Air Power Targeting Theory: A Key Element in Transformation

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MILITARY THEORY provides valuable guidance on how to effectively exploit new technologies through its explanation of cause-and-effect relationships. Given the importance of air power to U.S. military strategy, air power targeting theory should play a key role in transformation decisions.

U.S. Air Force leaders are advocating a targeting theory called effects-based operations (EBO) that is very similar to the functionally oriented targeting theory that airmen applied during World War II strategic bombing campaigns.[1] As the name implies, functionally oriented targeting is designed to create effects that make it impossible for a specific system to perform a function that is vital to an enemy's ability or will to continue effective resistance. It calls for achieving systemwide functional effects without destroying a significant part of the entire system. Compared to attrition-oriented targeting that relies on achieving objectives through causing massive destruction, a functional orientation has the potential to provide many important advantages. These advantages are derived from the potential to achieve desired objectives faster and with far fewer casualties, whether those casualties are friendly, civilian, or enemy.

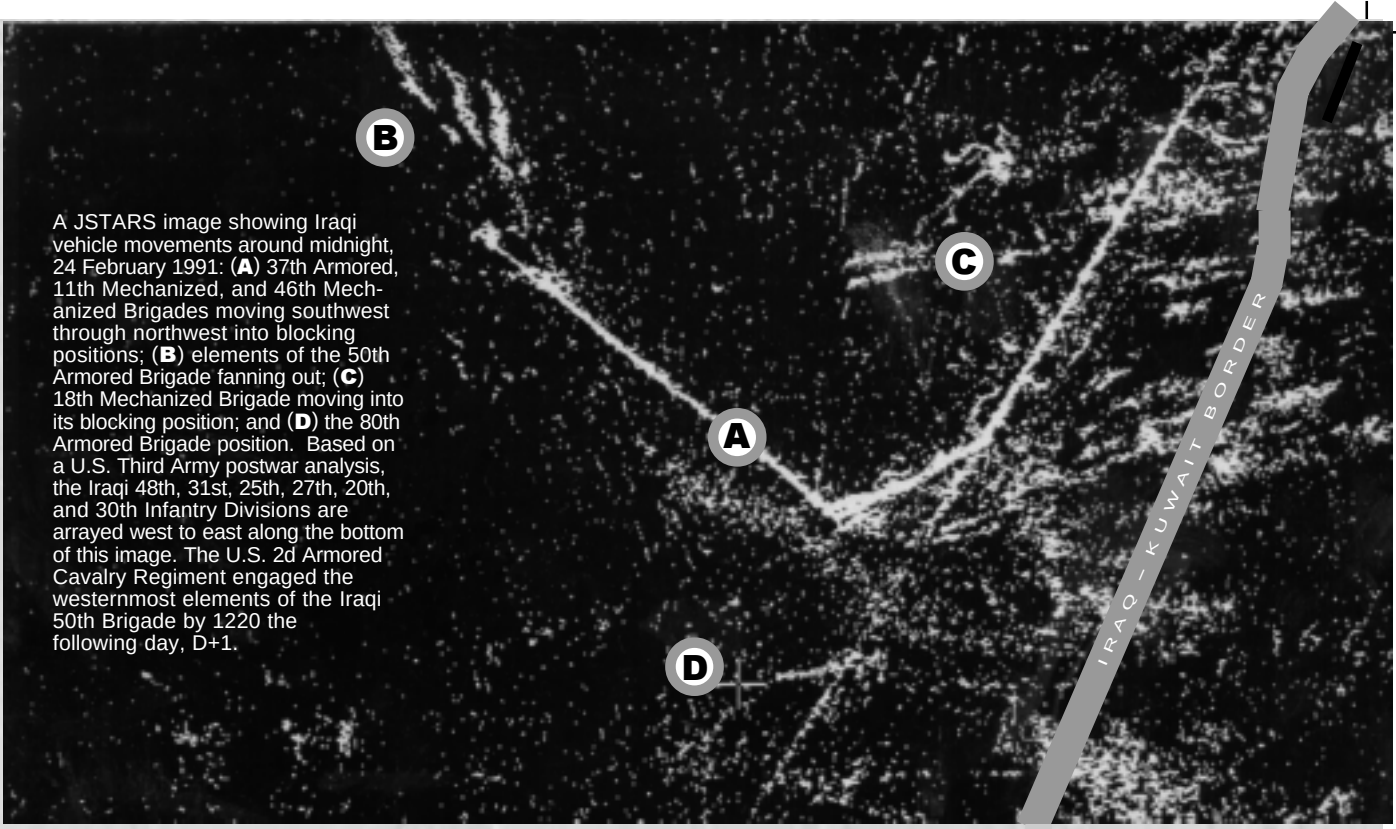
Much of the current interest in the functionally oriented targeting theory can be traced to the ability of stealth and precision-guided munitions technologies to overcome the problems of high losses and poor accuracy that handicapped strategic attacks during World War II.[2] Many air power supporters believe these technologies explain the dramatic outcome of Operation Desert Storm.[3] They also assert that using the B-2 bomber and the global positioning system (GPS)-guided joint direct attack munition (JDAM) made a decisive contribution to Operation Allied Force in Kosovo.[4] Although Air Force EBO discussions focus almost exclusively on the advantages associated with strategic targeting, recent developments in technology make it necessary to consider the advantages of a functional, rather than an attrition, orientation when targeting fielded land forces.[5]

