

# Landmine Warfare in Support of Multi-Domain Battle: Balancing Discrimination and Military Effectiveness

A Monograph

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## Abstract

Landmine Warfare in Support of Multi-Domain Battle: Balancing Discrimination and Military Effectiveness, by MAJ Brian C. Walker, US Army, 47 pages.

From the development of FASCAM in support of AirLand Battle through the latest Presidential Directive that prohibited the use of antipersonnel mines by the Department of Defense, the United States has pursued policy changes to landmine warfare with the goal of increasing the discrimination of the system while utilizing technological advances to maintain its counter-mobility capability. As a result, today's operational commander has fewer viable munitions and delivery systems to execute minelaying operations across the US Joint Force, creating a capability gap in addition to truncating operational reach. The recent transition to MDB increases the utility of landmines for counter-mobility, requiring that this capability gap be addressed. Ongoing efforts to address the gap are making progress, but they remain incomplete and potentially too reliant on the technological promise of networked munitions



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## Acronyms

ADAM	Area Denial Artillery Munition
AP	Anti-Personnel
AV	Anti-Vehicular
BCT	Brigade Combat Team
CCW	Convention on Certain Conventional Weapons
CTC	Combat Training Center
EMS	Electro-Magnetic Spectrum
FASCAM	Family of Scatterable Mines
FSO	Full Spectrum Operations
ICRC	International Committee of the Red Cross/Crescent
MDB	Multi-Domain Battle
MOPMS	Modular Pack Mine System
RAAM	Remote Anti-Armor Mine
ULO	Unified Land Operations
UN	United Nations
WWII	World War II

## Introduction

Landmines are controversial weapons of war. They provide a unique capability but carry moral ambiguity because of their inability to distinguish friend from foe, or combatant from noncombatant, after activation. The interplay between these two facets of landmines is best described as the tension between military effectiveness and the moral imperative of discrimination. While this tension is present in all weapons, the specific role of landmines in counter-mobility, and the methods of ensuring their discrimination, makes them unique.

Joint doctrine describes counter-mobility as, “[t]he construction of obstacles and emplacement of minefields to delay, disrupt, and destroy the enemy by reinforcement of the terrain.”<sup>1</sup> Counter-mobility is an operational requirement for land forces: “Operating on land drives the need for an effective combined arms obstacle capability that allows [US] forces to dictate the terms of the enemy’s movement and maneuver while maintaining friendly freedom of action.”<sup>2</sup> Counter-mobility is the manipulation of the battlefield’s space to friendly advantage while imposing additional costs on enemy movement in terms of constricted space, time, and resources. It has both a physical effect through the denial of access and a cognitive effect through its impact on enemy decision making. Counter-mobility effects can be produced by a variety of weapons or obstacles.

Landmines are employed in combination with natural and manmade obstacles as part of the Joint force’s integrated obstacle framework to produce counter-mobility effects.<sup>3</sup> Landmines

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<sup>1</sup> Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, rev. ed. (Washington, DC: Government Printing Office, 2016), 54.

<sup>2</sup> US Army Maneuver Support Center of Excellence (MSCoE), “White Paper on the Future of Combined Arms Terrain Shaping Obstacle Capability” (2015), 1.

<sup>3</sup> Joint Publication (JP) 3-15, *Barriers, Obstacles, and Mine Warfare for Joint Operations* (Washington, DC: Government Printing Office, 2016), I-5.

are a “negative aim” weapon, designed for the prevention or delay of action on the part of an enemy by denying or making his access to a piece of ground more difficult.<sup>4</sup> They support both offensive and defensive operations, and their employment influences all six of the warfighting functions of friendly and enemy combatants.<sup>5</sup> Landmines are an economy of force weapon, enhancing the combat power of friendly units while degrading enemy combat power whenever they are encountered at reduced risk to the force.<sup>6</sup> The requirement for counter-mobility, and landmines’ role in supporting it, is the basis for justifying their use. However, the operating method of landmines creates tension with the moral imperative of discrimination.

Discrimination is derived from the requirement in the Law of War for distinction, which “obliges parties to a conflict to distinguish principally between the armed forces and the civilian population, and between unprotected and protected objects.”<sup>7</sup> Within the US military, discrimination is a subcomponent of identification, describing the differentiation “between recognizable objects as being friendly or enemy.”<sup>8</sup> Appropriate discrimination, manifested in rules of engagement, supports the full range of military operations and diplomatic efforts by balancing the legal requirements of military necessity, proportionality, and humanity.<sup>9</sup>

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<sup>4</sup> Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), 357-59; JP 3-15, xi-xii; JP 1-02, 154-55.

<sup>5</sup> JP 3-15, I-1—I-2.

<sup>6</sup> JP 3-15, II-4; Joint Publication (JP) 3-0, *Joint Operations* (Washington, DC: Government Printing Office, 2017), A-2. Economy of Force: “[T]he judicious employment and distribution of forces so as to expend the minimum essential combat power on secondary efforts in order to allocate the maximum possible combat power on primary efforts.”

<sup>7</sup> Office of General Counsel, Department of Defense, *Department of Defense Law of War Manual* (Washington, DC: Government Printing Office, 2015), 62.

<sup>8</sup> JP 1-02, 107.

<sup>9</sup> General Counsel, *Law of War Manual*, 50-51.



Some international organizations and states consider landmine use a violation of the humanitarian aspects of the Law of War.<sup>10</sup> Landmines kill or maim non-military personnel, obstruct economic development and reconstruction following a conflict, inhibit the repatriation of refugees and internally displaced persons, and can present a threat years after emplacement.<sup>11</sup> According to Joint doctrine, “their employment can have an adverse effect on the perception of mission validity and undermine popular support [...] and can have political and psychological impacts detrimental to stability operations and counterinsurgency operations.”<sup>12</sup> The problems associated with landmines occur following their employment when they lack discrimination across time and space and between combatant forces and civilians.

The inherent discrimination shortfall in landmine usage is acknowledged by the United States, but the capability has been maintained to the present to bolster counter-mobility capabilities. In an effort to balance the tension between the two factors since the end of World War II, the United States has modified its landmine warfare doctrine and systems to achieve greater discrimination. These modifications resulted from changes in policy and the reaction to technological or environmental changes, ultimately influencing landmine capability and capacity. Capacity refers to the expected performance of an individual or system within the bounds of an assumed performance standard and environment. Capability refers to the performance of an individual or system external to ideal conditions, either exceeding or failing to meet the standard expressed by capacity. Capacity denotes potential while capability describes performance. In the

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<sup>10</sup> “Arguments for the Ban,” International Campaign to Ban Landmines, accessed March 16, 2017, <http://www.icbl.org/en-gb/problem/arguments-for-the-ban.aspx>; Michael J. Price, “The Mineless Battlespace: Shaping the Future Battlefield without Conventional Landmines” (monograph, School of Advanced Military Studies, US Army Command and General Staff College, 2002), 31, 36.

<sup>11</sup> United Nations (UN) General Assembly, *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction* (New York: UN, 1997), preamble, accessed April 5, 2017, [http://legal.un.org/avl/pdf/ha/cpusptam/cpusptam\\_e.pdf](http://legal.un.org/avl/pdf/ha/cpusptam/cpusptam_e.pdf).

<sup>12</sup> JP 3-15, I-2.

case of landmines, capacity derives from the number of employment systems, munitions, and mines available to the force. Obstacle capability results from the level of training on emplacement and environmental conditions during landmine employment. The Department of Defense's failure to manage this tension effectively over time has resulted in the atrophy of landmine warfare capacity and capability, generating a counter-mobility capability gap in the Joint force that must be addressed in order to support the Army's new operational concept of Multi-Domain Battle (MDB).

This monograph includes several sections that explore the effects of the tension between the moral imperative of discrimination and the operational requirements of counter-mobility on past and future US landmine warfare. First, a review of major US landmine warfare changes describes the role of this tension in the creation of the Army's present capacity and capabilities gaps. The next section assesses the relevance of landmine warfare in the emerging Army operational concept of MDB. The following section evaluates the Army's ongoing efforts to close these gaps, as well as how the inherent tension between discrimination and counter-mobility have informed this process. The next section examines shortfalls in the current proposed solutions stemming from a failure to effectively address the tension between discrimination and counter-mobility. Finally, the conclusion offers potential alterations or additions to the existing institutional approach while balancing the requirements of discrimination and military effectiveness.

## Prioritization of Discrimination: Evolution of the Gaps

Historically, the United States has prioritized discrimination over military effectiveness in counter-mobility by accepting additional risk, substituting capabilities from other systems to achieve the same effects as landmines, and leveraging new technologies. At the end of World War II (WWII), landmine-based counter-mobility was provided by persistent landmines, which

“remain active indefinitely waiting for activation by the presence, proximity, or contact of a person or vehicle.”<sup>13</sup> In the immediate aftermath of WWII, the economy of force, counter-mobility, and protection functions of landmines were critical factors in military plans to defend Western Europe against a ground attack by the Soviet Union. The United States and its allies required the capabilities provided by minefields to reduce the quantitative advantage of Soviet ground forces and create time for the mobilization of forces by interdicting Soviet movement.<sup>14</sup> A minefield 300m x 250m in size took an engineer company approximately eight hours to emplace by hand, but the investment of time was returned by the landmines’ persistent nature.<sup>15</sup> These semi-permanent minefields were clearly marked with signs and fencing to prevent civilian casualties. The landmines in these minefields existed in two forms, Anti-Personnel (AP) and Anti-Vehicular (AV), which were employed together to ensure effectiveness.<sup>16</sup> Landmine tension following WWII was balanced between the operational requirement to defend against the existential threat posed by the Soviet Union and the need for discrimination in the employment of persistent landmines by organizing them into well-marked fields.

For three decades following the Cold War, mutually assured destruction deterred conventional conflict and reduced the justification of permanent minefields in Europe, enabling the pursuit of policies limiting landmine usage. Globally, the employment of indiscriminate weapons, including incendiary, chemical, biological, and delayed-action weapons, generated

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<sup>13</sup> JP 3-15, I-5.

<sup>14</sup> Richard L. Kugler, “Case Study in Army Transformation: Creating Modular Forces,” *Case Studies in National Security Transformation*, no. 14 (Washington, DC: National Defense University, Center for Technology and National Security Policy, 2008), 5-6.

