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**The Military Technical Revolution--
Can Corps Deep Operations Now
Independently Achieve Battle Objectives?**

A Monograph
by
Major Glenn A. Gruner
Air Force

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**School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas**

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MONOGRAPH

THE MILITARY TECHNICAL REVOLUTION -- CAN CORPS
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BATTLE OBJECTIVES? (U)

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ABSTRACT

THE MILITARY TECHNICAL REVOLUTION--CAN CORPS DEEP OPERATIONS NOW INDEPENDENTLY ACHIEVE BATTLE OBJECTIVES? by Major Glenn A. Gruner, USAF, 48 pages.

This monograph discusses the implications of technology on military doctrine. Some military scientists and historians believe that the United States is currently witnessing a revolution in military technology. This monograph examines whether this revolution can significantly alter the nature of tactical warfare so that deep operations may now be the preferred means to achieve corps battle objectives.

This monograph first examines current and emerging Army and Air Force doctrine. This discussion establishes the framework for further comparison. The paper then explores the concept of military technical revolutions (MTRs) and evaluates current high-tech weapons systems to resolve whether or not the U.S. is currently witnessing an MTR. The monograph then relates the corps deep operations process of DECIDE-DETECT-DELIVER to the previously discussed weapons systems to determine if corp deep operations can now independently achieve battle objectives.

After concluding that corps deep operations can achieve battle objectives under certain conditions, the monograph then discusses potential implications for both Army and Air Force doctrine.

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Major Glenn A. Gruner

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I. INTRODUCTION

Compare this:

New weapons of warfare call for the total and radical reorganization of methods of warfare, and he who falls asleep during this process of reorganization may never wake up.

Mikhail Tukhachevskiy, 1931¹

To this:

The incessant emphasis on technology was little more than an artful dodge concealing the emptiness of the Army's thinking. . . . the Army's unfettered enthusiasm blinded it to the limits of technology in the overall equation of war and to the real problems that technological change brings in its trail."

A.J. Bacevich, 1986²

The previous quotes highlight a continuing debate occurring within military circles today--whether technological advances should drive changes in military doctrine or whether doctrine should provide guidance for the development of specific military technologies. This paper addresses the somewhat tenuous relationship between military technology and doctrine.

The ultimate goal of this paper is to resolve whether recent technological advances have fundamentally changed the nature of warfare so that the preferred means for achieving corps battle objectives is now through deep operations. An essential analysis for this monograph concerns a concept termed military technical revolution (MTR). In particular, this paper considers if MTRs can alter the nature of warfare to such a degree as to require a corresponding change to military doctrine.

Military scientists and historians have argued that military

technical revolutions have occurred throughout history and have radically change the way that nations fight their wars. What are these military technical revolutions? Mr. Frank Kendall, the current Deputy Director of Defense Research and Engineering for Tactical Warfare Programs, wrote in Strategic Review (Spring, 1992) that a military technical revolution "implies a technical development that when properly exploited through equipment, training, organization, and doctrine provides a decisive (although temporary) advantage."³ Stephen Peter Rosen in his book, Winning the Next War, further clarifies this concept. He writes that "these revolutions [MTRs] occur not as the result of a single new weapon or technology, but when groups of technologies emerge that together transform the nature of warfare."⁴ Both thoughts suggest that some advances in military technology are so radical that they cause corresponding changes to doctrine.

This monograph uses the following methodology to determine the potential implications of military technology on the Army's emerging doctrine for the corps deep battle.

--First, the paper analyzes current doctrine for corps deep operations. Doctrine provides the framework for understanding the application of military power.⁵ Further, doctrine describes how to think about applying the principles of war under whatever conditions one may be called on to fight. Therefore, it must be sufficiently dynamic to accommodate relevant aspects of change--to include technological change.⁶ Doctrine provides an essential analytical foundation for further discussion of the relationship

between technology and the corps battle.

This paper looks specifically at the relationship between close and deep operations from the current doctrinal manuals FM 100-5, Operations, and FM 100-15, Corps Operations. It also examines notable trends from emerging Army doctrine in the preliminary draft (PD) of FM 100-5, Operations. Finally, since tactical airpower adds significantly to the combat power of corps deep operations, this paper discusses applicable portions of Air Force doctrine in AFM 1-1, Basic Aerospace Doctrine of the United States Air Force.

--Following the analysis of applicable military doctrine is a discussion of military technical revolutions. The paper explores whether or not the United States has experienced a military technical revolution over the past decade. This analysis includes a detailed look at the target acquisition and target destruction weapons systems of this period and their contribution to the corps deep battle. It also incorporates scientific assessments and selected historical examples describing the effectiveness of these weapons systems. Taken as a whole, these weapons systems should either validate or refute the presence of an ongoing MTR.

--From this discussion of MTRs and high-tech weapons systems, the paper then evaluates corps deep battle doctrine against the high-tech weapons systems that have emerged over the past decade. This section initially examines the Decide-Detect-Deliver approach for the conduct of corps deep operations as

described in FM 100-15.⁷ The analysis then integrates current weapons systems capabilities with each step of this process. Again, the final aim is to resolve whether corps deep operations can be the preferred means for achieving battle objectives.

--The final section of the paper orients on the future. Specifically, it answers the following questions: Has technology fundamentally changed the nature of future warfare? If so, is it time to change our war-fighting doctrine--possibly to suggest that deep operations themselves can achieve battle objectives? If feasible, this concept could more closely reflect the current American view of conventional war--namely, to use overwhelming combat power to achieve quick, decisive victories.⁸ Such victories have the advantage of fewer casualties due to a greater reliance on firepower versus maneuver to achieve objectives. If this is possible, then military doctrine should reflect this potential.

II. DOCTRINE ANALYSIS

While current Army doctrine recognizes the capability of each service to contribute to the corps deep battle, most resources for a conventional land war come from the Army and Air Force. For this reason, this analysis will consider only Army and Air Force doctrine.

