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Battlespace Dominance in Expeditionary Warfare
The Challenge of Defeating a "Knowledge-Superior" Enemy

INTRODUCTION

Phrases such as "knowledge superiority", "dominant battlespace awareness", "speed of command", and the like are often used to express a vision of warfighting in which our superior ability to gather, process, disseminate, and use information will tip the scales in favor of our forces. This is an essential element in concepts such as Joint Vision 2010 (JV 2010) and Network-Centric Warfare.

The purpose of this paper is to view knowledge superiority in a different light, within the context of expeditionary warfare. When we project power into the homeland of our enemy or in territory adjacent to that homeland, we could be faced with a situation far different from the one in our visions, and we may find that the enemy has the advantage of information superiority.

THE "TILTED PLAYING FIELD"

Expeditionary operations are, by definition, fought on or near the enemy's territory. Clearly, the scales could be tipped strongly in the enemy's favor with respect to knowledge of the area and of everything that happens in that area. Where we may have to rely on technology to provide intelligence preparation of the battlespace and to support tactical engagements, the enemy could have a base of local knowledge and resources that provide far better information. This could include the services of indigenous enemy military and civilian personnel and enemy sympathizers among our local allied population. Any well prepared enemy would make sure that he had such local support.

The enemy would not need to rely on overhead sensors, synthetic aperture radars, or any other sophisticated technology to observe the situation in real time and in any desired detail. Our experiences in Vietnam, in Somalia, and in the Balkans, and Soviet/Russian experiences in Afghanistan and Chechnya attest to the effectiveness of the web of human sensors and processors that could be spread throughout the land area of battle. This web can provide real time information to support operational planning and tactical execution. The enemy also knows the terrain far better than we do. He knows where all the roads, bridges, tunnels, caves, swamps, and other features are, and he understands details of trafficability, concealment, and so forth. He also may have prepared defenses such as land mines and booby traps, whereas we have to search to find them.

As a result, the initial "playing field" could be "tilted" in favor of the enemy, and we could operate initially from a position of extreme information inferiority. We need to find a way to apply technology to "tip" the "field" back toward our favor to compensate for this initial inferiority. When the enemy is "user friendly", as in the Gulf War, we may actually achieve information dominance. However, in most cases the enemy will be clever and will continue to use his resources to see and understand the battlespace better

than we do. The Army's experience in Somalia is an unfortunate example of how a clever enemy was able to use and manage local assets to establish battlespace dominance against a force that was far more powerful.

We need to apply the technology advantages that we do have to enable us to use information more effectively and to "tip the scale" back toward our favor by being able to act on information more effectively than the enemy. This could compensate for the initial disadvantage that we have. The main point to understand is that we need to approach battlespace dominance not from an assumed initial basis of information dominance or even parity but from a basis of inferiority. We need to try to compensate for this disadvantage by leveraging whatever resources we have in the most effective way possible.

The technologies that can make a real contribution to offset enemy knowledge superiority are the information processing, management, and dissemination technologies that help the warfighters make decisions and take actions based on the full range of information available to the force. Even if our knowledge is only 70% or 80% as good as the enemy's, we may still achieve information dominance by being able to act on that information better and faster than the enemy. For example, if we have a 2-to-1 advantage in acting on information, our 70% disadvantage could become a 140% advantage. The overall "playing field" would become "tipped" in our favor. We need to recognize that our advantage probably will not come from superior battlespace awareness but rather from ability to act more effectively than an enemy, getting the most out of the information that we do have.

A GRAPHICAL DISPLAY OF BATTLESPACE DOMINANCE FACTORS

Graphical displays are sometimes useful ways to summarize relationships among factors contributing to an overall capability.

The following graphic display is illustrative of the interplay among battlespace awareness and ability to use information to achieve dominance. The Euclidean coordinate system and the orthogonal orientation of the two coordinate axes is not intended to imply mathematical precision in combining the factors but is only to illustrate how we can use improvements in one factor to compensate for shortfalls in the other.

In this display, the enemy capabilities are indicated by a black diamond and friendly capabilities are indicated by a circle.

The enemy is shown to have an advantage in battlespace awareness (the horizontal axis), and the friendly force is shown to have an advantage in its ability to act on information (the vertical axis). The relative advantages are indicated for each of these axes.

The graph shows the resultant battlespace effectiveness "vector" for both the enemy and the friendly force, assuming that effectiveness is simply the vector sum of the two

orthogonal contributions. Recall that this is not intended to be mathematically precise but only to help illustrate the principle.