<sup>15</sup> Field Manual (FM) 5-100, *Engineer Combat Operations* (Washington, DC: Government Printing Office, 1979), 1-4.

<sup>16</sup> Field Manual (FM) 3-34.210 (30-32), *Explosive Hazards Operations* (Washington, DC: Government Printing Office, 2007), Appendix D. The FM uses the “AV” classification to reflect a doctrinal change from the use of “AT” (Anti-Tank).

large-scale human suffering during regional and proxy conflicts since the 1950s, precipitating an international effort to mesh International Humanitarian Law and warfare to protect civilian populations.<sup>17</sup> The International Committee of the Red Cross/Crescent (ICRC) supported these efforts, working through the Geneva Convention authorities to create a Committee on Conventional Weapons during conferences in 1974 and 1977. Unable to reach an agreement between competing interests, the parties agreed to forward the issue to the United Nations (UN).<sup>18</sup>

At the end of its second session in 1980, the Convention on Certain Conventional Weapons (CCW), consisting of three protocols, was adopted and went into effect on December 2, 1983.<sup>19</sup>

Basing themselves on the principle of international law that the right of the parties to an armed conflict to choose methods or means of warfare is not unlimited, and on the principle that prohibits the employment in armed conflicts of weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering.<sup>20</sup>

Protocol II of the CCW established restrictions on landmine use, increasing the discrimination of landmine employment of all types in an effort to protect civilian populations on the battlefield.<sup>21</sup> In its ratification remarks, the United States noted that “[o]ur signature of this Convention reflects the general willingness of the United States to adopt practical and reasonable

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<sup>17</sup> Robert J. Mathews, “The 1980 Convention on Certain Conventional Weapons: A Useful Framework Despite Earlier Disappointments,” *International Review of the Red Cross* 83, no. 844 (December 2001): 993; Nicholas R. Nethery, “Evolution of United States Military Landmine Doctrine and Employment” (master’s thesis, US Army Command and General Staff College, 2015), 51-52, 63-64.

<sup>18</sup> Mathews, “The 1980 Convention on Certain Conventional Weapons,” 994-95.

<sup>19</sup> *Ibid.*, 996.

<sup>20</sup> UN General Assembly, *Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which May Be Deemed to be Excessively Injurious or to Have Indiscriminate Effects* (New York: UN, 1981), preamble.

<sup>21</sup> UN General Assembly, *Convention on Certain Conventional Weapons (CCW): Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices (Protocol II)* (New York: UN, 1981), Articles 3-5 and 7-9.

provisions concerning the conduct of military operations, for the purpose of protecting noncombatants.”<sup>22</sup> This sentiment reflected an American concern about the suffering caused by landmines and other weapons systems. Despite being an early signatory of the CCW, the United States did not initially ratify the treaty, remaining legally unbound to its limitations to preserve the potential use of certain weapons out of military necessity.<sup>23</sup>

This policy shift towards more stringent landmine discrimination requirements coincided with the adoption of a new military doctrine. In 1982, the Army introduced the AirLand Battle operational concept, which focused on greater air-ground integration and the execution of operations across the depth of the environment in contrast to the Active Defense concept of fronts.<sup>24</sup> In support of this new doctrine, AirLand Battle emphasized technology as a key component of modern battle.<sup>25</sup> With respect to landmines, the CCW agreement’s emphasis on greater discrimination and AirLand Battle’s operational requirements were balanced by advances in technology that promised to increase landmine effectiveness and discrimination.

The new technology consisted of the Family of Scatterable Mines (FASCAM), a collection of mine employment systems and munitions that could rapidly emplace non-persistent

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<sup>22</sup> “Treaty Compliance: CCW Ratification Summary,” Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, accessed March 19, 2017, <http://www.acq.osd.mil/tc/treaties/ccwapl/ratifsum.htm>.

<sup>23</sup> “Treaty Compliance: CCW Ratification Summary”; UN Office for Disarmament Affairs, Treaties Database, *Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects: Treaty Status*, accessed March 20, 2017, <http://disarmament.un.org/treaties/t/ccwc>.

<sup>24</sup> Field Manual (FM) 100-5, *Operations* (Washington, DC: Government Printing Office, 1982); John J. McGrath, *Fire for Effect: Field Artillery and Close Air Support in the US Army* (Fort Leavenworth, KS: Combat Studies Institute, 2010), 133.

<sup>25</sup> Douglas W. Skinner, *AirLand Battle Doctrine* (Alexandria, VA: Center for Naval Analyses, 1988), 1.

minefields across the depth of the battlefield.<sup>26</sup> FASCAM supported AirLand Battle while reducing the long-term impacts of mines on civilians in accordance with CCW mandates.<sup>27</sup> Because FASCAM mines would self-destruct after a given amount of time, the system heightened discrimination by reducing the permanent presence of landmines on the battlefield. FASCAM's variable dispersal rates and lack of minefield marking decreased discrimination in space, especially at the middle and deep ranges. However, elevating the level of authority for landmine employment mitigated this effect by tightly controlling the deployment of those systems. Operationally, FASCAM increased the reach, flexibility, and economy of force of American landmine warfare in support of AirLand Battle.<sup>28</sup> The additional risk to soldiers conducting reseeding of FASCAM minefields, caused by the loss of landmine endurance, was accepted in exchange for these anticipated gains in discrimination and operational effectiveness.

The next major change in American landmine warfare resulted from FASCAM's failure to meet expectations of discrimination and operational effectiveness during the Gulf War. Along with several other high profile Joint systems, FASCAM received its first test in the 1991 Gulf War.<sup>29</sup> Persistent mines, though deployed to the region, saw no use during the Gulf War based on the assumption that FASCAM was superior in supporting the AirLand Battle concept.<sup>30</sup> During the conflict, the United States employed close to 118,000 mines via FASCAM. The Air Force,

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<sup>26</sup> Martin B. Chase, "A Unique Capability: Scatterable Mines," *Army RD & A* 21, no. 2 (March-April 1980): 6-9, accessed March 16, 2017, [http://asc.army.mil/docs/pubs/alt/archives/1980/Mar-Apr\\_1980.PDF](http://asc.army.mil/docs/pubs/alt/archives/1980/Mar-Apr_1980.PDF); FM 5-100, 1-4, 2-4.

<sup>27</sup> UN General Assembly, *CCW (Protocol II)* (1981), Article 7.

<sup>28</sup> Chase, "A Unique Capability: Scatterable Mines," 6-9.

<sup>29</sup> Michael R. Gordon and Bernard E. Trainor, *The Generals' War: The Inside Story of the Conflict in the Gulf* (London: Atlantic Books, 2006), 120-21.

<sup>30</sup> Human Rights Watch, "Back in Business? US Landmine Production and Exports," briefing paper, 2005, 2, accessed March 16, 2017, <https://www.hrw.org/legacy/backgrounders/arms/arms0805/arms0805.pdf>.

Naval, and Marine fixed-wing platforms deployed over 117,000 mines using the GATOR munition variants. US Marine Corps artillery employed the remaining one thousand.<sup>31</sup> FASCAM's employment intended to deny airbase usage to Iraqi forces, interdict the movement of Iraqi SCUD missile systems and augment Marine defensive positions in the event of an Iraqi attack from the Al Jaber airbase.<sup>32</sup> Expectations did not match reality.

Despite FASCAM's promised increase in discrimination and military effectiveness, self-destruct failure rates, poor Joint obstacle execution, and reporting failures created a negative impression of the system. Higher than expected dud rates of GATOR-delivered landmines occurred, resulting in unmarked explosive hazards. Area Denial Artillery Munition (ADAM), Remote Anti-Armor Mine (RAAM), and non-fired VOLCANO systems were expected to have the same shortfalls.<sup>33</sup> In addition to these technical problems, commanders voiced concern about the potential for fratricide due to a combination of improper reporting and recording of emplaced fields within and between the services and the rapid pace of US ground advances.<sup>34</sup> Lack of Joint training on the employment of landmines as part of deep fires also contributed to synchronization failures, but did not receive the same emphasis as equipment failures. These shortcomings changed the perception of FASCAM's military utility and landmines in general, leading to a search for other systems that offered similar capabilities.<sup>35</sup> The success of AirLand Battle's offensive, maneuver-centric warfare under the protective cover of air supremacy during the Gulf

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<sup>31</sup> Government Accountability Office, "Military Operations: Information on US Use of Land Mines in the Persian Gulf War" (GAO-02-1003), 2002, 9, accessed March 15, 2017, <http://www.gao.gov/new.items/d021003.pdf>.

<sup>32</sup> Ibid., 10.

<sup>33</sup> Ibid., 27-29.

<sup>34</sup> Ibid., 33; Dupuy Institute, "Landmines in the 1991 Gulf War: A Survey And Assessment," 2000, accessed March 17, 2017, <http://www.dupuyinstitute.org/pdf/m-4minesgulfwar.pdf>.

<sup>35</sup> Dupuy Institute, "The Military Consequences of a Complete Landmine Ban," June 11, 2001, 29-33, accessed March 17, 2017, <http://www.dupuyinstitute.org/pdf/m-6mineban.pdf>.

War further deterred investment in improving landmine-based counter-mobility efforts.<sup>36</sup> At the policy level, this loss of confidence in landmine operational efficacy resulted in a temporary national ban on the sale of AP landmines.<sup>37</sup>

Less than three years later, the expansive media coverage of the Bosnian conflict increased the public's awareness of landmines, particularly their lack of discrimination and resulting civilian suffering in conflict zones.<sup>38</sup> In reaction, Congress temporarily banned the use of AP landmines.<sup>39</sup> Democratic Sen. Patrick J. Leahy of Vermont led efforts to take more permanent action with respect to landmines, increasing pressure on Pres. William J. Clinton's administration.<sup>40</sup> The White House's response to international and domestic pressures against landmine use elevated the importance of discrimination over military effectiveness, prompting a transition away from the use of persistent landmines.

While addressing the 1994 UN General Assembly, President Clinton proposed creating an international agreement focused on the global reduction and eventual elimination of persistent mines.<sup>41</sup> The administration's positive steps continued in 1995 when it submitted the ratified

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<sup>36</sup> McGrath, *Fire for Effect*, 145-46.