Targeting Requirements

To understand the transformation potential of functionally oriented targeting, it is necessary to apply a perspective to requirements that extends well beyond the survivability of attacking aircraft and the accuracy with which they can deliver their payloads. This wider perspective reveals that the viability of functionally oriented targeting, regardless of whether the target set is a strategic system or fielded land force, depends on meeting a set of five requirements, each of which is essential to success.

Widespread vehicular paralysis can be achieved quickly and without destroying excessively large numbers of vehicles, perhaps only hundreds of vehicles. Such success is possible when targeting decisions are designed to influence the behavior of enemy soldiers by creating and then exploiting fully their perception of an immense danger from air attack if they were to attempt to move.

Target identification. The first step in target identification is identifying the political, economic, and military systems that perform functions that are critical to a specific enemy's ability or will to resist. The next step is to identify critical elements, subsystems, or nodes that define a particular system. Identifying which specific elements make suitable targets requires analyzing how attacks against these elements will contribute to achieving the desired functional effects on the entire system. It also requires determining whether targeting specific elements could be counterproductive to the overall objective. For example, depending on the objective, it may not be acceptable to risk inflicting large numbers of civilian casualties even though targeting a specific element would render an entire vital system functionally ineffective.



A JSTARS image showing Iraqi vehicle movements around midnight, 24 February 1991: (**A**) 37th Armored, 11th Mechanized, and 46th Mechanized Brigades moving southwest through northwest into blocking positions; (**B**) elements of the 50th Armored Brigade fanning out; (**C**) 18th Mechanized Brigade moving into its blocking position; and (**D**) the 80th Armored Brigade position. Based on a U.S. Third Army postwar analysis, the Iraqi 48th, 31st, 25th, 27th, 20th, and 30th Infantry Divisions are arrayed west to east along the bottom of this image. The U.S. 2d Armored Cavalry Regiment engaged the westernmost elements of the Iraqi 50th Brigade by 1220 the following day, D+1.

[By 1990] advances in airborne ground surveillance radar technology made it possible . . . to eliminate the need for visual searches. JSTARS could reliably detect, accurately locate, and precisely track vehicles moving throughout a large surface area in all conditions. . . . One key difference between Operation Allied Force and the Gulf war was the Serb tactic of intermingling military vehicles within refugee traffic. This tactic prevented NATO air forces from relying on JSTARS radar for targeting to the degree that had been possible during the Gulf war.

Target location. Once specific elements are identified as suitable targets, they must be located reliably and precisely; in darkness and adverse weather; despite enemy camouflage, concealment, and deception measures. Precision requires timely information when targets are mobile or relocatable. Effectiveness requires the ability to pass target location information directly to attacking weapon systems.

Attack system survivability. The theory's feasibility requires that weapon systems, especially manned aircraft and uninhabited combat air vehicles, be able to deliver their munitions at an acceptably low risk of loss from an enemy's air defenses.

Munitions. Munitions must possess sufficient precision in all conditions, including darkness and adverse weather, to deliver enough force to achieve effects that will prevent the targeted system from continuing to function effectively. It is also essential that the same effects that prevent the targeted system from functioning effectively have an acceptably low risk of inflicting large numbers of civilian casualties or significant amounts of collateral damage.