CURRENT ARMY DOCTRINE (FM 100-5 AND FM 100-15)

An army's fundamental doctrine is the condensed expression of its approach to fighting campaigns, major operations, battles, and engagements. . . . It must be rooted in time-tested theories and principles, yet forward-looking and adaptable to changing technologies, threats, and missions. It must be definitive enough to guide operations, yet versatile enough to accommodate a wide variety of worldwide situations. Finally, to be useful, doctrine must be uniformly known and understood.¹

This paragraph from FM 100-5 summarizes the purpose of doctrine. Derived from experience and basic principles, doctrine provides guidance for the conduct of military operations. Just as important, it must remain adaptable to evolving technologies and concepts to retain this utility. If doctrine were to lose this adaptability, it could invite military catastrophes in future conflicts.¹⁰ Therefore, the focus of this section is on the adaptability of doctrine to advances in military technology.

Current Army doctrine describing the battlefield framework and corps tactical operations is in FM 100-5, Operations, and FM 100-15, Corps Operations. The following discussion of these two manuals evaluates the adaptability of the concepts of close and deep operations with technology.

The 1986 version of FM 100-5 clearly supports the concept

that close operations are the sole means for achieving battle objectives. The manual states:

At the operational level, close operations comprise the efforts of large tactical formations--corps and divisions--to win current battles. . . . Close operations bear the ultimate burden of victory or defeat. The measure of success of deep and rear operations is their eventual impact on close operations.¹¹

This doctrinal statement tends to constrain the potential for emerging military technologies to modify the current battlefield framework. It strongly suggests that only close operations can be decisive, regardless of technological advances that may offer the potential for decisive deep operations. Furthermore, it implies that deep operations provide only a supporting function for close operations.

Later statements in FM 100-5 also define deep operations in a supporting role: "Deep operations at any echelon comprise activities directed against enemy forces not in contact designed to influence the conditions in which future close operations will be conducted."¹² This statement again suggests a limited role for deep operations--namely to 'influence' the conditions for future battles, but not to win them outright.

Corps operations doctrine in FM 100-15 reinforces this current paradigm of the battlefield framework. Concerning close and deep operations, FM 100-15 states:

It is the outcome of the corps close operations which will ultimately determine the success or failure of the corps battle. The corps deep and rear operations are focused primarily on creating conditions favorable to the corps winning its close operations.¹³

This brief review of two key doctrinal manuals portrays a strong message--close operations win wars, while deep and rear operations serve only to support the decisive close battle. This model does not provide flexibility for decisive deep operations in the event a commander may prefer them for achieving specific mission objectives.

EMERGING ARMY DOCTRINE (PRELIMINARY DRAFT FM 100-5)

While the preceding discussion highlights the limitations imposed by current Army doctrine, there now seems to be an evolution towards making doctrine more adaptable to emerging technologies. PD FM 100-5 suggests that deep operations are gaining influence on the future battlefield. Chapter 7 of PD FM 100-5 discusses the link between close, deep and rear operations in the section on Operational Execution. While one may question the applicability of a discussion of 'operational execution' to the objectives of battles and engagements, the dialogue in this section clearly addresses both the operational and tactical levels of war.¹⁴ The intent of this section of doctrine is to explain concepts with universal application to both the operational and tactical levels of war.

The new discussions of close operations are evolutionary. First of all, the draft manual states that "it is vital to choose where close battles will take place since they *normally* [my emphasis] are decisive in operations on land."¹⁵ This indicates a subtle, but significant shift in the emphasis on close operations from the 1986 FM 100-5. No longer does the Army's

keystone doctrine manual state that close battles will always be decisive. Even more thought provoking is an idea stated later in this section. The draft manual states:

The concept of close operations is sufficiently elastic to adjust to the conditions of a wide range of combat situations. The commander, for example, may use them as a temporizing measure to help him set the terms for *decisive deep operations* [my emphasis].¹⁶

We can now see an evolution in Army doctrine concerning close operations--namely, that these operations may not always be the exclusive means for achieving battle objectives. Conceivably, either close or deep operations could now achieve mission objectives.

Later PD FM 100-5 dialogue further supports the idea that deep operations may have the potential to independently achieve corps battle objectives. The draft manual states:

Deep operations are also conducted simultaneously with close operations to destroy or defeat the enemy faster. Moreover, *close operations might not ever take place where deep operations were conducted* [my emphasis]. The preference is to defeat the enemy by fighting close and deep simultaneously throughout the depth of the battle space.¹⁷

While not explicitly stating the potential for deep operations to be decisive in tactical warfare, this passage strongly suggests that possibility. It therefore encourages tactical commanders to assess the possibility for either close or deep operations to achieve battle objectives.

Finally, PD FM 100-5 clearly links the evolution of these new concepts for close and deep operations with emerging military technologies. The draft manual states, "Increasingly, the

lethality of modern weapons, supported by the accuracy and responsiveness of communication and acquisition capabilities, also provides the potential for deep operations to contribute directly to the campaign objectives."¹¹ Remarkably, these technical characteristics match precisely the three technological capabilities cited by Mr Frank Kendall in suggesting that we are currently in an MTR: precision attack weapons, near real-time communications, and target quality resolution in acquisition systems!¹²

Supporting these evolving concepts, the emerging doctrine further bolsters the inter-relationship between doctrine and technology. It notes:

Any understanding of the relationship between doctrine and technology begins with the idea that doctrine drives the exploitation of technology. . . . A decisive factor in a future conflict will be the doctrinal integration of new technologies. We seek to gain decisive advantage over our opponents by leveraging those technologies which are key.¹³

While this assessment of PD FM 100-5 suggests some evolutionary concepts, conceived in part by the influence of emerging military technologies, there nevertheless appears to be some inconsistencies. Statements in Chapter 9 revert to the traditional close-deep-rear battlefield framework paradigm. This section, Fundamentals of the Offense, contradicts the earlier statements in Chapter 7.

In a discussion of the elements of offensive operations, PD FM 100-5 states that the commander conducts deep operations to deny the enemy freedom of action and to set the terms for future

battle. It further explains that through deep operations, the commander facilitates future offensive operations.²¹ Both of these statements support the traditional concept of deep operations as a supporting function for decisive close battles. There are no qualifying statements suggesting that deep operations may achieve battle objectives in their own right.