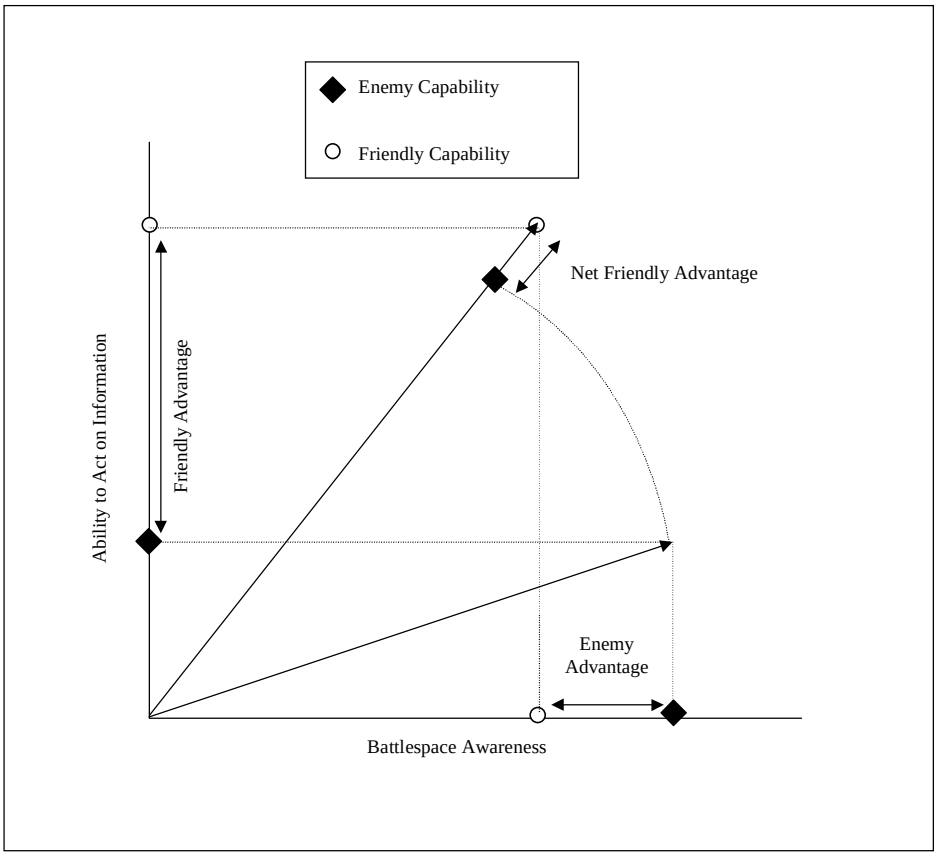

Illustration of Knowledge-Related Contributions to Battlespace Effectiveness

The graph shows how the resultant capability vectors can be compared to yield a net advantage for the friendly forces. This is done by rotating the resultant effectiveness vector for the enemy so that it lines up with the resultant for the friendly force. In this illustration, the friendly force vector is longer, and that indicates the advantage.

The key to achieving superior effectiveness is to increase advantage for factors under our control to compensate for disadvantages for factors that are beyond our control. This can provide us with superior speed and precision in command and execution even though the enemy may have advantages in battlespace knowledge.

OPERATING INSIDE THE ENEMY'S "OODA LOOP"

The OODA loop is a depiction of the process for deciding and acting based on observations of the battlespace. The acronym stands for Observe-Orient-Decide-Act. The OODA loop appears wherever a decision and action is needed, from strategic or operational planning through sensor-to-shooter execution.

If our OODA loop is faster than the enemy's, we have an advantage in being able to respond to his actions before they have the desired effect and to seize the initiative and force him to respond to our actions. This introduces an advantage in "speed of command". That advantage raises the point on the vertical axis in the previous illustration that corresponds to the friendly ability to act on information. It contributes to the friendly advantage relative to the enemy's ability to act on information, and it contributes to the overall friendly advantage in battlespace effectiveness. As a result, it helps introduce a "tilt" in our favor.

Speed and precision in the OODA loop can be achieved by applying technology to integrate, process, and manage information throughout the grid to help the warfighters identify and execute appropriate courses of action. A powerful feature of automated systems is their ability to perform computations very quickly and to be able to "remember" and compare quantitative results. As a result, they can help the warfighters evaluate many options quickly and precisely to develop courses of action at any desired level of detail. They can also keep track of large volumes of situation information and provide alerts, cues, and recommendations for adjusting the course of action during execution of the missions.

The United States has clear technological advantages over most potential adversaries, in particular in the areas of "intelligent software" and distributed computing. Those areas are key enablers of a faster OODA loop. For example, we are fielding systems that can identify and characterize time critical targets and develop targeting packages very quickly, and we can disseminate the information to all elements of the execution team. Our capabilities in areas such as image processing, data compression, and automated mission planning tools far exceed those of any enemy and allow us to take advantage of the transient opportunities to exploit critical battlespace knowledge.

