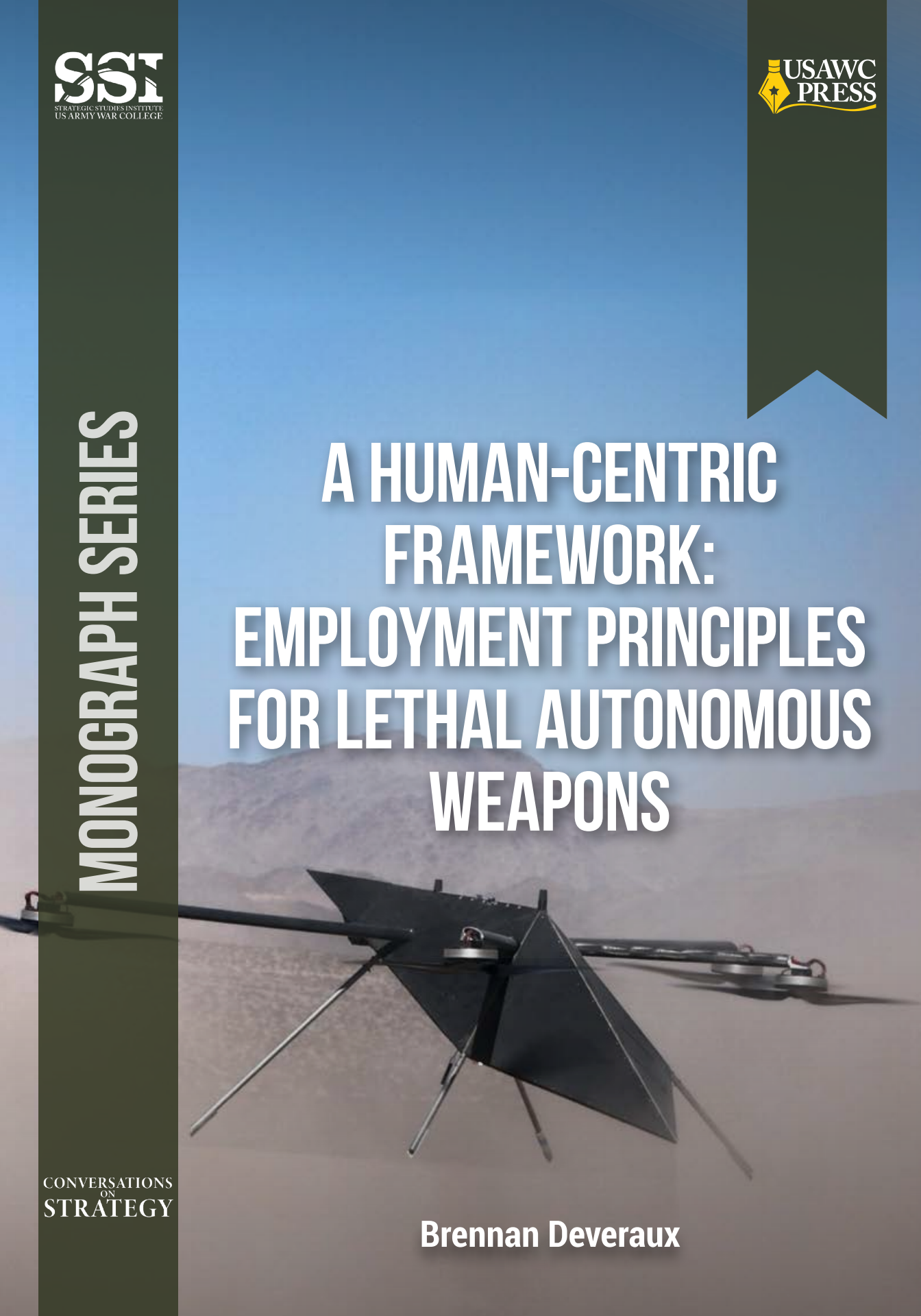


MONOGRAPH SERIES

A HUMAN-CENTRIC FRAMEWORK: EMPLOYMENT PRINCIPLES FOR LETHAL AUTONOMOUS WEAPONS

CONVERSATIONS
ON
STRATEGY

Brennan Deveraux





“The Army’s Think Tank”

The Strategic Studies Institute (SSI) publishes national security and strategic research and analysis to answer strategic security questions, inform strategic security decisions, and build networks of strategic security expertise in support of the Army and the Joint Force.