Assessment. The fifth requirement is to assess reliably and quickly, regardless of darkness and weather, the magnitude of the contribution specific attacks are making in achieving the desired systemwide functional effect.

Strategic Targeting Challenges

Operations Desert Storm and Allied Force provide evidence that, despite developments in stealth and precision-guided munitions, there are real challenges to meeting the requirements for effective functionally oriented strategic targeting. Identifying a strategic system whose functioning is critical to an adversary's ability or will to continue effective resistance proved to be difficult. For example, some critics are not convinced that strategic attacks in the Gulf war and Operation Allied Force contributed significantly to attaining the desired objectives.[6]

The lack of consensus on effectiveness is evidence of possible soft spots in the capabilities required for strategic targeting. One soft spot results from evidence that an adversary's camouflage, concealment, deception measures, and use of mobility have made it difficult to locate valid targets within command and control systems and the development of weapons of mass destruction. Even when located, hardened targets have made it difficult to achieve desired effects. Ensuring an acceptably low risk of civilian casualties is also an acute problem. The leaders of Serbia and Iraq have demonstrated that they are more than willing to put their own citizens, let alone hostages, at risk by locating them in and around likely targets.

Potential for Functionally Oriented Land Force Targeting

While there are potentially significant challenges remaining to be solved before it is safe to assume that strategic targeting will be effective, developments in surveillance and targeting technologies are providing excellent potential for meeting the requirements for the functionally oriented targeting of fielded land forces. Fielded forces' vulnerability results from the system of motorized vehicles that almost all land forces now rely on for movement.

Developments such as the low-cost antiarmor submunition and brilliant antitank submunition provide the potential to counter an army's ability to move in small convoys or with military vehicles intermingled with civilian vehicles . . . even when they move in adverse weather and darkness.

Movement is vital to their effective operation because it is how they achieve the advantages of surprise, superior force ratios, and favorable positions. Increasingly, the United States is finding that potential adversaries rely on mobility to obtain protection by making target location information perishable and, thus, unreliable.

When functionally oriented targeting can stop, not merely delay, a land force's militarily significant vehicular movement, it has the potential to keep an adversary from continuing resistance.[7] One way to do this is through denial since both a successful offense and defense depend on the ability of land forces to move effectively in response to or in anticipation of friendly land maneuver. Another way is through coercion since most potential adversaries depend on special police and army forces to remain in power. The prospect of these forces losing their ability to move and function effectively could cause successful coercion because of increased risk of being overthrown by internal revolt.

Within an army's system for movement, an occupied moving vehicle is a potential target. Occupied vehicles are susceptible because of the vital role they play in the effective functioning of armies as well as many paramilitary units. Vehicles not only provide mobility, they also provide heavy firepower, armored protection, supplies, sensors (radar), communications, and engineering support. Other good targets are nodes that support or constrain vehicular movement such as refueling, rearming, repair, and transshipment points, and bridges and tunnels.