<sup>37</sup> "US Has Spent more than \$1 Billion on Land Mine Removal: State Department Releases Chronology of Activities Spanning 143 Years," International Information Programs, US Department of State, 2005, accessed March 19, 2017, <http://iipdigital.usembassy.gov/st/english/article/2005/12/20051219181850sjhtrop0.5924341.html#axzz4bbja1ZD6>.

<sup>38</sup> United States Senate, *Congressional Record of the Senate*, 104th Cong., 1st sess., 1995. Vol. 141, no. 19, accessed March 16, 2017, <https://www.congress.gov/crec/1995/07/21/CREC-1995-07-21-pt1-PgS10481.pdf>.

<sup>39</sup> United States Congress, *Public Law 104-107: Foreign Operations, Export Financing, and Related Programs Appropriations Act of 1996*, 104<sup>th</sup> Cong., 1996, sec. 580, accessed March 19, 2017, <https://www.congress.gov/104/plaws/publ107/PLAW-104publ107.htm>.

<sup>40</sup> *Congressional Record of the Senate*, 104th Cong., 1995.

<sup>41</sup> William J. Clinton, "Remarks to the 49th Session of the UN General Assembly," US Department of State: Address by President Bill Clinton to the UN General Assembly, September 26, 1994, accessed October 5, 2016, <https://2009-2017.state.gov/p/io/potusunga/207377.htm>.



CCW documents to the UN prior to the convention's upcoming review.<sup>42</sup> On 3 May 1996, members adopted the Protocol II amendment to the CCW.<sup>43</sup> This amendment prohibited the use of non-detectable AP mines and further identified "requirements and restrictions on land mines includ[ing]: requirements to mark, record, and publicize minefield locations at the conclusion of hostilities; joint operations after cessation of hostilities to remove or render ineffective mines and booby traps; requirements on the use of mines or booby traps in areas containing concentrations of civilians; and prohibition on types of booby traps."<sup>44</sup> Ratification of the Protocol II amendment solidified the US commitment to increasing the discrimination of its landmine systems by accepting greater operational restrictions on their employment.<sup>45</sup>

Relative global stability and dissatisfaction with the CCW Protocol II amendment inspired many states to pursue greater discrimination efforts through the UN.<sup>46</sup> The UN passed resolutions in support of this effort in 1994, 1995, and 1996, each advocating a complete ban of AP landmines and global coordination for anti-mining efforts.<sup>47</sup> These efforts culminated with the Mine Ban Treaty of 1997, commonly referred to as the Ottawa Convention or Treaty, initially

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<sup>42</sup> "Treaty Compliance: CCW Ratification Summary," Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics.

<sup>43</sup> JP 3-15, I-8.

<sup>44</sup> JP 3-15, I-8; "Treaty Compliance: CCW Amended Protocol II," Undersecretary of Defense for Acquisition, Technology, and Logistics.

<sup>45</sup> JP 3-15, I-9—I-10.

<sup>46</sup> Mathews, "The 1980 Convention on Certain Conventional Weapons," 1000-2; International Committee of the Red Cross, "Anti-Personnel Landmines: Friend or Foe? A Study of the Military Use and Effectiveness of Anti-Personnel Mines," 1996; Stuart Casey-Maslen, "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction," Audiovisual Library of International Law, accessed 21 March, 2017, <http://legal.un.org/avl/ha/cpusptam/cpusptam.html>.

<sup>47</sup> UN General Assembly, *Resolution 51/45: General and Complete Disarmament: A Treaty on the Non-Proliferation of Nuclear Weapons: 2000 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons and its Preparatory Committee* (New York: UN, 1997), Section S.

signed by 122 nations and since expanded.<sup>48</sup> The Ottawa Convention “prohibits the development, production, stockpiling, transfer, and use of anti-personnel mines” after 1 March 2009 and advocates for the active reduction of AP mine stockpiles and mines in existing conflict zones.<sup>49</sup> Though the genesis of the Ottawa Treaty can be traced to President Clinton’s 1994 remarks, the United States is a non-signatory. From a realist point of view, the countries who have not signed are those most likely to militarily threaten the existing international order, leading the United States to maintain the capability. Aligning with Ottawa would also impact American partnerships with non-signatory states, most significantly South Korea.<sup>50</sup> This incongruence between the support the United States continues to provide to mine reduction efforts and its lack of signatory status to Ottawa highlights the difference between the international and national perspectives on landmines.

As a partial redress, the United States became and remains the number one contributing nation to humanitarian demining operations, but reconciling this incongruity remains a goal for US policymakers.<sup>51</sup> The Clinton administration proposed a path to Ottawa compliance by 2006,

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<sup>48</sup> UN General Assembly, *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer Of Anti-Personnel Mines and on their Destruction* (New York: UN, 1997); “Treaty Status,” International Campaign to Ban Landmines, accessed on March 17, 2017, <http://www.icbl.org/en-gb/the-treaty/treaty-status.aspx>; Anthony DePalma, “As US Looks on, 120 Nations Sign Treaty Banning Landmines,” *New York Times*, December 4, 1997, accessed on 21 March, 2017, <http://www.nytimes.com/1997/12/04/world/as-us-looks-on-120-nations-sign-treaty-banning-landmines.html>.

<sup>49</sup> UN General Assembly, *Convention On The Prohibition Of The Use, Stockpiling, Production And Transfer Of Anti-Personnel Mines And On Their Destruction* (New York: UN, 1997).

<sup>50</sup> The White House, Office of the Press Secretary, “Remarks by the President on Land Mines,” September 17, 1997, accessed March 17, 2017, <http://fas.org/asmp/resources/govern/withdrawal91797.html>; JP 3-15, I-9; Jim Wurst, “Closing In On a Landmine Ban: The Ottawa Process and US Interests,” *Arms Control Association*, 1997, accessed 21 March, 2017, <https://www.armscontrol.org/print/225>; James G. May, “New Technology Required to Implement US Anti-Personnel Landmine Policy” (master’s thesis, Carlisle, PA: US Army War College, 1998), 2.

<sup>51</sup> “Treaty in Detail,” International Campaign to Ban Landmines, accessed on March 17, 2017, <http://www.icbl.org/en-gb/the-treaty/treaty-in-detail/frequently-asked-questions.aspx>.

committing to the destruction all persistent mines by 1999, the ending of AP mines employment outside of Korea by 2003 and within the peninsula by 2006, and developing higher-discrimination alternatives to “mixed systems” with a view towards retiring the FASCAM system.<sup>52</sup> The perceived reduction in landmine warfare’s efficacy following the Gulf War and experience in recent conflicts reduced military resistance to the policy changes. Additionally, the proposed transition period provided adequate time for changes in force structure, doctrine, equipment, and training to adapt to the loss of persistent munitions despite concerns that self-destructing munitions would be outlawed in the future, or that adequate substitute systems remained unavailable.<sup>53</sup>

The domestic and international ideas shifted during the Bosnian conflict and heightened the importance of landmine discrimination for policymakers. The American ratification of the CCW’s Protocol II amendment as well as the Clinton administration’s commitment to future policy changes, sought to balance these tensions. The divestiture of persistent landmines bounded the military effectiveness of landmines in time and mandated greater discrimination through requiring either self-destruct or “man-in-the-loop” systems. Landmine capacity did maintain the operational reach, responsiveness, and increased economy of force it obtained during the transition to FASCAM, but these capabilities started to atrophy as the system was deemphasized. The Department of Defense underwrote the risk by substituting fixed-wing precision targeting to

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<sup>52</sup> Letter from Samuel R. Berger, Assistant to the President for National Security Affairs, to Sen. Patrick J. Leahy, “Landmine Policy Intent,” The White House, 1998; William J. Clinton, Presidential Policy Directive 64, “US Landmine Policy,” 1998, accessed March 17, 2017, <https://fas.org/irp/offdocs/pdd-64.htm>; Human Rights Watch, “Back in Business?” 3-4; James G. May, “New Technology Required,” 3-4, 10-11, 14-15; United States Senate, *Congressional Record – Senate*, “Remarks by Senator Leahy,” 108th Cong., 2nd sess., 2004. Vol. 150, no. 23; JP 3-15, I11; The White House, “Remarks by the President on Land Mines”; Landmine Action and German Initiative to Ban Landmines, “Alternative Anti-Personnel Mines: The Next Generations,” 2001, 41-43, 46-53, accessed 22 March, 2017, [http://www.landmine.de/fileadmin/user\\_upload/pdf/Publi/english\\_report.pdf](http://www.landmine.de/fileadmin/user_upload/pdf/Publi/english_report.pdf).

<sup>53</sup> Paul L. Aswell, “Operational Impact of the US Anti-Personnel Landmine Ban” (monograph, Naval War College, 1999); Dupuy Institute, “Consequences of a Complete Landmine Ban,” 2001, 35-37.

achieve counter-mobility effects via strike, a lesson learned in the Gulf War and reinforced in Bosnia.<sup>54</sup>

The next major change to US landmine capabilities was not driven by policy change, but organizational changes that underpinned a new Army operational concept. In 2001, the Army began shifting to Full Spectrum Operations (FSO).<sup>55</sup> FSO envisioned custom built force packages designed “to defeat the enemy on land and establish conditions that achieve the Joint force commander’s end state” across offensive, defense, stability, and civil support operations as part of a unified effort.<sup>56</sup> Beginning in 2003, “the Army transformed from a division-based force to a modular brigade-based [BCT] force with brigades organized by function” to provide the flexibility required by the concept.<sup>57</sup> In 2011, the FSO concept evolved into Unified Land Operations (ULO), “a natural intellectual outgrowth of past capstone doctrine” that integrated Joint, Interagency, and Multinational partnership with AirLand Battle and FSO concepts.<sup>58</sup> The conversion of the division-based force to a modular structure continued under ULO, officially ending in 2012. Modularity dramatically altered the distribution and composition of the three “legs” of the Army’s landmine warfare triad: the Engineer, Artillery, and Aviation branches.<sup>59</sup>

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<sup>54</sup> James G. May, “New Technology Required,” 17; McGrath, *Fire for Effect*, 145-47.

<sup>55</sup> Bill Benson, “Unified Land Operations: The Evolution of Army Doctrine for Success in the 21st Century,” *Military Review* 92, no. 2 (March-April 2012): 5, accessed March 17, 2017, [http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview\\_20120430\\_art004.pdf](http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20120430_art004.pdf); Kugler, “Case Study in Army Transformation,” 1, 8-9.