SSI serves as a valuable source of ideas, criticism, innovative approaches, and independent analyses as well as a venue to expose external audiences to the US Army’s contributions to the nation. It acts as a bridge to the broader international community of security scholars and practitioners.

SSI is composed of civilian research professors, uniformed military officers, and a professional support staff, all with extensive credentials and experience. SSI’s Strategic Research and Analysis Department focuses on global, transregional, and functional security issues. Its Strategic Engagement Program creates and sustains partnerships with strategic analysts around the world, including the foremost thinkers in the field of security and military strategy.

Research Focus Arenas

Geostrategic net assessment—regional and transregional threat analysis; drivers of adversary conduct; interoperability between partners, allied, IA, commercial, and Joint organizations

Geostrategic forecasting—geopolitics, geo-economics, technological development, and disruption and innovation

Applied strategic art—warfare and war-fighting functions, Joint and multinational campaigning, and spectrum of conflict

Industrial/enterprise management, leadership, and innovation—ethics and the profession, organizational norms and effectiveness, transformational change, talent development and management, and force mobilization and modernization

A Human-Centric Framework: Employment Principles for Lethal Autonomous Weapons

Brennan Deveraux

January 2026



Strategic Studies Institute

This publication is peer-reviewed. The views expressed in this publication are those of the authors and do not necessarily reflect the official policy or position of the Department of the Army, the Department of War, or the US government. Authors of Strategic Studies Institute and US Army War College Press publications enjoy full academic freedom, provided they do not disclose classified information, jeopardize operations security, or misrepresent official US policy. Such academic freedom empowers them to offer new and sometimes controversial perspectives in the interest of furthering debate on key issues. This publication is cleared for public release; distribution is unlimited.

This publication is subject to Title 17 United States Code § 101 and 105. It is in the public domain and may not be copyrighted by any entity other than the covered authors. You may not copy, reproduce, modify, distribute, or publish any part of this publication without permission.

Comments pertaining to this publication are invited and should be forwarded to: Director, Strategic Studies Institute and US Army War College Press, US Army War College, 47 Ashburn Drive, Carlisle, PA 17013-5010.

ISBN 1-58487-873-8

Cover Image Credits

Description: A multi-mission, utility, logistics, and expedition (MULE) drone lands during Project Convergence-Capstone 5 (PC-C5) at Fort Irwin, California

Image by: US Army Sergeant Marita Schwab

Date: March 9, 2025

VIRIN: 250309-A-US124-1161

Photo ID: 8922373

Website: <https://www.dvidshub.net/image/8922373/multi-mission-utility-logistics-expedition-mule-drone>

Foreword

Integrating emerging technology remains a fundamental component of how the US military prepares for future war. With the rise of artificial intelligence and the mass production of small drones, technological advancements may change the characteristics of the modern battlefield. One of the most controversial aspects of this technological revolution is the concept of lethal autonomous weapons systems (LAWS).

In this monograph, Brennan Deveraux identifies LAWS employment as a gap in Department of War policy. Deveraux provides a valuable framework for developing employment considerations built on the pillars of certification, authority, restrictions, and accountability. This straightforward framework focuses on humans' role in shaping mission parameters, ensuring controversial LAWS are employed responsibly, and the operators are held accountable for the missions they authorize. The monograph shifts from theory to practice through a series of historical and speculative missions that leverage autonomous characteristics. This analysis is applied to three enduring missions—critical-target engagement, protection, and terrain denial—providing readers with an understanding of how LAWS may be employed in the near future.

How emerging technologies and their interrelated relationships will shape the future battlefield remains to be seen. This monograph provides the Department of War with a baseline framework for managing one of the most important aspects of integrating LAWS—figuring out when, where, and how LAWS will be employed.

C. Anthony Pfaff
Director, Strategic Studies Institute
and the US Army War College Press

Executive Summary

This monograph challenges the US Department of War to reframe the conversation on human involvement with lethal autonomous weapons systems (LAWS) by codifying a human-centric framework that sets the foundation for employing the controversial systems. The crux of the argument is, in updating policy, the Department of War must not fixate on what an operator can or cannot do after activating a LAWS. Instead, it should clearly define what it means to have appropriate human judgment throughout the engagement process. This shift could provide commanders at different echelons with the requisite guidance for employing and activating LAWS in varying combat situations. The proposed framework balances the potential military benefits of embracing the application of new technologies with the moral and legal concerns associated with delegating lethal authority to a machine by incorporating aspects of the near-decade-long international debates of the Group of Governmental Experts, held by the UN Convention on Certain Conventional Weapons.