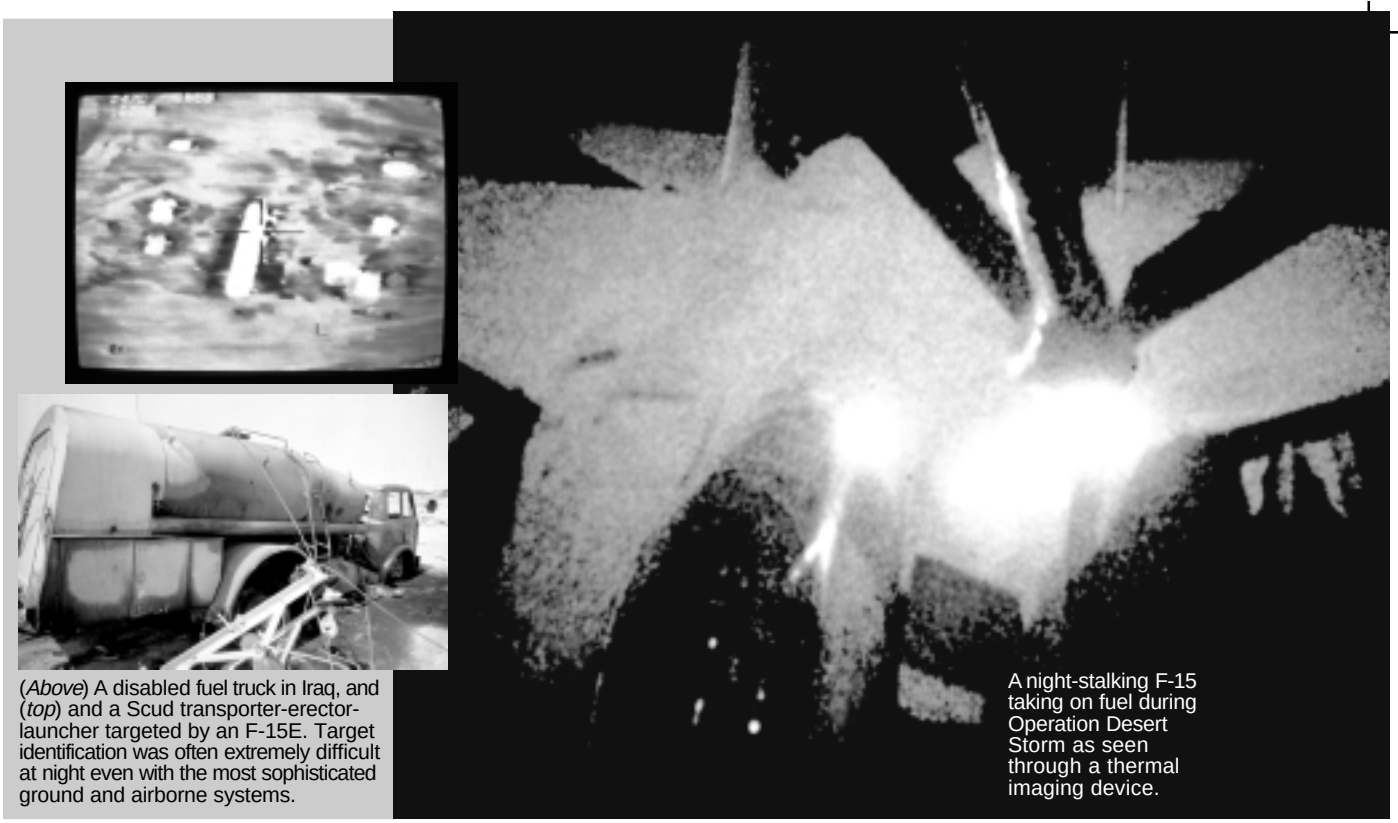
Given the key roles movement and vehicles play in the ability of fielded land forces to function, stopping militarily significant vehicular movement can quickly degrade or even destroy the ability to conduct effective offensive or defensive operations. Stopping movement would also reduce the need for friendly land forces to fight close, sustained battles with powerful units. Close battles will almost always still be necessary, but with functionally oriented targeting, these battles would be fought against units weakened by the loss of the important advantages vehicles and their movement can provide. Stopping an enemy's movement would provide U.S. forces with the maneuver dominance necessary to make medium-weight forces sufficient for defeating an enemy army at minimum risk.

The Role of Danger

The key to understanding the ability of functionally oriented targeting to quickly stop an enemy's vehicular movement is to recognize that it does not depend on physically destroying large numbers of vehicles. Widespread vehicular paralysis can be achieved quickly and without destroying excessively large numbers of vehicles, perhaps only hundreds of vehicles. Such success is possible when targeting decisions are designed to influence the behavior of enemy soldiers by creating and then exploiting fully their perception of an immense danger from air attack if they were to attempt to move.

Theorist Carl von Clausewitz recognizes that many neglect the importance of danger: "they direct their inquiry exclusively toward physical quantities, whereas all military action is intertwined with psychological forces and effects."[8] He also notes that "Danger is part of the friction of war. Without an accurate conception of danger we cannot understand war."[9] The ability of air attacks to quickly create and then maintain a perception of danger that causes militarily significant functional changes in behavior was especially apparent in suppression of enemy air defense (SEAD) operations during Operations Desert Storm and Allied Force. In both conflicts, it took relatively few precision attacks to persuade large numbers of surviving surface-to-air missile system operators to reduce their perceived danger by not letting their radar emit frequently or for very long periods of time.[10]

The perception of immense danger from air attack has had a similar impact on soldiers' behavior. Analyzing air operations in Normandy during World War II, the Gulf war, and Kosovo shows soldiers exhibiting similar behavior. In all three conflicts, soldiers occupying vehicles often stopped moving and even abandoned their vehicles as soon as they perceived that they were likely to be the tar-



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(*Above*) A disabled fuel truck in Iraq, and (*top*) and a Scud transporter-erector-launcher targeted by an F-15E. Target identification was often extremely difficult at night even with the most sophisticated ground and airborne systems.