<sup>56</sup> Bill Benson, “Unified Land Operations,” 6; Field Manual (FM) 3-0, *Unified Land Operations* (Washington, DC: Government Printing Office, 2008), Chapter 3.

<sup>57</sup> FM 3-0 (2008), 5-11, Para 5-61, and Appendix C; Stuart E. Johnson, John E. Peters, Karin E. Kitchens, Aaron Martin, Jordan R. Fischbach, *A Review of the Army’s Modular Force Structure* (Santa Monica, CA: RAND, 2012), 7-14; John J. McGrath, *The Brigade: A History* (Fort Leavenworth, KS: Combat Studies Institute, 2004), 133-34.

<sup>58</sup> Army Doctrinal Publication (ADP) 3-0, *Unified Land Operations* (Washington, DC: Government Printing Office, 2011), Foreword.

The Engineer Branch experienced significant changes as a result of the BCT restructuring, reducing its overall capacity and capability to execute landmine warfare. Corps and Division level units were inactivated and converted into combat engineer companies within the BCTs, reducing the number and variety of specialty engineer units available in the active component.<sup>60</sup> Significant reductions of engineer capabilities within the active component as part of the modularity conversion included bridging, construction, and counter-mobility. These capabilities transitioned to the Reserve and National Guard components, with the intent to call it forward if/when needed.<sup>61</sup> But limited Guard and Reserve training, combined with limited interoperability with the active component, further decreased aggregate capabilities.

Modularity also reduced the ratio of supporting units to maneuver units in the active force. For example, during the conversion to Heavy BCTs, combined arms battalions lost their organic engineer company. Within the Heavy BCT, one engineer company became responsible for supporting two maneuver battalions and one reconnaissance battalion, a reduction in engineer support of over 50% to the maneuver forces. Units converting to the BCT structure also changed their equipment sets for the ongoing Global War on Terror. As designed through 2016, the only BCT engineer element that employed ground based VOLCANO FASCAM was the Stryker BCT, which maintained two systems. Modularity transitioned landmine warfare capacity out of the active component, degrading the active component's VOLCANO capability by 73 percent from 2003 to 2012.<sup>62</sup> In addition to reduced capacity, incomplete institutional training further reduced capabilities.<sup>63</sup>

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<sup>60</sup> Stuart E. Johnson, et al., *A Review of the Army's Modular Force Structure*, 44 and Table 3.4.

<sup>61</sup> Field Manual (FM) 3-34.22, *Engineer Operations: Brigade Combat Team and Below* (Washington, DC: Government Printing Office, 2009), Annex B.

<sup>62</sup> Force Management System Website, accessed March 22, 2017, <https://fmsweb.fms.army.mil>.

<sup>63</sup> Nathan J. Smith, "Joint Countermobility Capabilities in The Department of Defense" (monograph, US Army Command and General Staff College, 2014), 21, 31-32, Table 3, 36, and Table 6.

The Artillery branch experienced a similar reduction in capacity and capability from force structure alterations and lack of training. The employment of the Artillery's FASCAM munition system, including the ADAM and RAAM, requires 155mm guns. Light BCTs were supported by 105mm Howitzer systems, with no artillery-deliverable FASCAM capacity. Other BCTs had their total number of guns reduced.<sup>64</sup> In addition to the loss of systems' capacity, the BCT restructure featured a smaller organic logistical element that reduced the overall capacity of munitions carriage, exacerbating a problem identified after Desert Storm.<sup>65</sup> This forced commanders to choose the types of missions they would be able to conduct, often assuming risk in the counter-mobility fires mission. Finally, the conversion of many artillery units into provisional infantry formations during the Global War on Terror led to general atrophy of artillery mission sets, including the ADAM/RAAM FASCAM mission.<sup>66</sup> The convergence of these factors resulted in a loss of capacity and capability across the Artillery Branch.<sup>67</sup>

The Aviation branch, though impacted by modularity, had additional incentives for allowing their FASCAM capabilities to atrophy. The risk associated with the implementation of Aviation FASCAM doctrine increased rapidly with the development and proliferation of Man-Portable Air Defense Systems and the increasing range and lethality of platform based anti-air

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<sup>64</sup> James T. Cobb, "Is the US Army Field Artillery Prepared to Support the Next Major Combat Operation?" (monograph, School of Advanced Military Studies, 2013), 37-38.

<sup>65</sup> Mark T. Kimmitt, "Rethinking FASCAM: Principles for the Use of Artillery Delivered Mines" (monograph, School of Advanced Military Studies, 1989), 23-25; James T. Cobb, "Is Field Artillery Prepared?" 38, 40-41.

<sup>66</sup> James T. Cobb, "Is Field Artillery Prepared?" 35-37.

<sup>67</sup> Sean MacFarland, Michael Shields, and Jeffery Snow, "The King and I: The Impending Crisis in Field Artillery's ability to provide Fire Support to Maneuver Commanders," white paper addressed to the Chief of Staff of the Army, 2008.

systems.<sup>68</sup> In response, the Aviation branch resisted employing the VOLCANO system.<sup>69</sup> This institutional resistance manifested itself in the limited distribution of the helicopter-mounted VOLCANO system into unit inventories and limited use of the systems in training after modularity, with the exception of units stationed in Korea.<sup>70</sup> The severe restriction of the Aviation branch's capacity and capability further reduced the active Army's landmine-based counter-mobility potential.

Modularity did not impact capacity across other elements of the Joint force. The FASCAM delivery system employed by fixed-wing platforms, the GATOR, is a munitions-centric capability. Any airframe capable of holding the munition could be assigned the firing mission, and the number of munitions required to emplace a standard field was constant at either six CBU-89B or nine CBU-78B munitions.<sup>71</sup> However, capabilities atrophied due to lack of landmine employment training at the unit level. At the time, this lack of change within the Joint force was indicative of a conceptual framework with respect to landmine warfare and warfare in general: that fixed-wing based landmine delivery would provide adequate counter-mobility in support of ground forces in the future.<sup>72</sup>

Army force structure changes during the transition from AirLand Battle to FSO/ULO, underwritten by perpetual air superiority during the expeditionary "small wars" since the Gulf

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<sup>68</sup> Field Manual (FM) 3-04.113, *Utility and Cargo Helicopter Operations* (Washington, DC: Government Printing Office, 2007), 3-61–3-67; McGrath, *Fire for Effect*, 152-53.

<sup>69</sup> MSCoE White Paper, 5.

<sup>70</sup> Charles A. Jarnot, "Air Volcano: In the Light Fighter's Toughest Scenario," *Infantry* 83, no. 3 (December 1998), accessed March 19, 2017, [https://www.benning.army.mil/magazine/1998/1998\\_3/notes02.pdf](https://www.benning.army.mil/magazine/1998/1998_3/notes02.pdf); Vincent Abril, "Training on the Air Volcano Mine System," DODLive, February 26, 2012, accessed March 19, 2017, <http://www.dodlive.mil/index.php/2012/02/training-on-the-air-volcano-mine-system/>.

<sup>71</sup> FM 3-34.210, D-12, Figure D-5.

<sup>72</sup> Kugler, "Case Study in Army Transformation," 10; Price, "The Mineless Battlespace," 52-54; McGrath, *Fire for Effect*, 155.

War, encouraged and validated the Army's divestiture of landmine warfare capacity from the active component. The Army's loss of landmine employment capacity and capability in short duration and initial contingency combat operations resulted in a drop in advocacy for, and understanding of, the Army's role in Joint counter-mobility operations and an aggregate loss of capability across the Joint force.<sup>73</sup> These factors accelerated the atrophy of US Joint landmine systems, paving the way for additional capability losses.

By 2014, FASCAM was over thirty years old. Technological advances in robotics and networked communications presented US policymakers with an opportunity to revisit the tensions of landmine employment, potentially increasing discrimination and preserving counter-mobility capability. Unilateral policy actions, intended to increase the discrimination of US landmine systems and force faster development of "smart" landmines, severely reduced the joint force's landmine capability. The Joint force bears some culpability for this capability gap due to its failure to develop landmine replacement solutions under the Clinton and Bush administrations.<sup>74</sup>

On June 27, 2014, a Presidential Directive banned the production and acquisition of AP mines.<sup>75</sup> This executive action codified a precedent set in the early 1990s when Congress temporarily banned the production and sale of landmines.<sup>76</sup> It also brought the United States into closer alignment with the Ottawa Treaty, with the expressed intention of becoming fully compliant.<sup>77</sup> Based on the life cycle of FASCAM landmines, curtailing the ability to replace

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<sup>73</sup> Price, "The Mineless Battlespace," 50.

<sup>74</sup> "State Department Chronology of Landmine Activities Spanning 143 Years"; "US Landmine Policy," 1998, accessed March 17, 2017, <https://fas.org/irp/offdocs/pdd-64.htm>; Human Rights Watch, "Back in Business?" 3-4; United States Senate, "Remarks by Senator Leahy."

<sup>75</sup> The White House, Office of the Press Secretary, "Fact Sheet: Changes to US Anti-Personnel Landmine Policy," June 27, 2017, accessed March 19, 2017, <https://www.whitehouse.gov/the-press-office/2014/06/27/fact-sheet-changes-us-anti-personnel-landmine-policy>.

<sup>76</sup> United States Embassy, "State Department Chronology of Landmine Activities Spanning 143 Years."

<sup>77</sup> The White House, Office of the Press Secretary, "Statement by NSC Spokesperson Caitlin Hayden on US Anti-Personnel Landmine Policy," September 23, 2014, accessed 19 March, 2017,



aging munitions with AP components will reduce the US inventory to zero within the next decade.<sup>78</sup> On September 23, 2014, a second Presidential Policy Directive went further, codifying another policy from the early 1990s by banning the use of AP mines by the US military outside of Korea. It also directed the destruction of AP mine stockpiles and “mixed” munitions not intended for use there.<sup>79</sup> The policy changes transitioned the Department of Defense away from AP landmines and towards only AV or man-in-the-loop systems, reflecting a desire to utilize technology to increase the discrimination of landmines to the point of Ottawa compliance and increasing pressure on the military to pursue new counter-mobility systems more aggressively.<sup>80</sup>

Both of these policies directed at AP landmines also affected the “mixed” systems within the US inventory. Within the FASCAM program, all munitions-based landmine delivery systems were prepackaged and included both AP and AV mines. As a result, the ban on AP landmines impinges on these systems as well. Operationally, the impacts of the 2014 presidential directives were that the AP elements of all VOLCANO munitions and all artillery fired ADAM rounds became illegal, a reduction in terms of ground-based counter-mobility munitions to 50 percent of previous levels. Additionally, the soldier deployed Modular Pack Mine System (MOPMS) and Navy and Air Force variants of GATOR became illegal for use by the military outside of the Korean peninsula. Due to Joint force’s reliance on fixed wing landmine employment and the Army’s the modularity restructuring, the capacity loss is even more dramatic.