Later discussions, also in Chapter 9, further insinuate a supporting role for deep operations. The draft manual states, "The close battle has always been decisive in land warfare. The commander picks the critical time and place to close with and destroy the enemy. This is the decisive time and place, when the commander commits himself to destroy or defeat the enemy."²² While not implicitly stating that close operations will always be decisive, there is a strong message to that effect. In the end, FD FM 100-5 encourages commanders to hold to the traditional battlefield framework paradigm--deep operations to shape the battle and close operations to win it.

In summary, Army doctrine is evolving in respect to technology and in efforts to update old paradigms to meet the new realities of warfare. The current manuals of FM 100-5 and FM 100-15 advocated a specific battlefield framework--close operations to close with and destroy the enemy and deep operations to shape the battlefield. Emerging Army doctrine is making great efforts to incorporate emerging technologies into an adaptable doctrine, but is inconsistent. Early chapters acknowledge the potential of technology to fundamentally change the nature of warfare. They

suggest that deep operations may be decisive and, in some situations, that close operations may perform a supporting role. However, these ideas are not consistent with later chapters that revert to the traditional close-deep-rear paradigm.

CURRENT AIR FORCE DOCTRINE (AFM 1-1)

Having concluded an analysis of Army doctrine, we now turn to applicable portions of Air Force doctrine. Once air superiority exists, the key missions with which airpower can affect corps deep operations are close air support (CAS) and air interdiction (AI).

Close air support is the employment of airpower to directly support the ground commander by destroying or neutralizing enemy forces in proximity to friendly forces.²³ CAS missions normally provide fire support in close operations. However, CAS may support the corps deep battle when providing fire support to either a ground maneuver or special operating forces (SOF) unit conducting deep operations.

Air interdiction is typically the mission associated with corps deep operations. "Interdiction disrupts, delays, or destroys an enemy's military potential before it can be used against friendly forces."²⁴ Effective employment of air interdiction missions requires commanders to be aware of several important considerations.

--First, if the effects of interdiction are to contribute fully to the operation, then air interdiction and employment of land forces must be synchronized so that each compliments and

reinforces the other.¹⁵ The object of this synchronization is to create a dilemma for the enemy. If he attempts to counter land maneuver (either actual or potential), then he risks unacceptable losses to air interdiction. On the other hand, if the enemy chooses to counter the potential losses from air interdiction, then he becomes fixed in position and susceptible to subsequent ground maneuver.¹⁶ Gaining maximum advantage from these conditions depends heavily on the ability of land forces to exploit the enemy's delay and disruption.

--A second consideration for employing interdiction concerns the desired effects of the mission. Commanders can choose to have air interdiction either delay or disrupt an enemy's plans and thereby cause a devastating impact on his ability to respond to the actions of friendly forces.¹⁷ This employment option matches closely with the Army's traditional role for deep operations--namely to control the tempo and to shape the battle for subsequent decisive close operations.

Another air interdiction effect is the destruction of enemy land forces. Airpower can be extremely effective at destroying enemy forces who are either fixed in place while attempting to maneuver or who are moving rapidly.¹⁸ This capability is provided primarily through the use of high-tech, precision-guided munitions.

--The final consideration for employing air interdiction concerns freedom of action. Generally, the depth at which interdiction is performed determines the freedom of action

available to the attacking force. Increasing the depth of interdiction missions reduces the risk of fratricide and decreases the requirements for detailed coordination with ground maneuver forces.¹⁹ While greater freedom of action is a valid consideration, the commander must carefully balance this desire with the synergistic effects achieved by synchronizing all available weapons systems against appropriate close-in interdiction targets.

In this brief review of applicable Air Force doctrine, we can see significant potential for integrating airpower with corps deep operations. First, to be most effective, air interdiction missions must be fully synchronized with ground maneuver to present the enemy with the greatest possible dilemma. Second, interdiction has the potential to either delay, disrupt, or destroy enemy forces. Finally, the greater the depth of interdiction missions, the greater freedom of action for air forces. While this is a consideration, it should not override efforts to obtain maximum combat power through joint operations against appropriate targets.

III. MILITARY TECHNICAL REVOLUTIONS

The introduction to this monograph briefly discussed the concept of military technical revolutions (MTR). This section will now look more closely at MTRs to determine whether or not current technology suggests the presence of an MTR in this decade.

In his book, Winning the Next War, Rosen discusses the Soviet military and the impact of certain scientific-technical revolutions on their military innovations since the turn of the century. He concludes that these revolutions occur not as the result of a single new weapon or technology, but when groups of technologies emerge that together transform the nature of warfare.¹⁰ This is a key point. It requires practically a simultaneous change in several militarily-significant industries to stimulate an MTR that fundamentally changes the nature of warfare.¹¹

Chris Bellamy, a noted military theoretician, also discusses a concept of 'military-scientific revolutions.' In his book, The Evolution of Modern Warfare, Bellamy links the idea of a scientific paradigm (original idea of Thomas Kuhn) to military science. He suggests that such a paradigm of 'military-scientific revolutions' is a scientific-technical achievement that embodies a whole bundle of theories, laws, procedures, and practices--eventually becoming a dominant theory and institutionalized practice within the military community.¹²

The Soviets identified three periods of time where these MTRs have caused a fundamental shift in their doctrine and force

structure. In the 1920s and 1930s the internal combustion engine, wireless radios, and military aviation combined to speed the maneuver and increase the depth to which armies could penetrate. In the 1950s, the ballistic missile and nuclear weapons made it possible to employ overwhelming firepower at strategic depths. And in the 1980s, the Soviet military identified the genesis of a third revolution founded on electronics, computers, and communications technology that signaled a qualitative change in the capability for near real-time employment of weapons against acquired targets.¹³

