of software and hardware to draw from and populate external databases throughout the JIM enterprise, in order to rapidly update all elements.

(g) The future Modular Force requires the capability to agilely and rapidly team with analysts across the JIM network, in order to solve problems and share knowledge.

(h) The future Modular Force requires the capability at the battalion and BCT levels of automated tools for assessing the performance of the network, acquiring, transforming, and providing processes, and how well the system has met stated and emergent requirements within a JIM construct, in order to ensure effectiveness and availability of knowledge development capabilities.

(5) *Leadership/Education*

(a) The future Modular Force leader at all echelons requires the capability to move knowledge, information and data throughout the JIM, in order to assure shared situational awareness and self-synchronization.

(b) The future Modular Force leader at the battalion and BCT levels requires the capability for requirements management in the JIM context, in order to properly manage the entire knowledge development process.

(c) The future Modular Force leader at all echelons requires the capability to understand the implications of collaboration and unity of command in the JIM environment, in order to properly lead units and individuals.

(6) *Personnel*

(a) The future Modular Force requires the capability at the BCT level of knowledge management specialists in the JIM context, in order to assist commanders and staffs in properly employing knowledge development capabilities.

(b) The future Modular Force requires the capability at the BCT level for knowledge delivery specialists, in order to assist commanders and staffs in properly employing knowledge development capabilities.

(7) *Facilities*

(a) The future Modular Force requires the capability of Knowledge Centers in the JIM context, in order to have expertise accessible from forward operating area.

(b) The future Modular Force requires the capability of centers for housing and processing data, information and knowledge in the JIM context, in order to house advanced and sensitive capabilities outside the operational area.

5-5. Data Exploitation Capabilities

a. Data exploitation will enable commanders to track and understand their own organizations without extensive reporting procedures or completely manual searches of databases. As units

plan and execute operations, commanders and other decisionmakers will be able to mine data for redundancies, inconsistencies and unanticipated problems. For example, in stability and reconstruction operations, different units and agencies may be in contact with the same local leaders without recognizing the redundancies and potential conflicts. Data exploitation will allow the organization to better understand itself without additional effort.

b. Potential Solution Sets

(1) *Data Mining.* The future Modular Force must have the ability to find and employ data from vast data sets in order to understand itself, the enemy and the environment in which each operates. Data mining involves many steps including data gathering, data cleaning, feature extraction, pattern discovery, data visualization, and analysis of results, all of which must be accomplished by the future Modular Force to take full advantage of its connectivity to see and understand. It will require a combination of processes, hardware, access to data, supporting software, data warehousing, and trained personnel.

(2) *Data and Database Structures*

(a) Data /metadata[28] configuration. In order to be useful for analysis and data exploitation, data must be indexed, and wherever possible, metadata tagged to permit rapid and full use of data and information.

(b) Database Architectures. Data mining requires specific models for specific mining activities. Future Modular Force analysts will play a significant role in tailoring and refining these models for the most effective exploitation of data.

(c) Access to local and distributed databases. Data exploitation requires more than search of organic data. In order to be effective, analysts from all functional areas must be capable of accessing distributed databases as well.

(3) *Assessing the Data Exploitation Process*

(a) The future Modular Force will require the ability to determine whether elements of the data mining and data preparation processes have functioned properly.

(b) Measures of Performance. This includes the technical performance of data links, architectures, and mining tools. Measures of performance will also determine errors, such as missing data, censored data, obvious statistical outliers, and unusual trends and data ranges. Measures of performance will require a considerable level of automation.

(c) Measures of Effectiveness. Effectiveness is largely a qualitative evaluation of data mining. Commanders, analysts, and users apply measures of effectiveness to determine how well data mining was able to answer requirements. It will also provide human interpretation of errors and anomalies discovered through application of measures of performance. Measures of effectiveness will require considerable human involvement.

[28] Metadata is information that describes or defines the data themselves.

c. Future Capabilities

(1) *Doctrine*

(a) The future Modular Force analyst at the BCT level requires the capability for conducting data mining within the JIM context, in order to fully exploit all acquired data and information.

(b) The future Modular Force at all echelons requires the capability to access all databases in the JIM enterprise, in order to find and employ all potentially useful data.