A night-stalking F-15 taking on fuel during Operation Desert Storm as seen through a thermal imaging device.

Technology developments are providing the United States with the potential to possess all of the capabilities required for functionally oriented targeting to quickly stop militarily significant movement within a large area while minimizing the risk of civilian casualties. The key enabling development is the radar upgrade known as the Multi Platform-Radar Technology Insertion Program (MP-RTIP).

get of an air attack. In each case, few would risk movement when conditions made air attacks likely. It is important to note that in all of these conflicts this effect was achieved despite the relatively small number of vehicles actually being hit and destroyed by air attack.[11]

The Importance of Technological Developments

Unfortunately, during all of these conflicts, the effect of paralysis achieved by vehicle attacks was not widespread and could not be sustained. During World War II, one reason was the requirement to locate German vehicles through a visual search performed by fighter-bomber pilots flying armed reconnaissance. These pilots' limited field of view made it necessary to fly large numbers of sorties to achieve paralysis even over a relatively shallow area behind the front lines. The low altitudes required to make an effective visual search and a precise attack—often through strafing—increased aircraft exposure to point air defenses, resulting in significant losses of aircraft and pilots.

Although the Allies could generate large numbers of sorties and absorb the high losses, their reliance on visual searches made it impossible for them to sustain paralysis during darkness or adverse weather. The German army was quick to exploit this limitation. Although German forces soon confined almost all of their movement to hours of darkness and periods of adverse weather, moving during these times was sufficient for their forces to achieve the force ratios, position, and surprise that made the close battle in Normandy extremely costly for Allied armies.

But, during the Gulf war, there was an important development. Advances in airborne ground surveillance radar technology made it possible for a prototype command, control, intelligence, surveillance, and reconnaissance (C2ISR) system, the Joint Surveillance Target Attack Radar System (JSTARS), to eliminate the need for visual searches. JSTARS could reliably detect, accurately locate, and precisely track vehicles moving throughout a large surface area in all conditions. Equally important for targeting mobile land forces, the system possessed the large onboard crew needed to make timely targeting decisions and the robust communications that could attack aircraft with accurate and timely targeting information. However, since there were only two systems available, they were unable to perform a persistent search over any single portion of the theater. Even when one of the systems was available, its ability to achieve and sustain Iraqi vehicular paralysis was limited to periods of good visibility that U.S. fighter and attack aircraft required

to make precision attacks.[12]

During Operation Allied Force, adverse weather seriously handicapped air operations. As for the Gulf war, there were still not enough JSTARS available to maintain a persistent search, even over an area as small as Kosovo. Yet another problem was the failure to learn from the Gulf war. When JSTARS first deployed, senior airmen, their staffs, and most fighter pilots were unfamiliar with JSTARS' capabilities and limitations. Gradually, as was the case in the Gulf war, pilots discovered JSTARS' ability to provide them with lucrative moving targets. One F-16 squadron commander stated, "JSTARS became my hero."[13] Because JSTARS detected movers, pilots could be confident that they were not wasting an attack on a previously destroyed vehicle or decoy.

Not only would functionally oriented targeting make it difficult for an enemy to achieve the advantages of mass, position, and surprise, but the same real-time information used for targeting would also allow the friendly land forces to use their maneuver to avoid fighting enemy forces except under ideal conditions.

One key difference between Operation Allied Force and the Gulf war was the Serb tactic of intermingling military vehicles within refugee traffic.[14] This tactic prevented NATO air forces from relying on JSTARS radar for targeting to the degree that had been possible during the Gulf war. To reduce the risk of targeting civilians, NATO pilots had to determine visually whether a specific vehicle was military or civilian. Even when JSTARS radar information cued pilots on suspected Serb movement, the requirement for visual identification made timely targeting of Serb mobile forces extremely difficult. Often, Serb forces were able to exploit the time required for visual target identification to disperse and hide.