Likewise, the United States also recognized an emerging MTR in the 1980s with a potentially significant impact on tactical warfare. In March 1992, Mr. Frank Kendall, Deputy Director of Defense Research and Engineering for Tactical Warfare Programs, suggested that the U.S. military continues to experience this continuing MTR today. Mr. Kendall states that this MTR is based on three emerging advanced capabilities: 1) sensors for broad area search with target quality resolution; 2) near real-time data-processing and communications to support mission planning and attack execution; and 3) highly lethal precision attack weapons.¹⁴

These technologies have lead to advanced acquisition systems and target destruction munitions which suggest that corps deep operations may gain a more significant role in future battles. To weigh this possibility, this paper now looks at current high-tech weapons systems to resolve whether technology is revolutionizing

the corps battle. The analysis will first evaluate Army and Air Force target acquisition systems followed by Army and Air Force target destruction systems. The evaluation will rely on unclassified performance data and recent historical experience to determine the presence of an MTR with the capacity to change the traditional paradigm of close and deep operations.

ARMY TARGET ACQUISITION SYSTEMS

The Army possesses several key reconnaissance systems with near real-time target acquisition capabilities. The most technically advanced acquisition systems are the OV-1D Mohawk, Guardrail Common Sensor, and unmanned aerial vehicles (UAVs).

The OV-1D Mohawk surveillance system provides several unique capabilities to the corps deep battle target detection process. These include a side-looking airborne radar (SLAR) and photographic system with a data-link to ground terminals that provides commanders with a near real-time display of the location of enemy first and second echelon units. Additional features include a moving target indicator with the ability to acquire individual vehicles.¹⁵ This capability is possible in day or night and in near all weather conditions. While an extremely effective system, the Mohawk will complete a phased drawdown in FY97 when JSTARS assumes this role for the Army.¹⁶

Guardrail Common Sensor (GRCS) combines the capabilities of the former Quicklook and Guardrail acquisition systems while providing a new capability to data-link collected targeting information to the user via the Commanders Tactical Terminal. A

key component of GCRS is the enhanced accuracy for communications targeting provided by a communications high accuracy airborne location system (CHAALS).¹¹ With the ability to collect both ELINT and COMINT from a single platform, intelligence personnel can more easily "fuse" this information to determine the location of critical enemy formations. These locations could then be data-linked to ground stations using the Commanders Tactical Terminal for subsequent targeting.

Unmanned aerial vehicles (UAVs) and remotely piloted vehicles (RPVs) are the final category of target acquisition systems. The Pioneer RPV system, employed by the Marines, Navy, and Army in Operation DESERT STORM, demonstrated a capability to provide real-time video imagery to ground stations out to a range of 100 nautical miles with a flight duration of five hours.¹² This imagery, acquired by either a television system or forward-looking infrared sensors for night operations, was invaluable for providing target area reconnaissance for AH-64 pilots or for the real time adjustment of corps deep artillery fires.¹³ While these systems have promise for future operations, the lack of an on-board navigation system limits the practical use of UAVs in featureless terrain such as wide open deserts.¹⁴ Once this limitation is corrected, UAVs will become a vital force multiplier for corps deep operations.

To summarize, Army target acquisition systems have an excellent ability to acquire and precisely locate communications and radar systems. Furthermore, each of these systems can operate

day or night and data-link position information in real-time to ground stations for subsequent targeting. These capabilities provide the potential to revolutionize corps deep operations.

However, a future limitation will be the Army's ability to acquire moving vehicles in all weather conditions once the Mohawk surveillance system is replaced by JSTARS. This will require detailed integration of Air Force target acquisition systems with those of the Army for successful prosecution of the corps deep battle.

AIR FORCE TARGET ACQUISITION SYSTEMS

The Air Force maintains several systems capable of battlefield surveillance and target acquisition. Some are tasked by national-level authorities and are not typically available to the tactical commander--the TR-1 and RC-135 are good examples. However, the Air Force has three target acquisition systems that are uniquely responsive to the tactical commander--the RF-4 reconnaissance aircraft, the joint surveillance target attack radar system (JSTARS), and the emerging advanced tactical air reconnaissance system (ATARS) pod.

The current RF-4 has limited capability for real-time target acquisition. All imaging and side-looking airborne radar (SLAR) capabilities require ground processing before they can be used for targeting purposes. However, the RF-4 does have a unique real-time capability--a system referred to as tactical electronic reconnaissance or TEREK. This system allows the aircrew to program and collect up to 20 electronic signatures from a stand-

off position. The RF-4 can then data-link the location of these signatures to a ground receiver, normally in the vicinity of the tactical decisionmakers.⁴¹ This capability provides near real-time targeting of enemy radar-guided SAMs or AAA.

JSTARS was undoubtedly one of the technological success stories of Operation DESERT STORM. Possessing both a moving target indicator and a synthetic aperture radar, the aircraft could provide either near real-time intelligence or function in a target acquisition role.⁴² This flexibility required commanders to establish a mission priority for each JSTARS sortie-- intelligence gathering or target acquisition. Nevertheless, JSTARS demonstrated a capability to provide critical information on the movement of enemy forces in a near real-time data-link to ground commanders. "The Army Central Command (ARCENT) Deputy Chief of Staff for Intelligence stated that Joint STARS was the single most valuable intelligence and targeting system in Desert Storm."⁴³ This day or night, all-weather capability allows real-time engagement of corps deep targets by either Army or Air Force systems.

The final Air Force target acquisition system is currently under development. Known as the advanced tactical air reconnaissance system (ATARS), it will be an external pod mounted on an F-16 and should be operational in the late 1990s. The capabilities will include a long-range oblique imaging system which includes low and medium altitude electro-optical sensors and an infrared line scanner. These capabilities suggest that ATARS

will be able to producing actual images, day or night, of enemy vehicles from a safe stand-off distance. The key feature of this system is its digitized imagery, which allows imagery to be transmitted from the aircraft to joint service imagery processing stations (JSIPS) during the mission." This near real-time imagery provided directly to the tactical commander, allows for potentially decisive deep operations.