(c) The future Modular Force requires the capability at the BCT level for developing and implementing data structures and architectures with the JIM construct, in order to facilitate data exploitation processes.

(d) The future Modular Force requires the capability at the battalion and BCT levels to conduct network operations and information management for discoverable databases within the JIM enterprise, in order to take full advantage of all sources and types of data.

(e) The future Modular Force requires the capability at the BCT level to model data and databases throughout the JIM team, in order to visualize and assess data exploitation processes.

(f) The future Modular Force requires the capability at the battalion and BCT levels to perform link and relationship analysis with the JIM, in order to discover relationships through data exploitation.

(g) The future Modular Force requires the capability at the battalion and BCT levels to construct queries with the JIM construct, in order to more effectively search databases.

(h) The future Modular Force requires the capability at the battalion and BCT levels to evaluate data in the JIM environment, in order to determine quality and relevance, and to account for data that is missing, incorrect, or incomplete.

(i) The future Modular Force requires the capability at the BCT level to establish standards for data tagging and use within the JIM environment in order to ensure accessibility and employment.

(j) The future Modular Force requires the capability at the BCT level of developing and accessing metadata in the JIM construct, in order to permit and conduct effective data mining.

(k) The future Modular Force requires the capability at the BCT level of developing and using data provenance or lineage of data that is mined within the JIM context, in order to support decisionmaking.

(l) The future Modular Force requires the capability at the battalion and BCT levels to establish clearances and permissions for access to distributed JIM databases, in order to facilitate effective data exploitation process.

(m) The future Modular Force requires the capability at the BCT level to employ measures of performance for data exploitation processes within the JIM context, in order to assist analysts in assessing and correcting shortcomings in data exploitation.

(n) The future Modular Force requires the capability at the BCT level to employ measures of effectiveness within the JIM context, in order to assist analysts in assessing and correcting shortcomings in data exploitation.

(2) *Organization*

(a) The future Modular Force staff requires the capability for conducting information management and data mining for functional areas within the JIM context, in order to effectively employ data and information in the absence of a high level of technical mining expertise.

(b) The future Modular Force staff requires the capability at the battalion and BCT levels to conduct interdisciplinary databasing and analysis in the JIM construct, in order to more fully employ the enterprise's full data potential.

(c) The future Modular Force requires the capability of analytical capacity at lower tactical organizations within the JIM context, in order to manage data and information for commanders.

(3) *Training*

(a) The future Modular Force staff and analyst requires the capability at the battalion and BCT levels of data management skills within the JIM context, in order to fully employ available data sources and exploitation means.

(b) The future Modular Force requires the capability at all echelons to use automated requirements aids in the JIM construct, in order to define and express the data needs of their functions and organizations.

(c) The future Modular Force requires the capability at the battalion and BCT levels of a working knowledge of other organizations' and activities,' including all elements of the JIM structure, both data structures and content, in order to understand and employ all relevant capabilities.

(d) The future Modular Force requires the capability at the battalion and BCT levels of access to a broad range of analytical skills at lower tactical organizations, including such areas as politics, economics, sustainment, intelligence, and culture within the JIM environment, in order to fully answer organizational knowledge requirements needed to operate.

(e) The future Modular Force requires the capability at the battalion and BCT levels to employ a variety of models and tools needed to exploit data in the JIM construct, in order to assist analysts and staffs in optimizing data exploitation processes.

(f) The future Modular Force staff requires the capability at the BCT level to develop data mining models within the JIM enterprise, in order to effectively exploit data.

(g) The future Modular Force requires the capability at the BCT level to explore and validate data mining models within the JIM context, in order to understand and adjust data exploitation processes without the presence of technical experts in all organizations.

(4) *Materiel*

(a) The future Modular Force requires the capability at the BCT level to adjust mining models in the JIM construct, in order to optimize data acquisition based on the probability of data exploitation finding required information.

(b) The future Modular Force requires the capability at the battalion and BCT levels for hardware and software at all levels to permit data mining and modeling within the JIM enterprise, in order to fully exploit all data sources and types.

(c) The future Modular Force requires the capability at the battalion and BCT levels of network resources and computing/warehousing capacity to permit full use of databases across the JIM enterprise, in order to fully conduct data mining.

(d) The future Modular Force analyst requires the capability at the battalion and BCT levels of analytical aids and tools in the JIM context, in order to permit the most effective use of human effort.