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<https://www.leahy.senate.gov/press/reaction-of-senator-patrick-leahy-to-the-white-house-announcement-of-changes-to-us-landmine-policy>.

<sup>78</sup> Edward Chin, Christopher E. Kramer, and Mr. Ken R. Schulters, “Area Denial,” *Army*, June 7, 2016, accessed on 19 March, 2017, [https://www.army.mil/article/169261/area\\_denial](https://www.army.mil/article/169261/area_denial).

<sup>79</sup> The White House, Office of the Press Secretary, “Fact Sheet: Changes to US Anti-Personnel Landmine Policy,” September 23, 2014, accessed 19 March, 2017, <https://www.whitehouse.gov/the-press-office/2014/09/23/fact-sheet-changes-us-anti-personnel-landmine-policy>; US Congress, *Public Law 104-107*.

<sup>80</sup> Human Rights Watch, “Back in Business?” 4-6.

As a result of the 2014 directive, the only FASCAM systems remaining available to the operational commander are the artillery-deliverable RAAM and the AV variant of the VOLCANO canister, deliverable by UH60 or vehicle-based launch systems. These systems' ranges are inferior to GATOR, leading to a loss of deep-strike mine capability against enemy air bases or transportation hubs, as anticipated in existing Joint doctrine.<sup>81</sup> Currently, the operational commander must rely on these three, now low-density, systems' limited operational reach for the execution of counter-mobility and protective minefield missions. In 2014, the desire for greater discrimination in landmines overrode their perceived operational utility as part of American counter-mobility capability. Until a new landmine capability is developed, airpower and other alternative systems continue to substitute as part-time providers of counter-mobility.

### Landmine Utility in Multi-Domain Battle

Current Joint force landmine capability's truncated operational reach, limited endurance, and restrictive approval authority does not support the Army's MDB operational concept. Understanding this gap requires examining the future operating environment MDB is designed for, how landmines theoretically support the concept, and how the Department of Defense envisions the future of landmine warfare.

The Joint force continually attempts to anticipate the future operating environment, the kind of missions each service or the Joint force could be expected to perform, and the capabilities and intent of future adversaries. This analysis, combined with lessons learned from historical and current conflicts and military theory, helps the services project their requirements in terms of capabilities and determine how to operationally employ capabilities in the near and long term. The primary vehicle for describing the future, and the capabilities and concepts the armed forces

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<sup>81</sup> JP 3-15, x.

may require, are forecasting reports like the Joint Operational Environment assessment and the Army Operating Concept.<sup>82</sup>

The future environment these studies envision is one of contested norms and persistent disorder amongst an increasingly diverse human geography, empowered and connected by technology.<sup>83</sup> Within this complex operating environment, American forces envision six operational contexts: “Violent Ideological Competition, Threatened US Territory and Sovereignty, Antagonistic Geopolitical Balancing, Disrupted Global Commons, A Contest for Cyberspace, and Shattered and Reordered Regions.”<sup>84</sup> In these contexts, the MDB concept predicts that:

US forces will likely confront sensor-rich militaries of peer states and proxies employing precision-guided munitions on highly lethal battlefields that can restrict Joint Force freedom of maneuver and action. Adversaries will counter US strengths such as air and maritime superiority, degrade key capabilities by limiting access to space, cyberspace, and the electromagnetic spectrum (EMS), and exploit perceived US weaknesses.<sup>85</sup>

To confront and deter these threats, “the ability to project power onto land from the air, maritime, space, and cyberspace domains will remain vital to Joint operations, [and] the employment of land forces will remain essential to achieve political outcomes.”<sup>86</sup>

In response to this anticipated future state, the Army adopted a new foundational operational concept, altered its assumptions about the global operating environment and how it

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<sup>82</sup> US Joint Headquarters, “Joint Operating Environment (JOE) 2035: The Joint Force in a Contested and Disordered World, Washington, DC, 2016; Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, *The US Army Operating Concept: Win in a Complex World* (Fort Eustis, VA: Department of the Army Training and Doctrine Command, 2014), iv and 21.

<sup>83</sup> US Joint Headquarters, “JOE 2035,” Executive Summary.

<sup>84</sup> Ibid.

<sup>85</sup> Army Capabilities Integration Center, “Multi-Domain Battle: Combined Arms for the 21st Century,” 2016, accessed March 19, 2017, [http://www.arcic.army.mil/App\\_Documents/Multi\\_Domain\\_Battle.pdf](http://www.arcic.army.mil/App_Documents/Multi_Domain_Battle.pdf).

<sup>86</sup> TRADOC Pamphlet 525-3-1 (2014), 9.

will succeed within it, and transitioned from ULO to MDB on November 11, 2016 with the publication of Army Doctrinal Publication 3-0.<sup>87</sup> MDB is designed to “allow US forces to outmaneuver adversaries physically and cognitively, applying combined arms in and across all domains. It provides a flexible means to present multiple dilemmas to an enemy and create temporary windows of localized control to seize, retain and exploit the initiative.”<sup>88</sup> This transition requires the Army to review its doctrine, equipment, force structure and organization, and training programs and adjust them to support the new operational concept. As the land domain proponent, the Army must also examine the impacts of changing its operational concept on the Joint force.

The ongoing transition from ULO to MDB increases landmine warfare’s potential utility in three important ways. First, it accepts the loss of superiority in non-land domains, increasing the importance of the land force’s ability to self-secure in order to execute the “cross-domain fires” that are central to the MDB concept.<sup>89</sup> Second, the economy of force landmines provide while supporting the mobility and protection of friendly forces increases as the Army grows its reliance on qualitative advantage to enable the MDB concept. Finally, landmines, as currently designed and envisioned by the Army and the Joint Force, are a multi-domain weapon system with extended operational reach, a high economy of force, and a capacity for distribution at all echelons.

The key difference between ULO and MDB lies in their conceptualization of the domains in which the Army operates. Under ULO, integration with Joint forces occurs from the perspective of their ability to assist in the Army’s domain during the execution of operations.

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<sup>87</sup> Army Doctrinal Publication (ADP) 3-0, *Operations* (Washington, DC: Government Printing Office, 2016), 6.

<sup>88</sup> ARCIC, “Multi-Domain Battle.”

<sup>89</sup> ADP 3-0, 2016, Foreword and 6-8.

Two of ULO's underlying assumptions are that adjacent domain superiority will be achieved during shaping operations prior to the commitment of ground forces, and that such superiority would be maintained throughout ground combat. MDB explicitly denies the assumption of superiority in any domain prior to the commitment of ground troops, especially the air domain. This is a foundational pivot from the Army's operational concepts since the 1991 Gulf War, which assumed domain superiority in the air and, generally, the local sea prior to the execution of major ground combat operations.<sup>90</sup>

Traditionally, a domain's proponent shouldered responsibility for superiority within that domain through the control of access and the attrition of the enemy's capacity within the domain.<sup>91</sup> During this effort, the support provided to secondary missions of the domain's proponent declined. In the case of the air domain, this manifested itself in the reduction of the number of available sorties that fixed wing aviation provided to the ground force. As a result, ground forces operating in a contested air environment relied more on their own assets, or assets from other domains in which superiority had been achieved, for protection against opposing maneuver forces while establishing air superiority and when local air superiority was contested. The establishment of domain control prior to the commitment of ground forces, as part of the Joint force's shaping effort, mitigated the risks to the ground force presented by this problem.<sup>92</sup>

MDB envisions the ground force as a contributor to the establishment of superiority in other domains through the execution of cross-domain fires. MDB assumes that in potential future

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<sup>90</sup> Price, "The Mineless Battlespace," 38, 40-41.

<sup>91</sup> Milan N. Vego, *Joint Operational Warfare: Theory and Practice* (Newport, RI: US Naval War College, 2009), II-48—II-59; Julian S. Corbett, *Some Principles on Maritime Strategy* (London, 1911), Part II, Section I, and Part III, Section II-III, accessed 21 March, 2017, <http://www.gutenberg.org/files/15076/15076-h/15076-h.htm>; Joint Publication (JP) 3-01, *Countering Air and Missile Threats* (Washington, DC: Government Printing Office, 2012), GL-8.

<sup>92</sup> Joint Electronics Library, *Universal Joint Task List Database (15 February 2017)*, ST.1.6.2, accessed 19 March, 2017, [http://dtic.mil/doctrine/training/ujtl\\_tasks.htm](http://dtic.mil/doctrine/training/ujtl_tasks.htm).

conflicts the establishment of sustained superiority in any domain will require the commitment of ground assets beneath potentially contested airspace and/or adjacent to contested sea and cyberspace. General David Perkins, the commander of Training and Doctrine Command, emphasized this concept:

What can the Army do to help the Air Force deal with anti-access area denial? [...] Rather than cramming a bunch of Joint Strike Fighters in there with a high casualty rate, maybe you use ground forces to take up the air defenses. In the maritime domain, instead of expending the Navy's capabilities, maybe the Army's land-based artillery systems can be equipped with anti-ship missiles.<sup>93</sup>

MDB increases the ground component's responsibility, requiring active participation in securing adjacent domains. This is reflected in MDB's opportunistic exploitation of "windows" of local superiority in one domain to conduct cross-domain fires in support of other operations through asymmetric advantage.<sup>94</sup> The ability to execute cross-domain fires implies, at a minimum, local security within the firing domain at the unit level. Under the MDB concept, the utility of landmines will increase because they augment the mobility, firepower, and protection aspects of local security for ground units, enabling the creation of "windows" and the execution of cross domain fires.