In summary, the Air Force now has target quality acquisition systems capable of providing near real-time locations, day or night and in all weather, of moving enemy vehicles and radar-emitting SAMs and AAA. A current limitation is the ability to identify specific vehicle type and then data-link this information to ground stations. However, the ATARS-equipped F-16 should provide this capability by the end of the 1990s.

ARMY TARGET DESTRUCTION SYSTEMS

In assessing Army target destruction systems, this paper will first evaluate the delivery vehicles and then discuss the actual kill mechanisms or munitions. The Army has two delivery vehicles that contribute significantly to the firepower of the corps deep battle--the AH-64 Apache helicopter and the Army tactical missile system (ATACMS). The relatively short range of the multiple launch rocket system (MLRS) and field artillery (under 30 km) limits the utility of these systems to a smaller percentage of corps deep targets and will not be discussed.

The AH-64 APACHE attack helicopter provides a vital capability to the corps deep battle. The Tactical Acquisition

Designation Sight and Pilot Night Vision Sensor (TADS/PNVS) system permits the two-man crew to navigate and attack in dark and adverse weather conditions.⁴⁵ This capability, coupled with enhanced aircraft survivability equipment, allows the Apache to penetrate deep to interdict enemy forces. The primary mission of the Apache is to destroy armor with its Hellfire missiles, of which it can carry up to 16 per aircraft.⁴⁶

The Army TACMS provides a long-range missile system that can operate day or night in near all weather conditions.⁴⁷ The Block I System, currently fielded, can deliver aerial denial artillery munitions (ADAMs) at ranges greater than 100 kilometers.⁴⁸ These sub-munitions are effective against surface-to-surface missiles, air defense systems, logistics elements, and C2 nodes. The Block II System is currently under development and will carry a 'smart' anti-armor sub-munition--most likely the emerging brilliant anti-armor sub-munition (BAT).⁴⁹ ATACMS fills a vital role as a highly responsive fire support system for the corps deep battle. Potential limitations include limited employment opportunities precipitated by a limited procurement of just over 1,500 missiles.⁵⁰

Moving to munitions, the Army has two primary anti-armor capabilities--the Hellfire missile and the brilliant anti-armor technology (BAT) sub-munition. The Hellfire missile is the primary weapon system of the Apache while the BAT sub-munition is an emerging capability for ATACMS.

The Hellfire, or air-to-ground missile system (AGMS), is a

third-generation anti-armor weapon. Its laser-guidance with a range in excess of 7 kilometers provides a significant stand-off capability.³¹ This precision guidance coupled with improved capabilities against reactive armor and electro-optical counter-measures has strengthened the capability of the Hellfire to function on the modern battlefield. However, a potential shortfall is the laser guidance itself. As with all laser guidance systems, adverse weather tends to attenuate range and effectiveness. Current efforts to develop a millimeter wave seeker variation should eliminate this current shortfall.³²

The final target destruction means for this discussion is the BAT sub-munition for ATACMS and other types of artillery. This sub-munition just entered a 42-month Engineering and Manufacturing Development program and should go into production in FY 96. The strength of this weapon lies first in its range via the ATACMS and then in its 'brilliant' target acquisition capabilities. The sub-munition uses two sensors--acoustic and infrared--to autonomously locate, attack, and destroy moving tanks and other vehicles.³³ When coupled with the moving target indicator capabilities of JSTARS, this munition could produce devastating results in the corps deep battle. Potential shortfalls could include the target requirement for moving vehicles to develop the signatures necessary for guidance. Armor vehicles stopped and shut down in a given location may not have the infrared or acoustic signature necessary for precision guidance.

In summary, Army deep target destruction systems offer both shortfalls and promise. First, the delivery vehicles have a somewhat limited range for corps deep operations--nominally estimated at 100 to 150 kilometers beyond the FLOT for both the Apache and ATACMS. Second, weather currently hampers the precision guidance features of most munitions--the Hellfire missile, for example, must have favorable weather to achieve optimum standoff ranges with its laser guidance. However, emerging technologies from the ongoing MTR offer potential solutions for weather-associated problems. The Hellfire missile with millimeter wave guidance and the BAT sub-munition with an acoustic guidance sensor should be relatively immune to adverse weather. Technology is rapidly approaching the potential of providing precision munitions that can be employed at anytime and in any weather.

AIR FORCE TARGET DESTRUCTION SYSTEMS

As with the discussion of Army target destruction systems, this assessment will evaluate Air Force systems in two separate categories: first the delivery vehicles (aircraft) and then the target destruction mechanisms (bombs).

There are many different aircraft capable of providing fires for corps deep operations, from the B-52 to the A-10. However, to keep the discussion in perspective this analysis will focus on the two high-tech aircraft most likely to provide air interdiction--the F-16 Fighting Falcon and the F-15E Strike Eagle.

Perhaps the most versatile of Air Force aircraft is the

F-16--called on to perform all missions from counterair to air interdiction to close air support. However, the primary mission for most F-16 units is air interdiction. With the Low Altitude Navigation and Targeting Infra Red for Night (LANTIRN) attack system, the aircraft has the capacity to perform interdiction missions day or night below the weather.

The LANTIRN system consists of two externally mounted pods--one for navigation and one for targeting. Together they provide forward looking infra red (FLIR) sensors, a laser target designator, terrain-following radar and an automatic multi-mode target-tracker.⁴⁴ These technological achievements allow the pilot to deliver precision guided munitions (PGMs) day or night, below the weather, with a reduced cockpit workload requirement. Together these capabilities increase the survivability of the aircraft and pilot.

In addition to the LANTIRN system, the F-16 also has numerous on-board systems that further enhance aircraft survivability. Some of these systems include an electronic counter-measures pod, chaff and flare dispensers, threat warning system, and air-to-air missiles.⁴⁵ Working together, these high-tech systems ensure a highly survivable aircraft with the ability to respond rapidly to targets in the corps deep battle.