(e) The future Modular Force requires the capability at the battalion and BCT levels of adequate network connection in the JIM environment, in order to assure analysts can conduct data mining processes without significant delay.

(f) The future Modular Force requires the capability at the battalion and BCT levels of adequate computing power within the JIM environment, in order to assure that automated, intensive mining activities can be accomplished rapidly and effectively.

(g) The future Modular Force requires the capability at the battalion and BCT levels of adequate electrical generation capability within the JIM context, in order to assure that power intensive mining and computing activities can be accomplished rapidly and effectively.

(h) The future Modular Force requires the capability at the battalion and BCT levels of software or “smart” agents within the JIM construct, in order to automate some aspects of data exploitation.

(i) The future Modular Force requires the capability at all echelons of algorithms for searching multiple, distributed databases, including machine learning and automated discovery tools within the JIM enterprise, in order to assist analysts in rapidly and effectively exploiting all available databases.

(j) The future Modular Force requires the capability at all echelons of data visualization tools within the JIM context, in order to find, understand, and use data from all sources.

(k) The future Modular Force requires the capability at the battalion and BCT levels of predictive analysis tools within the JIM context, in order to provide statistical correlation between data, including such tools as decision trees, neural networks, and other pattern matching algorithms.

(l) The future Modular Force requires the capability at all echelons to access stream data, such as full motion video and economic data within the JIM context, in order to exploit all potentially relevant sources of data and information.

(m) The future Modular Force requires the capability at the battalion and BCT levels to temporarily consolidate and manipulate large amounts of data within the JIM enterprise, in order to effectively mine data.

(n) The future Modular Force requires the capability at the battalion and BCT levels of tools to identify and tag unstructured data outside the JIM environment, in order to make use of all data and information.

(o) The future Modular Force requires the capability at the BCT level to deploy and update data mining models within the JIM enterprise, in order to dynamically adjust data mining processes.

(p) The future Modular Force requires the capability at the battalion and BCT levels of automated analytical tools within the JIM enterprise, in order to assess the performance of data exploitation processes.

(5) *Leadership and Education*

(a) The future Modular Force leader requires the capability at the battalion and BCT levels for understanding and employing hardware and software with the JIM context, in order to permit data mining and modeling.

(b) The future Modular Force leader requires the capability at the battalion and BCT levels for understanding and employing databases, data architectures, and structures within the JIM context, in order to effectively lead and direct organizations and staffs.

(c) The future Modular Force leader requires the capability at the battalion and BCT levels for understanding and using data provenance within the JIM context, in order to support effective decisionmaking and compliance with rules of engagement.

(6) *Personnel*

(a) The future Modular Force requires the capability at all echelons of dealing with increased demands on intellect and breadth of experience within the context of the JIM, in order to effectively develop information and knowledge.

(b) The future Modular Force requires the capability for analytical expertise at all echelons within the JIM construct outside of normal military functions, in order to deal with full spectrum requirements.

(c) The future Modular Force requires the capability at the battalion and BCT levels to employ data mining and modeling within the JIM construct, in order to accomplish staff and analyst requirements.

(7) *Facilities*

(a) The future Modular Force requires the capability to establish and operate knowledge centers inside the JIM enterprise, in order to support forward deployed knowledge development.

(b) The future Modular Force requires the capability for data warehousing, physical and virtual, within the JIM enterprise, in order to conduct full data mining activities.

Chapter 6
Conclusion

a. Acquiring and developing knowledge will form the basis for every successful action performed by the future Modular Force. Commanders must plan and execute operations based on the most detailed knowledge possible of the state of their own forces and the operating environment, and intelligence about the enemy. Strike is a key component of maneuver and joint effects, and the future Modular Force's ability to gather and process knowledge in close proximity to adversary forces, particularly shielded or ambiguous targets, will provide crucial contributions to successful strike and damage assessment. The distributed nature of the operational environment will place a premium on knowledge to support every element of the future Modular Force, providing the ability to sustain and protect forces and operations in the face of an opportunistic adversary. In irregular warfare, knowledge requirements will often be more difficult to obtain as opponents' identity is often unclear, data elements are more numerous and ambiguous, and emphasis is shifted from physical terrain to culture and human aspects of the environment.