Though MDB disavows the assumption of persistent superiority in any domain, it further advances the US military's reliance on a qualitative-oriented structure. A single actor is expected and required to perform a variety of missions across domains, assisted by training and technology. This consolidation of capabilities that occurs due to qualitative-oriented force structure acts as a form of economy of force, enabling the operational concepts' "employ[ment of] all combat power available in the most effective way possible" by increasing the available

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<sup>93</sup> General David Perkins, quoted in Michelle Tan, "The Multi-Domain Battle," *Defense News*, October 2016, accessed 19 March, 2017, <http://www.defensenews.com/articles/the-multi-domain-battle>.

<sup>94</sup> ARCIC, "Multi-Domain Battle"; Julian S. Corbett, *Some Principles on Maritime Strategy*, Part IV, Section III.

combat power of each individual platform or unit.<sup>95</sup> MDB's operational concept of mobile, distributed cross-domain fires relies on this qualitative advantage to succeed. This degree of consolidation contains several weaknesses that increase the operational potential of landmines.

A platform, be it a soldier or a machine, can occupy only one position on a battlefield. A platform's capacity is a function of its position and the range of its weapons and sensors. Weapons and sensors have distinct limits on the amount and type of armament they can carry, the distance at which those armaments can engage, and how long they can operate. The confluence of these factors typically determines a platform's mission set, which is the tasks it is expected to perform. MDB mitigates these shortfalls through greater dispersion of individual units, increasing small unit mobility, and diffusing capacity-dense elements across the operational environment. Such a dispersion of forces increases the utility of systems that are low cost, easy to employ, and maximize economy of force.

System loss and degradation has a larger impact on forces that rely on qualitative advantage. Qualitatively oriented systems are complex, requiring increased maintenance in addition to a longer time period to produce systems and train soldiers. Assuming an equal-to or less-than parity-cost attrition rate, as a conflict lengthens the side with the qualitative advantage exhausts more quickly than the one that maintains a quantitative advantage. The regenerative weakness of qualitative advantage was illustrated by the erosion of Japanese aviation capabilities in the Pacific during World War II compared to their US counterparts.<sup>96</sup> MDB relies on a small number of multi-mission platforms as opposed to a larger number of mission-specific platforms. As a result, forces lose a larger number of capacities and capabilities per individual platform

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<sup>95</sup> Robert Leonhard, "Economy of Force," white paper, originally published in *The Armchair General*, 1, accessed 19 March, 2017, <http://www.jhuapl.edu/ourwork/nsa/papers/economyofforce.pdf>.

<sup>96</sup> Richard B. Frank, *Guadalcanal: The Definitive Account of the Landmark Battle* (Random House, 1990), 24-25 and 66-67.

destroyed than a force structure built on single-mission platforms. Because of the greater potential impact of losses, qualitative-oriented forces must invest more heavily in the protection of each of their assets.

To be effective, a qualitative force must be supported by doctrine and systems that reduce the risks assumed by the consolidation of capabilities in fewer systems. Time must be managed to increase the number and correctness of unit actions. Space must be managed through mobility and counter-mobility to achieve effective positioning. Together, these factors create “windows” of land domain security from which distributed, mobile forces can conduct cross-domain fires. The economy of force landmines provide while supporting mobility, counter-mobility, and protection of forces supports the MDB operational concept and reduces risk to the qualitative-oriented force structure.

Based on the conceptual underpinnings of MDB, landmines have a great potential to support operations in the future environment. They enable lethal overmatch against the enemy, protect friendly forces and minimize risk to noncombatants, deny freedom of maneuver across the depth of the operational environment, enhance friendly mobility, and influence the movement of noncombatants.<sup>97</sup> To accomplish these tasks, landmines in the future will provide controllable AP and AV lethal or non-lethal capabilities that are not hazardous until activated by the operator, are simple to employ and recover, are deployable across the full depth of the operational environment, and are authorized for use as low as the company level.<sup>98</sup>

The Joint force’s current landmine capabilities do not meet the requirements for the envisioned role of landmines in the future or the capability requirements necessary to support MDB, resulting in a capability gap. Major General Kent D. Savre, commander of the Maneuver

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<sup>97</sup> MSCoE White Paper, 3.

<sup>98</sup> Ibid., 4.



Support Center of Excellence (MSCoE), described this gap in his forward to the “Future of Combined Arms Terrain Shaping Obstacle Capability,” a white paper released in December of 2015 by MSCoE. His words could be applied across the Joint force as well:

Our Army’s ability to shape the terrain has been seriously degraded over the past two decades by changes in the operational environment and supporting policies that prohibit the use of what were once the Army’s foundational obstacle systems, by obsolescence in the remaining obstacle systems, and by lack of integrating obstacles in training and operations.<sup>99</sup>

## Efforts to Close the Gaps

According to the MSCoE, the Joint force lacks “the capability to employ US Policy compliant (man-in-the-loop) obstacles to influence the movement and maneuver of enemy forces or which deny enemy forces use of or access to key terrain/facilities.”<sup>100</sup> The problem facing the Joint force is how to regenerate military effectiveness within the constraints imposed by existing discrimination requirements and in anticipation of greater discrimination requirements in the future should the man-in-the-loop concept prove successful. In essence, the Joint force must rebalance the tension between discrimination and military effectiveness following the 2014 presidential directives. The MSCoE white paper proposes short and long-term measures, including the development of a new foundational obstacle system to replace FASCAM, closing the existing landmine warfare capability gap.

The initial attempt to address the landmine counter-mobility gap occurred during the modification of the BCT’s design as structure-based capability gaps were identified during its implementation, in simulations, and during the execution of operations.<sup>101</sup> The addition of a

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<sup>99</sup> Ibid., Foreword.

<sup>100</sup> Ibid., 1.

<sup>101</sup> C. Todd Lopez, “Brigade Combat Teams Cut at 10 Posts Will Help Other BCTs Grow,” *Army*, June 25, 2013, accessed on 21 March, 2017, <https://www.army.mil/article/106373>.

second engineer company to each BCT, beginning in 2013 with an anticipated completion by 2018, addressed shortfalls in engineer capacity and capability and included a limited transition of VOLCANO back into the active component.<sup>102</sup> At the same time, the BCTs received another maneuver battalion, changing the ratio of engineer support within the BCT from 1:2.5 to 2:3.5, more than doubling available engineer capability. The Artillery branch also increased the aggregate number of guns available within a division and reestablished a divisional level Artillery command and control structure, providing for better planning and synchronization of fires and effects.<sup>103</sup>

The Army also attempted to increase the BCT's effectiveness and flexibility by systematizing the inclusion of National Guard and Reserve Component forces as modular attachments. In 2014, the Total Army Force Concept directed that "the Army will integrate [Active Component] and [Reserve Component] forces and capabilities at the tactical level (division and below)."<sup>104</sup> This increased the potential capacity and capability of the active component to include that of the Guard and Reserves, recapitalizing all engineer, artillery, and aviation FASCAM equipment. These changes within the Total Force and the BCT resulted in an increase in FASCAM capacity and capability, but as a secondary effect. Until the publication of the MSCoE's white paper, there was no plan of action to address the gap directly.

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<sup>102</sup> David C. Hill, "The Army Engineer Total Force: Transformation, Training, and Leader Development," *The Military Engineer*, March-April, 2014, accessed on 19 March, 2017, <http://themilitaryengineer.com/index.php/item/302-the-army-engineer-total-force>; Center for Army Lessons Learned Handbook, *The Brigade Engineer Battalion: A Leader's Guide*, no. 15-12 (2015): Foreword, accessed 19 March, 2017, [http://usacac.army.mil/sites/default/files/publications/15-12\\_0.pdf](http://usacac.army.mil/sites/default/files/publications/15-12_0.pdf); Jim Rowan, Deputy Commandant, US Engineer School and Regimental Headquarters, "Achieving the Vision 2010 and Beyond," slide presentation, August 24, 2010.

<sup>103</sup> Lopez, "BCTs Cut Will Help Others Grow."

<sup>104</sup> Army Directive 2012-08, *Army Total Force Policy*, 2012, 2, accessed on 19 March, 2017, [http://www.apd.army.mil/pdf/files/ad2012\\_08.pdf](http://www.apd.army.mil/pdf/files/ad2012_08.pdf).

The MSCoE white paper provided an overview of the capability gap from the perspective of the Army's Engineer branch and proposed three major corrective measures: the recapitalization of existing FASCAM systems, an increased focus on landmine systems training, and the development of a new obstacle system to replace FASCAM, called the Family of Networked Munitions, through the combined Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities fielding process.<sup>105</sup> Networked munitions are "remotely controlled, interconnected, weapons systems designed to provide rapidly emplaced ground-based counter-mobility and protection capability through [the] scalable application of lethal and nonlethal means."<sup>106</sup> A suite of these systems is envisioned as "a next generation obstacle capability [that] will provide the solution to the army's extremely high-risk gap."<sup>107</sup> In February 2016, the Army Capabilities Integration Center formally endorsed the MSCoE's White Paper, giving it Army level emphasis.<sup>108</sup>

Recapitalization consists of the redistribution of engineer FASCAM systems within the Army's inventory to the active component in order to increase its capacity and capability, the refurbishment of FASCAM systems to extend their lifespan, and the potential modification of mixed-munitions into modified AV munition systems to align them with current US policy, and restoring their viability. Within the Engineer Branch, recognition of counter-mobility shortfalls has led to the projected increase in the number of VOLCANO systems in Stryker and Heavy BCTs. Other elements of the recapitalization effort are hardware oriented, addressing gaps in capability presented by aging delivery systems and mine stocks as well as the loss of viability of

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<sup>105</sup> MSCoE White Paper, Foreword.

<sup>106</sup> JP 3-15, GL-6.

<sup>107</sup> MSCoE White Paper, 1.

<sup>108</sup> H. R. McMaster, "Endorsement of Maneuver Support Center of Excellent White Paper on the Future of Combined Arms Terrain Shaping Obstacle Capability," ARCIC Memorandum, 2016.

mixed-munitions systems. The program life of FASCAM systems is expiring, leading to stopgap acquisitions to extend the lifespan of the redistributed systems.<sup>109</sup> Concurrently, there are efforts to determine the feasibility of rebuilding mixed-munitions into AV-pure munitions that meet the requirements of US policy directives but at reduced capacity.<sup>110</sup> These recapitalization efforts have the potential to restore some of the Joint force's lost capacity and capability, particularly with respect to fixed-wing FASCAM deep fires.