A more recent addition to the Air Force inventory is the F-15E Strike Eagle. Like the F-16, the F-15E also has the LANTIRN system for low altitude night navigation. In addition, the F-15E

has two other capabilities that make it a tremendous interdiction asset in the corps deep battle--a Hughes AN/APG-70 radar and a large bomb capacity. The radar provides the F-15E with a high resolution mapping mode and a synthetic aperture radar capability (similar to JSTARS) which permits the aircraft to perform its mission day or night in all weather conditions. The resolution of this radar is so sensitive that it "can locate a vehicle in the forest or pick out a house in a town and hit it."⁶⁶ As for payload, the F-15E routinely flew anti-armor interdiction missions with eight GBU-12, laser-guided, 500-pound bombs.⁶⁷ On several occasions, a two-ship of F-15Es with 16 bombs destroyed 16 tanks.⁶⁸ As can be seen, the F-15E provides some unique capabilities to the corps deep battle--namely a day or night, all-weather capable aircraft that can deliver an awful lot of firepower.

While current Air Force aircraft possess some robust characteristics as the result of technology, the target destruction munitions require more emphasis. The Air Force has a huge arsenal available for interdiction missions--to include precision guided munitions (PGMs), cluster bomb munitions, and free-fall munitions. Each of these categories include many types of weapons with different fusing, different guidance, and different warheads to achieve specific target effects. Since it is very difficult to realize a catastrophic kill on an armor vehicle with either cluster or free-fall munitions, due to a lower probability of hit, this paper will only examine PGMs.

Within the family of PGMs are several types of guidance packages: laser-guided (GBU-10/12/24), infrared-guided (AGM-65D), and electro-optical or EO/TV-guided (GBU-15). As a result of the ongoing MTR and extraordinary gains in enabling technologies, the PGM appears to be a truly revolutionary weapon.

Laser-guided bombs (LGBs) use reflected laser energy to guide on their targets. The Air Force typically uses self-designating aircraft to accomplish this task.⁵⁹ The LANTIRN system on the F-16 and F-15E provides laser designation and will automatically maintain the laser spot on a selected target, thereby freeing the pilot for other cockpit tasks.⁶⁰ Operation DESERT STORM became a proving ground for LGBs where approximately 80% of the LGBs dropped by F-15Es scored direct hits on their targets.⁶¹ In spite of the remarkable success of this weapon, it does have a shortfall. While the aircraft and bomb are all-weather capable, the laser is not. Bad weather or dust can attenuate the laser and render it unusable for guiding the weapon.

The second type of PGM is the infrared or IR-guided variant. The most common of these munitions is the imaging infrared (IIR) Maverick (AGM 65D). Carried primarily by A-10 and F-16 aircraft, the AGM-65D achieved 'catastrophic kills' about 80% of the time that the missiles were fired in Operation DESERT STORM. The AGM-65D IIR Maverick attains this destruction by using an infrared seeker that guides on a thermal image of a target and then delivers a 125-pound anti-armor, shaped-charge warhead which detonates on impact.⁶² While the IIR variant provides

significant enhancements over the original television variation. once again bad weather hampers the missile's ability to acquire and guide on targets.

The final category of PGM is the EO/TV-guided GBU-15. This weapon is a 2000-pound bomb, with either a TV or imaging infrared (IIR) seeker head, a control/data-link, and a cruciform wing. Once the bomb is released, the Weapon System Officer (WSO) continues to refine the target aimpoint from a data-link image in the aircraft from a seeker on the bomb.⁴¹ This is the weapon that produced the video footage of bombs flying into the windows of buildings during Operation DESERT STORM. In practice, this weapon would target predominately fixed, hardened facilities and would not normally be used against enemy armored or mechanized forces. The discussion of this weapon is only to bring up the fact that this guidance also is limited by weather. If the bomb cannot see the target area with IIR or TV imaging, then the WSO cannot guide it on the target.

Air Force aircraft offer several unique capabilities to corps deep operations. First, target range is essentially not a consideration. With or without air refueling, Air Force aircraft can engage targets several hundred kilometers beyond the FLOT. Second, with high-speed, low-altitude flight and numerous on-board self-protection measures, today's fighter aircraft are highly survivable. Finally, with emerging high-tech systems such as LANTIRN and high-resolution radars, the F-16 and F-15E can operate day or night in all weather conditions. On the other hand, Air

Force munitions currently limit employment opportunities.

Much like the Block I ATACMS, air-delivered cluster munitions have the capability to destroy personnel in the open and soft-skinned vehicles. However, the destruction of armor requires a precision guided munition with a shaped-charge to achieve a "catastrophic kill." The current inventory of Air Force PGMs can be either laser-guided (GBU-10/12/24), EO/TV-guided (GBU-15), or IR-guided (AGM-65D). Unfortunately, each of these weapons are limited by adverse weather. The ongoing MTR attempts to solve this dilemma with emerging weapon systems such as the air-delivered Sensor Fused Weapon (SFW) which would provide a multiple-kill capability against armored vehicles. Each 1,000 pound weapon can deliver more than 40 armor-piercing warheads.⁶⁴ Hopefully, this all-weather capability will soon exist.

IV. ANALYSIS OF CORPS DEEP OPERATIONS

The key question that this monograph must answer is this: Has technology altered the nature of tactical warfare so that the preferred means for achieving corps battle objectives is now with deep operations?

Answering this question requires a further review of three subordinate questions? First, what is an objective? Second, what is the corps deep operations process? And finally, has technology fundamentally changed deep operations so that they can now independently achieve corps battle objectives?

OBJECTIVES

Both Army and Air Force doctrine contain similar concepts for 'objective' in their respective discussions on the principles of war. Essentially, an objective guides military efforts by providing a clearly defined and attainable goal.⁴¹ PD FM 100-5 adds to this definition and suggests that "commanders designate physical objectives such as an enemy force, decisive or dominating terrain, a juncture of lines of communications, or other vital areas essential to accomplishing the mission."⁴² Battle objectives then fall into one of two categories: force-oriented or terrain-oriented.