The monograph makes the case for the Department of War to embrace the proposed framework by arguing that human beings are always in control of LAWS by virtue of designing them, tasking them with particular missions, and determining when and where the systems should be used. It addresses existing policy and identifies a gap in employment considerations, highlighting a need to codify the guidance to allow war fighters to use these systems ethically and effectively. The manuscript is divided into two distinct parts.

The first part of the monograph begins by examining the existing Department of War guidance on lethal autonomy, noting how existing policy outlines development processes that include testing, experimentation, and the designation of approval authorities and responsibilities for the development of LAWS. To address the gap in employment principles, the section outlines the proposed human-centric framework by establishing the pillars of certification, authority, restrictions, and accountability.

- **Certification.** This pillar focuses on training and certifying those individuals who would plan for or employ LAWS. It recommends that the Department of War identify an overarching LAWS proponent, proposing suitable options like the US Army Fires Center of Excellence or the US Army Aviation Center of Excellence. A significant component of this training is the development of an Army Additional

Skill Identifier or Joint Service equivalent that could augment existing artificial intelligence users and technicians.

- **Authority.** This pillar focuses on the requirements a commander must complete before employing LAWS. It challenges that, similar to the release authority of other destructive munitions, the planning process for a legal military engagement conducted by a staff trained and certified with LAWS satisfies the appropriate judgment required to launch the munition. This section also cautions against retaining release authority at unnecessarily high levels.
- **Restrictions.** This pillar focuses on establishing initial restrictions on using LAWS. It highlights potential overarching restrictions, such as limiting the types of targets and situations in which organizations can employ the weapon. Additionally, the section proposes including the idea of expected planning considerations, as most restrictions would need to be considered in the context of the operation, not managed with wide-sweeping constraints that limit employability. To do so, it outlines an employment checklist that forces organizations to account for and implement mission-specific restrictions.
- **Accountability.** The final pillar addresses a military commander's responsibility concerning unintended engagements, emphasizing what happens when a mission goes wrong. This section makes two tangible recommendations. The first is to codify reporting and investigation procedures to ensure that external organizations, such as the LAWS proponent, understand the importance and responsibilities of conducting an investigation. The second is to create a lessons-learned feedback mechanism by establishing reporting processes that incorporate the distribution of critical information to all parties with equities in the development, training, and employment of LAWS, which could include a formal reporting database for mishaps, like how the department manages aviation safety.

The second part of the monograph shifts the discussion from theoretical to practical by overlaying the human-centric framework onto three distinct mission types that have historically required weapon systems with autonomous characteristics. The first of these mission types deals with identifying and hunting

critical targets, with different levels of autonomy based on the threat and the time period. The second is protection, specifically the rapid response required to stop an incoming missile attack. A generally accepted battlefield necessity, this protection is distinct from other categories and is treated as human-machine teaming rather than employing autonomous weapons. Terrain denial is the final mission type examined, as generations have employed mines in all shapes and sizes that have had diverse roles in warfare, from simply denying an enemy a piece of terrain to being an instrumental part of a nation's theory for victory.

Each mission type is first analyzed historically to demonstrate a Department of War precedent for outsourcing an aspect of lethality to machines without direct human supervision. This precedent gives credence to the importance of preparation and human input that occurs before deciding to engage a potential target. After each historical analysis, this section presents a hypothetical scenario within the same mission type where LAWS would enable future operations. Each hypothetical mission is briefly detailed, followed by a short analysis of how the lead organization could justify its mission by accounting for the pillars of certification, authority, restriction, and accountability.

The monograph concludes by noting LAWS are a unique tool for adapting current techniques or conducting operations in a novel way. It challenges the Department of War to codify guidance on the future employment of LAWS in a way that avoids ambiguous language and helps the services prepare for the integration of controversial systems. To do so, the Department of War must reframe the conversation on human involvement with LAWS and highlight how war fighters can employ the systems ethically and responsibly by reinforcing the role of humans throughout the process, not simply in the final moments of a strike.