Closing the training and experience gaps occurs on two separate horizons. The first ranges from the present until the FASCAM replacement system is fielded as a natural outgrowth of the recapitalization effort and the Army's ongoing emphasis on its conventional combat mission. It requires the continuation of existing efforts to train Army elements in the maintenance, operation, and synchronization of FASCAM munitions and their deployment systems. Including simulated FASCAM systems at the Army's Combat Training Centers (CTCs) as part of the transition from counter-insurgency centric training scenarios to those reemphasizing conventional doctrine and capabilities in 2012 is evidence of this effort.<sup>111</sup> While the proposal does not provide specifics for increased training of the Joint component's landmine capability, coordination between the services is implied. The second horizon is based on the progress of the FASCAM replacement, which will continue for the next several decades. It consists of the introduction of the new family of systems into test forces, the development and publication of new doctrine, and the formalized adoption and distribution of the system throughout the Army.

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<sup>109</sup> Headquarters, Department of the Army, Office of the Deputy Chief of Staff, G-8 Future Force Division (FDF), "Army Equipment Modernization Strategy: Equipping the Total Force to Win in a Complex World," March 31, 2015, Annex H, accessed on 21 March, 2017, [http://www.g8.army.mil/pdf/AEMS\\_31MAR15.pdf](http://www.g8.army.mil/pdf/AEMS_31MAR15.pdf).

<sup>110</sup> Javier Gestido, Senior FOFUC Developer, US Army Material Systems Analysis Activity, to Brian Walker, e-mail, April 11, 2017, in author's possession; Derek Powell, Chief, Soldier Analysis Division, to Brian Walker, e-mail, April 12, 2017, in author's possession.

<sup>111</sup> Gary Sheftick, "3rd ID Brigade to Test New Immersive Training at NTC," *Army*, February 24, 2012, accessed on 21 March, 2017, <https://www.army.mil/article/74496>.

In developing a replacement system for FASCAM, the white paper focused specifically on “US policy compliant (man-in-the-loop) obstacles.”<sup>112</sup> This implies that current man-in-the-loop obstacles are not able to influence the enemy or deny him access to terrain to the degree required. It also indicates that the US policy trends are expected to require all obstacles to be man-in-the-loop. Proposed characteristics of the new system include a controllable AP and AV lethal and non-lethal capability that is not hazardous until activated by the operator, simple employment and recovery, deployable across the full depth of the operational environment, and that its execution authority is distributed as low as the company level.<sup>113</sup> The description of the capabilities gap and proposed characteristics of the replacement system capture the Army’s current attempt to balance discrimination and military capability following the 2014 policy changes.

The controllable requirement indicates that the desired discrimination level of the new system is precision targeting. Mine delivery munitions are “area of effect” weapons systems. Precision target discrimination, in this case, is contingent on the individual munition, hence the desire for control over the individual munition following its deployment. Control over the activation of an individual mine converts it to a direct fire weapon system, the closest military equivalent to perfect discrimination.

Another alluring characteristic of the man-in-the-loop systems is that they are legally classified as “other devices” rather than mines.<sup>114</sup> This legal status would allow the use of anti-personnel designed munitions, restoring a capability the Department of Defense relinquished in

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<sup>112</sup> MSCoE White Paper, 1.

<sup>113</sup> Ibid., 4.

<sup>114</sup> UN General Assembly, *Convention on Certain Conventional Weapons: Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices (Amended Protocol II)* (New York: UN, 1996), Article 2.

2014. Regaining the capability would require the normalization of experimental programs already under development. “As an alternative to persistent APLs, the Spider program was initiated to address humanitarian concerns while still meeting essential military requirements,” the white paper explained.<sup>115</sup> The Spider serves as a test-case for future networked munitions development and experimentation.

Improved discrimination drives down approval authority for the employment of the system.<sup>116</sup> Currently, the authority to employ mines is maintained by the combatant commander or a higher authority, depending on the rules of engagement.<sup>117</sup> Precision landmine capabilities could be treated as a direct fire weapon system, lowering the authority required to use them. The Spider is intended for employment at the company level.<sup>118</sup> A “networked munitions” system would, in theory, regenerate the military effectiveness of landmines within the confines of existing discrimination requirements. This is similar to the promise made by the FASCAM system thirty years ago.

## Shortfalls in the Existing Approach

The institutional approach spearheaded by the Army to address the capability gap in the Joint force has some shortfalls. The Total Force Concept, force structure changes, and recapitalization efforts assume capability follows capacity changes and do not fully address interoperability and logistical shortfalls. A complete analysis of the nature of the problem at the Joint level is also lacking, which increases overall program costs and undermines

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<sup>115</sup> MSCoE White Paper, 6; Inspector General, US Department of Defense, “Spider XM-7 Command Munition,” Report No. D-2008-127, 2008, 1.

<sup>116</sup> Smith, “Joint Countermobility Capabilities in the Department of Defense,” 53.

<sup>117</sup> JP 3-15, xiii; FM 3-34.210, Appendix D, 8.

<sup>118</sup> Smith, “Joint Countermobility Capabilities in the Department of Defense,” 64.

interoperability.<sup>119</sup> Most importantly, the pursuit of networked munitions manifests unrealistic expectations for discrimination and effectiveness as a result of a failure to place the system in the context of the future environment, risking a technology let-down similar to FASCAM's disappointing performance during the Gulf War.

The Total Force Concept and other force structure modifications do increase the Army's landmine based counter-mobility capacity. However, capacity changes may not translate into an increase in overall capability and have unintended logistical side effects. An increase in landmine capability as a result of Active, Guard, and Reserve integration is likely, but its extent and scope should not be overestimated. Initial landmine capability in contingency operations is still provided by the active component. Adding systems to the active component without a corresponding increase in operators merely decreases the time available for training requirements, potentially lowering the overall capability of the unit. The fielding of a system without regard for its logistical requirements can also render it ineffective. The organic logistical element of a standard artillery battalion is incapable of supporting the munition requirements of FASCAM emplacement.<sup>120</sup> Engineer units also suffer from logistical shortfalls in lift and haul capacity.<sup>121</sup> The Total Force Concept and other force structure changes are valid approaches to increasing landmine capability and capacity, but their secondary effects must be analyzed to increase overall effectiveness.

The purpose of landmines is the same as obstacles: to "[deny] enemy freedom of maneuver across the full depth of the environment."<sup>122</sup> The method the system employs to

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<sup>119</sup> Director, Operational Test and Evaluation, "FY 16 Army Programs: Spider XM-7 Network Command Munition," 2016, 2, accessed March 22, 2017, <http://www.dote.osd.mil/pub/reports/FY2016/pdf/army/2016spider.pdf>.

<sup>120</sup> Army G-8 FDF, "Army Equipment Modernization Strategy," 2015, 44 and 46.

<sup>121</sup> Dupuy Institute, "Consequences of a Complete Landmine Ban," 36.

<sup>122</sup> MSCoE White Paper, 3; JP 3-15, I-1, Figure II-1.

achieve its purpose is by controlling or modifying behavior via the threat of injury from a static position. The causing of friendly, enemy, or civilian casualties is a secondary effect of the system. As a result of the United States' historic landmine policy trends, the moral imperative to discriminate with respect to the secondary effect of the system has become the controlling factor for the system's employment. This is the underlying justification for the pursuit of high-tech man-in-the-loop and networked munitions.

The networked munitions concept has several potential shortfalls stemming from the Vampire Fallacy, that "[t]echnology would make the next war fundamentally different from all that had come before it because information and communication technologies had shifted war from the realm of uncertainty to that of certainty."<sup>123</sup> Networked munitions are promising capabilities they cannot be reasonably expected to deliver. The technologies the system relies on to function are degraded by the environment it is anticipated to be employed in. While there will be some increase in the level of discrimination in landmine use, failures in discrimination will still occur. Additionally, the employment of networked munitions is likely to reduce the economy of force of US landmine warfare, one of the critical characteristics of its military efficacy.

As currently envisioned, networked munitions increase discrimination through communication between each other, their operator's console, and the strength of their relay systems if employed at long ranges to control individual munitions.<sup>124</sup> In order to do this, networked munitions rely heavily on communications architecture and integrity. The Department of Defense expects these capabilities to be denied or degraded by the enemy in future conflicts. If a networked system is compromised the field is defeated or potentially becomes an enemy

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<sup>123</sup> H. R. McMaster, "Thinking Clearly about War and the Future of Warfare – The US Army Operating Concept," *Military Balance Blog*, October 23, 2014, accessed March 21, 2017, <http://www.iiss.org/en/militarybalanceblog/blogsections/2014-3bea/october-831b/thinking-clearly-about-war-and-the-future-of-warfare-6183>.

<sup>124</sup> MSCoE White Paper, 8; Inspector General, US Department of Defense, "Spider XM-7 Command Munition," Report No. D-2008-127, 2008, 2.



minefield, if it is degraded it operates at a reduced capacity. Thus, networked munitions are knowingly signals-dependent systems that are likely to be deployed in a degraded or denied signals environment, an obstacle the Spider has yet to overcome.<sup>125</sup> The interplay between the systems' design and anticipated operating environment results in an increased risk of system failure and an increased risk to the soldier.

Any degradation of signals capability carries a corresponding loss in discrimination for the networked munition system. While networked munitions' on/off capability does increase the potential for better discrimination, it occurs at distance through the intermediary of sensors. Reliably achieving the sort of precise target discrimination from a distance in a permissive environment where sensors are degraded has produced mixed results. The success and collateral damage rates of Unmanned Aerial Systems' strike missions have demonstrated this trend. There is no reason to believe that networked munitions can achieve better rates in permissive or degraded environments.<sup>126</sup>

Networked munitions could also result in a loss of economy of force in landmine counter-mobility. Networked munitions, as currently visualized, are recoverable and reusable.<sup>127</sup> While deployment via vehicle or munition is likely to maintain the rapidity of existing FASCAM systems, establishment of the network backbone upon firing will increase the activation time for a minefield. Creation of redundancy systems to protect the communications architecture will also

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<sup>125</sup> MSCoE White Paper, 4; ARCIC, "Multi-Domain Battle"; "FY 16 Army Programs: Spider XM-7 Network Command Munition," 2; Director, Operational Test and Evaluation, "Army Programs: Spider XM-7 Network Command Munition," 2012, 2, accessed March 22, 2017, <http://www.dote.osd.mil/pub/reports/FY2012/pdf/army/2012spider.pdf>.