But now technology developments are providing the United States with the potential to possess all of the capabilities required for functionally oriented targeting to quickly stop militarily significant movement within a large area while minimizing the risk of civilian casualties. The key enabling development is the radar upgrade known as the Multi Platform-Radar Technology Insertion Program (MP-RTIP). The high-power, multiple-mode radar will make it possible for a C2ISR system to accurately locate, automatically track, reliably characterize, and precisely target air attacks against individual vehicles moving within a large area, even in dense traffic and during adverse weather or darkness. The radar's automatic tracking is the key to minimizing the risk of civilian casualties because it identifies, perhaps from an unmanned aerial vehicle video collected earlier on a track, specific vehicles as military or civilian.

An MP-RTIP-equipped C2ISR system's ability to track and characterize vehicles will also make it easy to trace tracks back to their sources to locate and target critical nodal points such as vehicle refueling points. These nodes could be refueling and missile storage points for missile transporter-erector-launcher (TEL) systems. The same ability of the C2ISR system to detect, locate, characterize, and target individual vehicles will make it possible to quickly and reliably assess whether attacks are achieving the desired functional effect. The system can instantly assess an attack's success because it can see whether vehicular movement has stopped. With a functional orientation, it is not necessary to know whether an attack destroyed the vehicle or made its crew too afraid to move and caused them to abandon it.

Just as important to effectively targeting land forces is the fact that these enhanced surveillance and targeting capabilities are being complemented by developments in precision weapons technology. JDAM and the Wind-Corrected Munitions Dispenser System are making it possible to target fixed nodal points of a fielded force's movement system precisely in all weather conditions. These munitions can also stop and quickly destroy convoys before the vehicles and their occupants can disperse.

Even more important, developments such as the low-cost antiarmor submunition and brilliant antitank submunition provide the potential to counter an army's ability to move in small convoys or with military vehicles intermingled with civilian vehicles. The key to success is the potential of these submunitions to use their sophisticated sensors and software to accurately characterize and precisely target individual military vehicles even when they move in adverse weather and darkness. With the ability to precisely target specific military vehicles, it would be possible to avoid causing collateral damage to nearby buildings or civilian vehicles. Further risk reduction could be achieved by waiting to target military vehicles until after they have moved out of areas where large numbers of civilians and buildings are located.[15]

The same technologies that make it feasible to target an enemy's military vehicles also provide the advantage of dramatically reducing the risks facing friendly military personnel. On the ground, stopping militarily significant enemy movement would mean that friendly forces would have less need to fight powerful enemy units. Not only would functionally oriented targeting make it difficult for an enemy to achieve the advantages of mass, position, and surprise, but the same real-time information used for

targeting would also allow the friendly land forces to use their maneuver to avoid fighting enemy forces except under ideal conditions.

Should an enemy's movement present a threat to a friendly unit, this same movement would make the enemy visible to the C2ISR system's sensor and extremely vulnerable to devastating air and artillery attacks. Besides making it likely that the enemy unit would be quickly destroyed, these attacks would also make it impossible for the enemy to match the speed of the friendly unit's maneuver. In the air, the C2ISR system's high-power radar reduces risks by making it possible to see a very large area while flying at a safe standoff distance from an enemy's surface-based air defenses. Also reducing risks are GPS and sensor developments that make it possible for U.S. aircraft to precisely deliver their weapons from medium altitude, well above the reach of the difficult-to-suppress, nonradar-guided air defenses.

Other Applications for Functionally Oriented Targeting Technology

It is important to note that the same enhanced surveillance capabilities MP-RTIP provides will have many other important applications in both war and peace. During war, the ability to precisely track and characterize individual vehicles will be invaluable for supporting counterair operations by making it easier to detect and target missile TELs. In peace, it will provide reliable and early indications and warnings of potential aggression, help verify treaties, and contribute to confidence-building measures. Precise, real-time surveillance of movement will also make crisis management much easier by making it possible to see if diplomatic and military actions are having the desired effect of causing forces to stop movements.

Although developments promise to make it technically feasible to apply the functionally oriented air power targeting theory to fielded land forces, realizing the advantages of such targeting is unlikely unless the Department of Defense takes further action. Clearly, the United States must devote the necessary resources to completing the development of the required technologies. For C2ISR systems, this means accelerating the development of the technically low-risk MP-RTIP. Next, it is necessary to field MP-RTIP-equipped C2ISR systems in the appropriate numbers. The current requirement for 19 JSTARS did not consider either the immense advantages provided by the functionally oriented targeting theory or the system's value during peacetime operations.[16]