b. Through its ability to acquire data, information, and knowledge and a radically better ability to mine and manipulate large data sets, the future Modular Force will possess significant operational advantages. It will have access to or possess advanced sensor capabilities, permitting more agile and mission-based collection. Commanders will understand their forces with a high degree of assurance, enabling self-synchronization, rapid joint strike, and distributed sustainment. Knowledge of the environment will afford the future Modular Force many of the same benefits of local knowledge as its opponent.

c. The future Modular Force will also take advantage of advances in data and information transformation. Data exploitation will permit human analysis, aided by automated tools, to more rapidly develop information and knowledge, and to find patterns and linkages not readily apparent today using largely manual mining methods. Commanders and other users will be able to "pull" information from a wide variety and number of databases and knowledge centers, simultaneously broadening and deepening their knowledge. The future Modular Force will also be able to provide the benefit of its unique acquisition capabilities to the JF by "pushing" data, information, knowledge and at times tailored products throughout the JIM team. Together, these strategies for transforming data and information into knowledge will improve the operational value of data acquisition, and directly impact tactical and operational decisionmaking.

d. Finally, the net-enabled environment will allow more rapid, tailored movement of knowledge, permitting users throughout the operational environment to employ anything produced by any element of the JIM team. To the extent that the future Modular Force commander is able to understand and decide more effectively than the enemy, the force will be able to set the tempo of operations, retain the initiative, and ultimately possess the best opportunity to achieve tactical and operational decision superiority.

Appendix A
References

Section I
Required Publications

Capstone Concept for Joint Operations, Version 2.0.

Functional Concept for Battlespace Awareness.

JP 3-0
Joint Operations.

The Joint Operational Environment: The World Through 2030 and Beyond.

TRADOC Pam 525-3-0
The Army in Joint Operations, Version 2.0.

TRADOC Pam 525-3-1
The Army Operating Concept for Operating Maneuver 2015-2024.

TRADOC Pam 525-3-2
The Army Concept for Tactical Maneuver 2015-2024.

TRADOC Pam 525-3-3
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Section II
Related Publications

Advanced Database Research Group, Project on Data Provenance. University of Arizona, "Understanding Semantics of Data Provenance", Tsinghua University Research Seminar, Beijing, China, June 21, 2006.

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FM 1-02
Operational Terms and Graphics.

FM 3-0
Operations.

FM 5-0
Army Planning and Orders Production.

FMI 5-0.1
The Operations Process.

FM 6-0
Mission Command: Command and Control of Army Forces.

JP 1-02
DOD Dictionary of Military and Associated Terms.

JP 2-0
Doctrine for Intelligence Support to Joint Operations.

JP 3-13.1
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TRADOC Pam 525-3-0.1
U.S. Army Battle Command Concept.

TRADOC Pam 525-3-4
The United States Army Functional Concept for Strike 2015-2024.

TRADOC Pam 525-3-5.
The United States Army Functional Concept for Protect 2015-2024.

TRADOC Pam 525-3-6
The United States Army Functional Concept for Move 2015-2024.

TRADOC Pam 525-4-1
The United States Army Functional Concept for Sustain 2015-2024, 30 April 2007.

U.S. Army Transformation Roadmap.

Appendix B
Assumptions

a. Opponents will continue to adapt their organizations and operations in response to U.S. capabilities. If future conflicts involve peer and near peer competitors, the organization, echelon and capabilities of the future Modular Force may vary considerably from this concept.

b. The future Modular Force will have highly reliable internal and external connectivity within the larger global network.

c. Advancements in automation will permit high amounts of data to be mined without significant levels of human intervention. Should the trend in advancements slow in developing the ability to mine and employ disparate data into information, and provide that information through the network, the future Modular Force would require alternative capabilities.

d. Army and DOD efforts to establish horizontal integration throughout the force will provide the information architecture needed to allow all elements of the JF to share data, information, and knowledge.