The commander may first choose (or be tasked) to defeat or destroy a particular enemy force. FM 100-15 defines these objectives as follows:

Defeat may or may not entail the destruction of any part of the enemy army; rather, the objective is to either disrupt or nullify his plan and/or subdue his will to fight so that he is either unwilling or unable

to further pursue his adopted course of action. On the other hand, destruction of the enemy force renders it combat ineffective unless reconstituted.⁵⁷

Corps deep operations may have the potential to independently achieve this objective. Relying on overwhelming firepower, deep operations could likely destroy an enemy force.

The commander may also choose (or be tasked) to seize or secure a particular piece of terrain. To 'seize' terrain requires a force to clear a designated area and obtain control of it.⁵⁸ To 'secure' an area requires a force to gain possession of a terrain feature, with or without force, and to prevent its destruction or loss to enemy action.⁵⁹ Corps deep operations cannot normally complete the 'seize' or 'secure' missions of terrain-oriented objectives without committing ground maneuver forces. This may be prohibitive depending on the depth of the operation. However, deep operations may have the potential to be decisive by destroying organized enemy resistance prior to the final objective.

CORPS DEEP OPERATIONS PROCESS

The corps uses the decide-detect-deliver approach to conduct deep operations. The DECIDE phase provides the focus for the target acquisition and fire planning process. The DETECT phase executes the decisions reached in the decide phase based on 'trigger events.' Finally, the DELIVER phase is executed rapidly by designated target destruction systems when defined enemy activities are detected by sensors.⁶⁰

The purpose of the DECIDE phase is to focus priorities for

the collection management and fire planning process. The key is to synchronize corps deep and close operations to attain a synergistic effect and to present the greatest possible dilemma for the enemy. To have the potential to achieve the corps' battle objective, the commander must first 'decide' to make deep operations his main effort. This potential for decisive deep operations rests primarily in the commander's assessment of the potential for high-tech weapons systems to influence the METT-T variables--mission, enemy, terrain, troops, and time.

The unit mission specifies essential objectives that a commander must accomplish. As described earlier, these objectives can be one of two types: terrain- or force-oriented. Objectives that call for the defeat or destruction of enemy forces are more appropriate for independent deep operations than terrain-oriented objectives. The greatest potential for deep operations, due primarily to increased firepower, is the destruction of enemy forces.

The second component of METT-T, enemy, is a critical evaluation. As discussed earlier, our target acquisition and target destruction systems are optimized for motorized, mechanized, or armor forces. An enemy that is primarily dismounted infantry or urban guerrilla fighters is not as susceptible to acquisition and destruction with today's weapon systems. That is not to say that deep operations are ineffective, only that the likelihood of them accomplishing battle objectives on their own is diminished.

The third component of METT-T, terrain, is currently the key consideration. Operation DESERT STORM, with its relatively flat and featureless terrain, enhanced the effectiveness of our current weapons systems. However, extremely mountainous terrain or thick jungle canopies can attenuate both the radar and infrared acquisition capabilities of current weapon systems. A further area of concern is weather. As discussed earlier, neither the Army or the Air Force currently has the capability to deliver PGMs in adverse weather conditions. Weather considerations should be an integral part of a commander's assessment in determining the potential for decisive deep operations.

The fourth consideration, troops, gains its significance in determining what assets are available for deep operations. The key elements include intelligence, fires (both organic and others such as airpower), and command and control. Intelligence assets must be capable of providing near real-time acquisition and targeting of key enemy forces and air defense assets. Corps deep fires and air interdiction assets must be of the correct quality and quantity. The qualitative nature of these fires must provide the destructive and non-destructive means for the suppression of enemy air defense as well as appropriate munitions for the objective--i.e., PGMs for catastrophic kills against enemy armor. Also, the quantity and availability of delivery systems (missiles and aircraft) must be sufficient to support the final battle objective--i.e., the destruction of an enemy tank division. Finally, a harmonious, joint command and control element must be

in place to rapidly synchronize all elements of the deep operation into a synergistic package. This is presently our greatest weakness.

Finally, the commander must assess time available. The less time a commander has to achieve an objective, the greater reliance he may place on decisive deep operations. This allows simultaneous close and deep operations in order to conclude the battle sooner. However, the commander must remember that adequate time must be available to properly plan and synchronize all joint aspects of deep operations to obtain the synergistic effects of overwhelming firepower at the decisive point.

This brings the discussion to the DETECT phase. Through the proper use and execution of 'trigger events' the corps acquires targets for subsequent engagements. Here the process begins to rely more on the capabilities provided by our present MTR.

Currently, if a vehicle moves then it can be seen, regardless of day, night or adverse weather conditions. The moving target indicator of JSTARS has the ability to identify numbers and precise locations of individual moving vehicles. When this capability is used to direct UAVs, then the type of vehicle (armor, mechanized, or motorized) can be determined in day or night conditions. The only current shortfall is the ability to identify specific types of vehicles in adverse weather conditions, although the synthetic aperture radar capability of JSTARS has a limited capacity in this role. Furthermore, RF-4s and GRCS can acquire and precisely locate radar emissions from SAM and AAA

systems.

All of these systems have near real-time data-links to ground stations. Certainly, technology has shown that target acquisition systems can contribute to decisive deep operations.

The final step in corps deep operations is the DELIVER phase. This phase employs designated fire support systems in response to corps attack directives when defined enemy activities (trigger events) are detected by acquisition sensors." Once appropriate targets are detected, the corps executes its planned delivery options.

A notional target of an enemy mechanized or armor force could involve a 'deliver' phase that progresses something as follows. First, ATACMS fires JSEAD missions against acquired radar-guided SAM and AAA systems. Second, Air Force aircraft deliver GATOR mines (a cluster munition similar to FASCAM) to delay and disrupt the march formation. Additionally, Air Force aircraft employ random-delay cluster munitions to keep engineers from clearing mines and to suppress hand-fired SAMs (SA-7/14/16). Finally, Apache attack helicopters employing Hellfire missiles along with Air Force aircraft employing Maverick missiles and laser-guided bombs destroy the column in detail. If properly synchronized, alternating fast-moving fighters with terrain-masking Apaches would frustrate enemy air defense efforts. Again, the technical ability to precisely deliver ordnance on all vital enemy forces in near real-time indicates a potential decisive nature for corps deep operations.