As important as technology can be to success, it is not sufficient by itself. Success requires institutionalizing the targeting theory in joint and service doctrine and training. Clearly, given its ability to guide thinking on key cause-and-effect relationships, the functionally oriented air power targeting theory can and should play a valuable role in helping determine future force structure and training requirements. ***MR***

NOTES

1. Brigadier General David A. Deptula, *Effects-Based Operations: Change in the Nature of Warfare* (Arlington, VA: Aerospace Education Foundation, 2001); and Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf* (Annapolis, MD: Naval Institute Press, 1995), 202-204.
2. Deptula, 8-11.
3. John T. Correll, "In the Wake of the Storm," *AIR FORCE* Magazine (January 2001), 2.
4. John A. Tirpak, "With Stealth in the Balkans," *AIR FORCE* Magazine (October 1999), 23-28.
5. The United States has had an attrition-orientation when targeting land forces as can be seen with destruction being the chief measure of air power's effectiveness in Vietnam, the Gulf war, and Kosovo. Attrition is also the basis for the models that are still being used in the services' requirements and force-sizing processes. See Robert W. Komer, *Bureaucracy at War: U.S. Performance in the Vietnam Conflict* (Boulder, CO: Westview Press, 1986), 56; Keaney and Cohen, 40-41; *Kosovo/Operation Allied Force After-Action Report,* Department of Defense Report to Congress, 31 January 2000, 84-85; and Maggie Belknap, "The Force-on-Force Model: An Anachronism in the Information Age," *Joint Force Quarterly* (Spring 1997), 116-19.
6. Michael R. Gordon and Bernard E. Trainor, *The Generals' War: The Inside Story of the Conflict in the Gulf* (Boston, MA: Little, Brown, & Co., 1995), 331; and Earl H. Tilford, Jr., "Operation Allied Force and the Role of Air Power," *Parameters* (Winter 1999-2000), 24-38.
7. Remarks by German army officers on Allied air interdiction during World War II indicate that stopping every single vehicle is probably not necessary to severely degrade an army's ability to conduct an effective campaign. See "A German Evaluation of Air Interdiction in World War II: Saber Measures (Echo)," U.S. Air Force Assistant Chief of Staff, Studies and Analysis, Washington, D.C., November 1970, 26.
8. Carl von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), 136.
9. Ibid., 114.
10. Keaney and Cohen, 195-96 and 203; Major William A. Hewitt, USAF, *Planting the Seeds of SEAD* (Maxwell Air Force Base [AFB], AL: Air University Press, June 1993), 24; and John A. Tirpak, "Lessons Learned and Re-Learned," *AIR FORCE* Magazine (August 1999), 23.
11. Ian Gooderson, *Air Power at the Battlefront: Allied Close Air Support in Europe 1943-5*, (London: Frank Cass, 1998), 110-11 and 116-17; Keaney and Cohen, 93-94 and 101-103; and *Kosovo/Operation Allied Force After-Action Report*, Report to Congress (Washington, DC: Department of Defense, 31 January 2000), 80-87.
12. James Titus, *The Battle of Khafji: An Overview and Preliminary Analysis* (Maxwell AFB, AL: Airpower Research Institute, September 1996), 20; and Keaney and Cohen, 145-46 and 161-62.
13. "Allied Force Pilots Say Improved Training Key to Strike Operations," *Inside the Air Force* (13 October 2000), 7.
14. *Kosovo/Operation Allied Force After-Action Report*, 62.
15. The combination of developments in C2ISR systems and precision weapons will make it easy to defeat most concealment and camouflage measures because movement puts vehicles out in the open. Precisely tracking individual vehicle movement will make it possible to locate where they stop, helping defeat enemy attempts to camouflage or conceal the vehicles. Where high-value vehicles, like transporter-erector-launchers (TELs), are concealed within the movement of large numbers of other vehicles, stopping militarily significant movement will reduce the amount of cover other vehicles provide. Decreased traffic will make high-value vehicles stand out and make them easy to locate and target if they continue to move. Deception will also lose much of its effectiveness because using decoy vehicles that move is neither productive nor feasible on a large scale. When an adversary uses decoys that move, as may be the case with TELs, the perceived of danger that stops the militarily significant movement of army units should help have a similar effect on occupants of the decoy vehicles, doing much to neutralize the effectiveness of this deception measure.
16. "Loh Sees Need for More JSTARS; Services Eye Increase to Over 30," *Inside the Air Force* (25 February 1994).

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