Glossary

Section I
Abbreviations

C3	command, control, and communications
CCIR	commander's critical information requirements
CBRN	chemical, biological, radiological, and nuclear
CCJO	Capstone Concept for Joint Operations
COP	common operational picture
DA	Department of the Army
DOD	Department of Defense
DOTMLPF	doctrine, organization, training, material, leadership and education, personnel, and facilities
ES2	every Soldier a sensor
FM	field manual
GEOINT	geospatial intelligence
HUMINT	human intelligence
IED	improvised explosive device
IMINT	imagery intelligence
ISR	intelligence, surveillance and reconnaissance
JF	joint force
JIM	joint, interagency, and multi-national
JOA	joint operations area
JOE	joint operational environment
JP	joint publication
METT-TC	mission, enemy, terrain and weather, troops and support available, time available, and civil considerations
OSINT	open source intelligence
PAM	pamphlet
PMESII	political, military, economic, social, infrastructure, information
SA	situational awareness
SIGINT	signals intelligence
TRADOC	United States Army Training and Doctrine Command
U.S.	United States

Section II
Terms

acquire
To obtain data about the friendly force, the environment, and the enemy in order to support development of relevant information and knowledge that supports understanding. [Derived definition from Merriam-Webster].

analysis
In intelligence usage, the conversion of processed information into intelligence through the integration, evaluation, analysis, and interpretation of all source data. [Derived from JP 1-02]. The process by which collected information is evaluated and integrated with existing information to produce intelligence that describes the current, and predicts the future, impact of the threat and/or environment on operations. [FM 34-3]. Determination of the significance of the information, relative to information and intelligence already known, and drawing deductions about the probable meaning of the evaluated information. [FM 2-0].

battlespace awareness
The situational knowledge whereby the JFC plans operations and exercises command and control. It is the result of the processing and presentation of information comprehending the operational environment, the status and dispositions of friendly, adversary, and non-aligned actors; and the impacts of physical, cultural, social, political, and economic factors on military operations. [The Battlespace Awareness Functional Concept].

collaborative information environment
Tools and protocols to enable the sharing of quality information among and across disparate organizations. [Battlespace Awareness Functional Concept].

collaborative planning
The real-time interaction among commanders and staffs at two or more echelons developing plans for a particular operation. [FM 1-02].

collect
The competitive acquisition of data and information on the enemy and some aspects of the environment. Collecting typically applies to data gathering in support of the intelligence process. [Derived definition from Merriam-Webster].

commander's critical information requirements (CCIR)
A comprehensive list of information requirements identified by the commander, as being critical in facilitating timely information management and the decisionmaking process, that affects successful mission accomplishment. The two key subcomponents are critical friendly force information and priority intelligence requirements. (Army) – Elements of information required by commanders that directly affect decisionmaking and dictate the successful execution of military operations. (FM 3-0) (Marine Corps) Information regarding the enemy and friendly activities and the environment identified by the commander as critical to maintaining situational awareness, planning future activities, and facilitating timely decisionmaking. [Note: in Marine

Corps usage, commander's critical information requirements are normally divided into three primary subcategories: priority intelligence requirements, friendly force information requirements, and essential elements of friendly information.] See essential elements of friendly information; information, intelligence, and priority intelligence requirements. [FM1-02].

common operational picture
Single display of relevant information within a commander's area of interest, tailored to the user's requirements, based on common data and information shared by more than one command. [JP 1-02] An operational picture tailored to the user's requirements, based on common data and information shared by more than one command. Also called COP. [FM 3-0].

cooperative employment
The employment of combined arms or joint capabilities across organizational boundaries without changing command or support relationships. In intelligence, it is the shared use of collection capabilities across the joint and coalition force, through collaboration and networked sensor links. [Derived definition from Merriam-Webster].

data
The lowest level of information on the cognitive hierarchy. Data consist of unprocessed signals communicated between any nodes in an information system, or "sensings" from the environment detected by a collector of any kind (human, mechanical, or electronic). [FM 6-0].

data exploitation
The extraction of implicit, previously unknown, and potentially useful knowledge from data, and includes not only the actual extraction of data, but the preparation of data, and the assessment and optimization of the data preparation and mining process. [Derived from Knowledge Discovery and Informatics literature].

data fusion
A multilevel, multifaceted process dealing with the automatic detection, association, correlation, estimation, and combination of data and information from single and multiple sources [U.S. DOD data Fusion Sub-panel of the Joint Directors of Laboratories, Technical Panel for C3, "Data Fusion lexicon," 1991.]

data mining
The non-trivial extraction of implicit, previously unknown, and potentially useful knowledge from data. A variety of techniques used to identify nuggets of information or decisionmaking knowledge in bodies of data, and extracting these in such a way that they can be put to use in areas, such as decision support, prediction, forecasting, and estimation. [Data and Analysis Center for Software].