CONCLUSIONS--TECHNOLOGY AND CORPS DEEP OPERATIONS

The U.S. military is currently experiencing an MTR characterized by emerging technologies in micro-electronics, communications, data-processing, and low-observable technologies. These technologies have provided weapons systems with the potential for a pivotal impact on corps deep operations. Target acquisition systems, combined with high-lethality precision munitions, now indicate a capacity to achieve the objectives of corps battles with only deep operations--possibly without even committing close operations forces.

Deep operations can destroy large mechanized or armor units. This occurred during Operation DESERT STORM when, on 22 January 1992, JSTARS vectored an AC-130 and two A-10s to destroy 58 of 71 vehicles in a convoy and again, on 13 February 1992, when an Iraqi armored division was caught moving at night and was destroyed by airpower.¹² Furthermore, by 17 February 1992, airpower had destroyed 1,300 of Iraq's 4,280 tanks and 1,100 of the 3,110 artillery pieces in Kuwait.¹³ All these examples support the concept that deep operations can independently achieve typical corps objectives. Synchronizing these efforts with Army systems for close-in interdiction would only be more effective.

However, in the event of adverse weather, current weapon systems, no matter how well synchronized, will be unable to destroy an enemy armor or mechanized force. There currently exists the capability to delay and disrupt that force, but destruction requires the employment of PGMs which rely on clear

weather, either day or night. On the other hand, the future holds some promise with emerging weapons such as the BAT sub-munition of the Army and the sensor fused weapons of the Air Force that are less affected by adverse weather.

Under the right conditions, deep operations can independently achieve the objectives of corps tactical battles.

V. IMPLICATIONS FOR DOCTRINE

Given the conclusions of the previous sections, this paper now looks at the potential implications for military doctrine.

Recent advances in military technology have forever altered the nature of warfare. At the corps level, the commander now has a direct interest in a much broader scope than previously. Direct fire weapons such as the M-1A1 tank can engage targets more than three kilometers away. Indirect fire weapons can engage targets greater than 100 kilometers. Meanwhile, the speed of maneuver units has also expanded the battlefield, to where an armor unit can easily travel over 100 kilometers in a single day. Altogether, the modern Army corps possesses the acquisition assets, maneuver capability, and deep fires ability to fight several hundred kilometers deep.

In consonance with this concept of fighting in depth are some ideas presented by Lt Col Price Bingham in his paper, Ground Maneuver and Air Interdiction in the Operational Art. Writing for the Airpower Research Institute, Lt Col Bingham suggests that "air interdiction and ground maneuver must be *synchronized* so that each complements and reinforces the other."⁴ Lt Col Bingham further explains that the purpose of this synchronization is to present the enemy with a dilemma: either to attempt to counter ground maneuver by moving rapidly and expose himself to unacceptable losses to air interdiction or restrict his maneuver to avoid losses to air interdiction and become susceptible to the maneuver of ground units.⁵ This description of how air interdiction and

ground maneuver complement each other reinforces the concept of working in harmony towards a single objective--the destruction of the enemy. However, at this point Lt Col Bingham restricts his ideas too much.

Lt Col Bingham next emphasizes the importance of campaigns, rather than battles to synchronize air and land forces. He focuses on the operational level of war at the exclusion of the tactical level, while many of his ideas are equally applicable. One of his suggestions is to examine organizations charged with planning and controlling air interdiction and ground maneuver to see if synchronization can be achieved easier and to ensure that air interdiction can be planned and controlled to be responsive to the dynamics of ground maneuver.¹⁶ Clearly, this idea has tactical as well as operational significance.

So what adjustments can we make to doctrine? Certainly both the Army and the Air Force must recognize a joint operations area of some sort where corps deep operations overlap with air interdiction. This area must be controlled jointly with both services maintaining the capability to quickly engage targets that may impact either the tactical or operational level of war. The overriding goal should be to integrate both service actions to achieve a synergistic effect with our combined combat power and to confront the enemy with the greatest possible dilemma. Accordingly, there are some implications for both Army and Air Force doctrine.

First, FM 100-5 should develop and support the concept that

deep operations can achieve the objectives of corps battles under the right conditions. This depends largely on favorable weather, the availability of an adequate number of joint interdiction systems, and the nature of the mission. While corps deep operations do not have the ability to achieve battle objectives in all situations, the corps commander can use the standard METT-T analysis to determine if deep operations are the appropriate means to achieve the objectives of battle.

Second, while Air Force doctrine is adaptable to the idea of decisive deep operations, Air Force leaders do not always support it. While the doctrine proclaims the importance of orchestrating and synchronizing air interdiction with ground maneuver, current Air Force leaders seem to resist efforts to synchronize close-in interdiction missions with ground forces. Recent Air Force Times articles confirm this trend. In a 9 November 1992 issue, Col John A. Warden of the Air Command and Staff College suggested that in future wars the Air Force's primary mission will be hitting high value strategic targets while every other mission, including CAS, will have to take a lower priority.¹¹ In a 16 November 1992 issue, the Air Force Times published an article contending that Air Force Chief of Staff Gen. Merrill McPeak proposed a division of battlefield duties where ground commanders would control close-in battles and Air Force CAS missions while the Air Force would control the deep battle and the Army's ATACMS, and possibly MLRS fires.¹²

While these efforts to gain increased freedom of action are

noteworthy, the Air Force must acknowledge their responsibility to affect the outcome of tactical battles with close-in interdiction missions against lucrative, appropriate targets--ideally in synchronization with Army systems. It is much easier to destroy an armor unit with joint deep operations than to destroy tanks one at a time with less efficient single-service close operations. Technology has greatly improved the navigation, on-board target acquisition, and precision weapons systems that should simplify this process. Air Force doctrine, as well Air Force leaders, should continue to emphasize a commitment to air interdiction across the entire battlefield.

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