<sup>126</sup> Spenser Ackerman, "41 Men Targeted but 1,147 People Killed: US Drone Strikes – the Facts on the Ground," *The Guardian*, November 24, 2014, accessed March 22, 2017, <https://www.theguardian.com/us-news/2014/nov/24/-sp-us-drone-strikes-kill-1147>; Micah Zenko, "America's 500th Drone Strike," *Council on Foreign Relations*, November 21, 2014, accessed March 22, 2017, <http://blogs.cfr.org/zenko/2014/11/21/americas-500th-drone-strike/>.

<sup>127</sup> MSCoE White Paper, 7.

consume resources. Network-based minefield will also require operators, further reducing the economy of force of the capability.<sup>128</sup> Additionally, the recoverable aspect of the new munition implies that recovery of devices is expected. This recovery time increases both the manpower and time requirements of landmine based counter-mobility, also reducing its economy of force.<sup>129</sup> It is possible that the lack of requirement to reseed envisioned by the white paper could balance this loss of force and time caused by recovery. However, in the high-mobility environment envisioned in the future, long duration minefields in the deep and middle ranges are likely to have limited utility. Based on these unaddressed shortfalls in the networked munitions concept, it is imperative that the army tailors its expectations of how well the new system will close the remainder of the gap.

## Conclusion and Considerations

Since WWII, the pursuit of greater discrimination in landmine policy, doctrine, technologies, and employment have led to a capability gap in landmine warfare within the Joint force. This gap was further widened during the modularity conversion, which reduced the capacity of the Army to employ landmines. The operational risk the gap presented was underwritten by ensuring adjacent domain superiority prior to the commitment of ground forces. The MDB operational concept requires counter-mobility capability that can no longer be substituted for by fires from persistently-dominated domains. Natural obstacles and constructed obstacles remain valid methods for counter-mobility, but lack the economy of force and flexibility of landmines in time, space, and resources. As a result, landmines continue to

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<sup>128</sup> Derek Powell, Chief, Soldier Analysis Division, to Brian Walker, e-mail, April 12, 2017, in author's possession.

<sup>129</sup> Director, Operational Test and Evaluation, Department of Defense, "FY 2013 Annual Report," 2013, 131-32, accessed on March 22, 2017, <http://www.dote.osd.mil/pub/reports/FY2013/pdf/other/2013DOTEAnnualReport.pdf>.

constitute an important subcomponent of any future obstacle framework, and are a gap in current Joint force capability.

The Army has taken the lead amongst the Joint force in addressing this gap, but its current proposed solutions only partially ameliorate the problem. A lack of Joint force understanding of the problem's extent has the potential to slow the gap's closure because of competing priorities for training and budgeting. Short term organizational changes have partially closed the gap, but their effectiveness is not yet known. Networked munitions have the potential to help close the gap, but are unlikely to provide the level of discrimination and military effectiveness desired, particularly in the deep fight. As a result, existing shortfalls in the gap closure effort have room for improvement.

Adjustments to the current proposed solutions to reduce the capabilities gap and/or address other shortfalls include the expansion of existing training programs and efforts, the augmentation of organic logistical support elements of FASCAM or networked munitions deploying units, greater Joint force participation in the development of the next landmine system and its related doctrinal concepts, and the expansion of existing FASCAM recapitalization efforts with the intent of including them into the future system as a mid to deep range counter-mobility capability.

The Total Force Concept could pursue greater interoperability through the regular integration of Guard and Reserve forces at the CTCs. Coupling this effort with a similar exchange program that requires active component units to participate in traditionally guard or reserve capstone training exercises would increase its effectiveness. Outside of the Total Force Concept, the development of a Counter-mobility Leader's / Landmine Operator's Course for both current and anticipated future systems is recommended. This course could feature both service-specific doctrine and systems as well as an overview of Joint capabilities and integration concepts. A Mobile Training Team option would provide responsive and flexible training support for units.

Further evaluation of the logistical requirements of FASCAM or future Networked Munitions Systems is necessary. One potential solution would require changes in unit level organization and equipment to increase internal haul and lift capability, with the caveat that additional equipment must come with additional soldiers. A second could be the development of a FASCAM or Networked Munitions System logistical augmentation package as a situation-based doctrinal procedure. Both of these options present potential solutions to mitigate existing or future logistical shortfalls.

Assessing the penetration of the capability gap at the joint level is critical to the development of comprehensive short and long-term system and doctrinal solutions. Studies similar to the MSCoE white paper should be initiated across the Joint force to generate a shared understanding of the gap and advocacy for the Joint development of the next landmine system. The most important impact of such coordination would be the extension of operational reach. Achieving unity of effort within the Joint force for the development of the landmine system across the delivery range categories of “Mid” (8-40 km), and “Deep” (40 km and beyond), via unmanned aerial systems, missile delivery platforms, and fixed-wing aviation assets would ensure holistic system development.<sup>130</sup> At present, there is no inclusion of a ship-based landmine employment system, and it is recommended that a feasibility evaluation for one be considered to provide support to amphibious operations.

Recapitalization of existing FASCAM systems could increase the system’s discrimination system to morally acceptable levels, rapidly reconstitute the US landmine deep strike capability, and potentially carry a lower cost than the development of a “deep” deployable networked munitions system. To accomplish this, steps must be taken to address the shortfalls of the current FASCAM system. The primary arguments against FASCAM are four-fold. It lacks

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<sup>130</sup> MSCoE White Paper, 9 and 11.

On/Off Capability, has known pre-set detonation times, is indiscriminate once deployed, and requires reseeded, increasing logistical strains.<sup>131</sup> While these points are valid critiques of the FASCAM system, the first and third are only made relevant by the United States' historical desire for a form of warfare with little to no collateral damage—precision warfare. It is possible to increase the discrimination and longevity of a FASCAM or a FASCAM-like self-destructing landmine system to address these concerns. Such changes would enable these systems to maintain viability within the Joint force, particularly with respect to long range landmine employment.

The discrimination networked munitions seek to create is rooted in a vision of landmines as a direct fire weapon system, but discrimination can be increased in a variety of other ways. The most important change to FASCAM, or any FASCAM-like system, is to reduce the dud rate of individual mines. This would increase the systems' discrimination with respect to time. Additionally, if behavioral control or modification is the intent of the mine, then the detectability of a mine following its deployment is immaterial. This is further reinforced by the United States' existing ban on the use of non-detectable mines.<sup>132</sup> Discrimination via marking is the reason for doctrinal processes and procedures for the marking and dissemination of positional data for executed minefields. With this in mind, a modest network capability designed to transmit the borders of the minefield for mapping and dissemination could be embedded into the system. Extending this concept of marking further, discrimination could also be obtained through the marking of the mine itself. Such markings could be visual or auditory in nature and increase the discrimination of the munitions while achieving their effects. Any of these changes would increase the systems discrimination and viability.

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<sup>131</sup> MSCoE White Paper, 5; James G. May, "New Technology Required," 16.

<sup>132</sup> "State Department Chronology of Landmine Activities Spanning 143 Years."

The longevity of a FASCAM-like system could be increased and its predictability and reseed requirements reduced through modifications to the existing timer system. FASCAM currently has four timer settings, though many of its individual systems maintain only one or two.<sup>133</sup> An expansion of the possible settings would increase the potential longevity of the system once employed. Additionally, enabling systems to accept multiple time settings would increase enemy uncertainty and reduce predictability, but within an overall known range. These changes would increase the military effectiveness of the system without compromising its discrimination.

Failure to conduct effective target discrimination in the near and rear area fights has the potential to cause unnecessary civilian casualties in close proximity to friendly forces, creating negative second and third-order effects. As the separation between forces, or between forces and civilians is achieved, the impact of these potential effects will diminish. This results from the degree of mixture between friendly, enemy, and civilian forces on the battlefield and the obligation of the belligerents to protect the populations within their physical control in accordance with the Laws of War.<sup>134</sup> Concurrently, EMS interference is greatest where forces are in contact and behind enemy forward positions where their system architecture maintains a dominant position. Under these considerations, non-networked FASCAM remains a viable and potentially vital means of delivering counter-mobility effects on the battlefield from the defense in the near fight. It provides a means to conduct rapid re-seeding, ranging forward to disruption in the deep fight, where the impact of low-discrimination mines has a lower impact of friendly forces and civilians in areas controlled by friendly forces.

FASCAM, modified or updated to have lower dud rates, improved discrimination, additional timer settings, and the ability to mix the timing on munitions within one delivery

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<sup>133</sup> FM 3-34.210, Appendix D.

<sup>134</sup> Michael Walzer, *Just and Unjust Wars* (New York: Basic Books, 2006), 133-69.

system, could provide a viable answer to “Mid” and “Deep” range and emergency mission capability requirements. At a minimum, these measures would provide a stop-gap until the development of “mid and deep range delivered AP and AV obstacles... [to] replace the current scatterable mine systems,” as well as a redundant capability in the event networked munitions are countered effectively by enemy electronic warfare.<sup>135</sup> The pursuit of a hybrid approach, with the aim of using network munitions to increase landmine discrimination in the near range, while maintaining a less discriminatory, but more responsive and mobile, self-destructing landmine capability at the middle and deep ranges, would provide both the military effectiveness required by MDB while ensuring an appropriate level of discrimination during landmine employment.

Landmines provide a unique capability, but carry a similarly unique moral cost. The tension between the military requirement of effective counter-mobility and the moral imperative to discriminate lethal effects must be understood and managed with an eye towards boosting discrimination, but not at the cost of providing a counter-mobility capability to the Joint force. The existing gap in landmine capabilities in support of MDB is ongoing, but requires further refinement to successfully balance landmines’ tension between military effectiveness and discrimination. If the Department of Defense fails in its efforts, the Joint force will be forced to rely on substitute capabilities, increasing the risk to future ground forces.

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<sup>135</sup> MSCoE White Paper, 6.

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