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 its mission. [Joint Vision 2020].

de-confliction
Preventing elements of the JF from operating at cross-purposes. [Joint Command and Control Functional Concept].

explicit
Fully revealed or expressed without vagueness, implication, or ambiguity; leaving no question as to meaning or intent. [Derived from Merriam-Webster Dictionary].

fusion architecture
A system of components whose structure and integration enables it to perform the functions of processing data and information. The fusion architecture describes how and where data handling and processing will occur. [Derived from U.S. Army Battle Command Concept].

gather
The non-competitive acquisition of data and information on friendly forces and some aspects of the environment. [Derived from Merriam-Webster Dictionary].

implicit
Capable of being understood from something else though unexpressed. Involved in the nature or essence of something though not revealed, expressed, or developed. [Derived from Merriam-Webster Dictionary].

information
The meaning that a human assigns to data by means of the known conventions used in their representation. A collection of related data. [JP 3-13.1] In the general sense, the meaning humans assign to data. In the context of the cognitive hierarchy, data that have been processed to provide further meaning. [FM 6-0].

information management
Collection, processing, storage, display, dissemination, and presentation, to facilitate situational understanding and decisionmaking while maximizing the effective use of available information resources. [U.S. Army Battle Command Concept]. The provision of relevant information to the right person at the right time in a usable form to facilitate situational understanding and decisionmaking. It uses procedures and information systems to collect, process, store, display, and disseminate information. [FM 6-0].

information superiority
That degree of dominance in the information domain which permits the conduct of operations without effective opposition. [Joint C2 FC]. The operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same. [FM 3-0].

intelligence
The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas; Information and

knowledge about an adversary obtained through observation, investigation, analysis, or understanding. [JP 2-0].

intelligence running estimate
A continuous flow and presentation of relevant information and predictive intelligence, when combined with other staff running estimates, enable the decisionmakers visualization and situational understanding of the AOI in order to achieve information superiority. [FM 2-0].

intelligence, surveillance, and reconnaissance
An enabling operation that integrates and synchronizes all battlefield operating systems to collect and produce relevant information to facilitate the commander's decisionmaking. Also called ISR. [FM 1-02].

knowledge
In the context of the cognitive hierarchy, information analyzed to provide meaning and value or evaluated as to implications for the operation. [FM 6-0].

knowledge discovery in databases
The non-trivial extraction of implicit, previously unknown, and potentially useful knowledge from data; A variety of techniques used to identify nuggets of information or decisionmaking knowledge in bodies of data, and extracting these in such a way that they can be put to use in areas, such as decision support, prediction, forecasting, and estimation. (Term is often used synonymously with Data Mining) [DOD Data and Analysis Center for Software].

metadata
Information about information. More specifically, information about the meaning of other data. [DOD Discovery Metadata Standards (DDMS). Metadata is information that describes or defines the data themselves. [Derived definition from Merriam-Webster Dictionary].

military systemology
A theory of modern warfare that views armed conflict as a process of mutual interactions between the complex systems of the contending sides. The method of military systemology emphasizes complexity and the need for models based on dynamic, evolving, self-organizing systems and emphasizes a shift from modeling combat as force-on-force to system versus system. [29] In systemology, the forecaster searches for ways combat systems and subsystems can maintain effectiveness and how enemy combat systems can be disrupted by targeting critical subsystems for destruction, disruption or neutralization.[30]

network
An interconnection of three or more communicating entities and (usually) one or more nodes. A combination of passive or active electronic components that serves a given purpose. [FM 25-1-1 Information Technology Support and Services 25 October 2006].

29 Forecasting Future War: Andrei Kokoshin and the Military-Political Debate in Contemporary Russia Andrei Kokoshin: Scholar and Bureaucrat; Dr. Jacob W. Kipp, Foreign Military Studies Office, Fort Leavenworth, KS. January 1999.