Our ability to react swiftly and precisely against time critical targets will limit the ability of an enemy to employ massive forces against us, and it will begin to "tip" the scales in a favorable direction but it will not necessarily "tip" them back in our favor. An enemy operating within his home territory has too many options that deny us the full effectiveness of this technology.

DISTRIBUTED, SELF-SYNCHRONIZED OPERATIONS

The force effectiveness is further enhanced if each element of the force can respond in near real time to the situation in such a way that coherence across the force is maintained without time-consuming centralized control. This can be accomplished only if the individual elements of the force have the same understanding of the situation with respect to their individual roles, responsibilities, and assignments and if they share common doctrine, tactics, techniques, and procedures for responding to changes in the situation. If these conditions apply, and if the force is trained sufficiently for this type of decentralized control, self-synchronization can be achieved.

A self-synchronized force has many advantages over a centrally controlled force or a decentralized and unsynchronized force. The main advantage is that each element of the force can take immediate actions to exploit operational and tactical opportunities or to respond to unexpected contingencies without disrupting the overall coherence and unity of command. It allows each warfighter to exercise initiative within predefined bounds and consistent with commander's intent and with the understood cooperative reactions to other elements of the force when that initiative is taken. It allows for the ad hoc establishment of tactical task teams as well as automatic self-deconfliction across other tasks and functions being performed.

Distributed, self-synchronized execution allows each element of the force to use its OODA loop with full effectiveness rather than being constrained by higher level command OODA loops. It also helps assure that the individual OODA loops will result in actions that are consistent with the overall force-level objectives and with one another.

US capabilities for distributed, mobile computing and communications provide the basis for a significant advantage over most potential enemies. Our forces are trained to exercise initiative. Information systems that provide consistent battlespace knowledge and ability to evaluate alternative actions in near real time are the tools that they need to be able to apply initiative in a distributed, self-synchronized way.

It is important to note that the force can operate in this manner even if the battlespace knowledge is incomplete. The key requirement is that it is consistent across the force. The more complete the information, the more precise and effective the actions, but any reasonable degree of battlespace knowledge can support some degree of enhanced effectiveness through distributed self-synchronization.

When a force operates this way, it is important that the commanders have some means to monitor actions and to reimpose hierarchical control when self-synchronization errors reach limits of acceptability. This is a principal element in many control systems. For example, a thermostat will turn on either a heat source or a cooling source when temperature reaches a control limit. The self-synchronized force needs to be monitored and controlled in much the same way. Centralized monitoring can detect when the commander needs to "control by exception". As we move toward this concept for decentralized control we will need to implement new information processing capabilities to support "control by exception". Once again, the US has clear advantages in the technology areas that will allow this.

ACHIEVING BATTLESPACE DOMINANCE

The Revolution in Military Affairs (RMA) envisioned in JV 2010 can be achieved by applying information technology and adapting operational concepts to improve the way that we acquire and use information.

The approach can be considered as three levels that build upon one another:

- Acquiring, disseminating, and integrating information
- Processing, displaying, and understanding information
- Determining how to act on information

The first level of capability involves sensors, sensor processors, and communications to extract information from the environment and to move it to where it is needed. This provides us with the best knowledge of the battlespace that we can achieve and corresponds to the "observe" phase of the OODA loop. We may not have as clear and complete a view of the battlespace as the enemy has, but we need to try to do the best job with the resources that we do have.

The next level builds upon the battlespace knowledge that was achieved. This level of capability appraises the available information to identify significant patterns and to define critical pieces that are missing or that are ambiguous. At this level, we reach some understanding, corresponding to the "orient" phase of the OODA loop. Here we begin to achieve some degree of advantage over the enemy, since our technology should help us interpret fragmentary information and correlate observations with complex models of friendly and enemy capabilities and behaviors. We therefore begin to have an advantage in using the information available to us. Technologies for imagery interpretation, multimedia information integration, case-based and constraint-based reasoning, and visualization are key enablers at this level.

The third level builds upon understanding to support the decision to act. This is probably the area where we have the greatest potential to exploit battlespace awareness to think and perform faster and better than the enemy. This corresponds to the "decide and act" phases of the OODA loop. The information technologies at this level are extremely sophisticated and can consist of "artificial intelligence", "intelligent agents", "faster-than-real-time simulation", and the like.

If we can build strong capabilities at each level, the end result can be battlespace dominance. We would have "tilted" the playing field back in our favor.