30 Confronting the RMA in Russia by Dr. Jacob W. Kipp, Foreign Military Studies Office, Fort Leavenworth, KS. Military Review, June-July 1997.

observables
A physical property, such as weight or temperature, that can be observed or measured directly, as distinguished from a quantity, for example, work or entropy, that must be derived from observed quantities. [American Heritage Dictionary] Observables are the unique descriptive features associated with the visible description (or signature) of the target, whether it is specific units, equipment or facilities. [MCWP 2-2 MAGTF Intelligence Collection]. All military activities produce "observables" related either to time, space and mass, or to a specific platform or system. It is the observable that sensors detect, and fusion and analysis interpret to provide meaning. [TRADOC Pamphlet 525-3-0.1].

persistent surveillance
Continuous or near-continuous monitoring or tracking of targets and areas of interest. It may be accomplished by one type of system or means, or by multiple systems and means. [Derived definition from Battlespace Awareness FC] A collection strategy that emphasizes the ability of some collection systems to linger on demand in an area to detect, locate, characterize, identify, track, target, and possibly provide battle damage assessment and re-targeting in near or real-time. Persistent surveillance facilitates the formulation and execution of preemptive activities to deter or forestall anticipated adversary courses of action. See also **surveillance.** [JP 2-01].

precision engagement
The ability of JFs to locate, surveil, discern, and track objectives or targets; select, organize, and use the correct systems; generate desired effects; assess results; and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations. [Joint Vision 2020].

provenance
A special form of audit trail that traces each step in sourcing, moving, and processing data. It can apply to a single data item, a logical data record, a subset of a database, or to an entire or database. Metadata provides the means to create a record of provenance in a consistent and structured way. [Derived definition]. Provenance refers to the knowledge that enables a piece of data to be interpreted correctly. It is the essential ingredient that ensures that users of data (for whom the data may or may not have been originally intended) understand the background of the data. [Advanced Database Research Group, University of Arizona, National Science Foundation Project on Data Provenance].

reconnaissance
A mission undertaken to obtain visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. [JP 1-02].

red teaming
Red teaming is a function executed by trained, educated, and practiced team members that provides commanders an independent capability to fully explore alternatives in plans, operations, concepts, organizations, and capabilities in the context of the operational environment and from the perspectives of partners, adversaries, and others. [University of Foreign Military and Cultural Studies, Fort Leavenworth, KS].

self-synchronizing
The ability to arrange military actions in time, space, and purpose to produce maximum relative combat power at a decisive place and time using the mission and intent and without pauses or transitions to orchestrate the force. [Derived definition] The collaborative and decentralized initiation and execution of actions by elements of a JF in support of the desired end state. Also defined as the interaction between two or more entities to operate in the absence of hierarchical mechanisms for Joint C2. [Joint C2 FC].

situational awareness (SA)
Knowledge and understanding of the current situation which promotes timely, relevant, and accurate assessment of friendly, enemy, and other operations within the battlespace in order to facilitate decisionmaking. An informational perspective and skill that fosters an ability to determine quickly the context and relevance of events as they unfold. [Marine Corps; FM 3-0] Situational awareness is knowledge of the immediate present environment, including knowledge of the factors of METT-TC. More simply, it is knowing what is happening around you now. In the context of the cognitive hierarchy, situational awareness is at the knowledge level. [FM 5-0.1].

situational understanding
The product of applying analysis and judgment to the common operational picture to determine the relationship among the factors of METT-TC. [FM 3-0].

surveillance
The systematic observation of aerospace, surface or subsurface areas, places, persons or things, by visual, aural, electronic, photographic or other means. [JP 1-02].

synchronization
(1) The arrangement of military actions in time, space, and purpose to produce maximum relative combat power at a decisive place and time; and (2) in the intelligence context, application of intelligence sources and methods in concert with the operation plan. [JP 2-0; FM 3-0].

System of Systems
A grouping of organized assemblies of resources, methods, and procedures regulated by interaction or interdependence to accomplish a set of specific functions. For example, a "system of systems" could include the economic entities in a nation, such as the banking system, production system, etc. [Joint Forces Command Glossary].

transform
The process of fusing related data into information, and analyzing situationally relevant information to produce knowledge. [New definition].

understanding
In the context of the cognitive hierarchy, knowledge that has been synthesized and had judgment applied to it in a specific situation to comprehend the situation's inner relationships. [FM 6-0]. Understanding typically refers to knowledge in the mind of the commander. [U.S. Army Battle Command Concept].

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