A Human-Centric Framework: Employment Principles for Lethal Autonomous Weapons

Brennan Deveraux

This monograph is designed to reframe what using lethal autonomous weapons systems (LAWS) ethically and responsibly means, providing the Department of War (DoW) with a clear path toward managing the integration of this emerging technology by focusing on human judgment and accountability for its employment. Lethal autonomous weapons systems (LAWS) are “weapon system[s] that, once activated, can select and engage targets without further intervention by an operator.”¹ The United States shared this straightforward definition with the UN. Because this monograph argues the US Department of War should adjust its framework for understanding LAWS, the established DoW definition provides this monograph’s logical argumentative foundation. The DoW directive also provides definitions of a human-supervised autonomous system and a semiautonomous system. One can easily translate the directive’s three definitions to more common terminology using the loop framework, which describes humans’ levels of terminal control over three distinct system types. Notably, the international community has struggled to agree on a standard definition of LAWS.

The existence of LAWS is a technological reality and these systems will likely proliferate on the battlefield in the next few years. But conversations about employing LAWS have been skewed by an overly narrow focus on the extent of human beings’ involvement in the terminal control of weapons (the aspect of the kill chain that comes after a weapon is activated). This hyperfocus on the final steps of a strike creates an inaccurate narrative about humans’ level of involvement in employing weapons.

The most common framework for understanding LAWS categorizes weapons based on whether a human is in, on, or out of the loop. But this characterization of the level of human involvement is misleading. A human is always in the loop, but the human’s involvement varies depending on where one begins tracking the process. Whereas the loop framework may serve a purpose in understanding a weapon’s characteristics, the framework creates confusion when superimposed on conversations about employment considerations. Joseph O. Chapa, an Air Force lieutenant colonel who previously served as the Department of the Air Force’s

first chief responsible artificial intelligence (AI) ethics officer, contends the loop framework “muddles more than it clarifies,” arguing “[w]hether there is a human in the loop depends upon where we draw the loop.”² Whereas the activated weapon may be able to strike without gaining further approval from a human operator, the system’s independence is based entirely on the human operator’s established parameters and restrictions. Stated another way, human beings are always in control of LAWS by virtue of designing them, tasking them with particular missions, and determining when and where they should be used. At the end of the day, humans are responsible for employing weapons.³

In turn, the element that is missing from the current framework for understanding LAWS, and the corresponding DoW definitions, is an account of the proper human role in choosing when, where, and how to employ the system. Consequently, if the Department of War plans to integrate a new system, it must address this gap and unambiguously articulate the requirements military commanders must meet to employ LAWS. Whereas the existing DoW policy outlines development processes including testing, experimentation, and the designation of approval authorities and responsibilities for developing LAWS, the policy lacks the necessary guidance to allow war fighters to use LAWS ethically and effectively. Additionally, no international consensus has been reached on what requirements must be met before activating LAWS, what level of influence a human must have over the process, or what type of tactical situation warrants the weapons’ employment.

Therefore, this monograph challenges the US Department of War to reframe the conversation about humans’ involvement in employing LAWS. This shift will require the department to move past weapon characteristics and development guidelines, instead codifying a human-centric framework that sets the foundation for employing controversial LAWS. The crux of this monograph’s argument is in updating policy, the Department of War must not hyperfocus on what an operator can or cannot do after activating LAWS. Instead, the department should clearly define what the presence of appropriate human judgment throughout the engagement process means, providing the requisite guidance to allow for the employment and activation of LAWS in various combat situations. This proposed framework balances the potential military benefits of embracing the application of new technologies with the moral and legal concerns associated with delegating lethal authority to a machine. This balance is achieved by incorporating aspects of the near-decade-long international debates of the Group of Governmental Experts, held by the UN Convention on Certain Conventional Weapons.

The subsequent analysis is divided into two parts. The first part of the monograph examines the existing DoW guidance on lethal autonomy and then outlines the proposed human-centric framework by establishing the pillars of LAWS

employment: certification, authority, restrictions, and accountability. The second part of the monograph shifts the discussion from theory to practice by overlaying the human-centric framework onto three distinct mission types, which have historically required weapon systems with autonomous characteristics.

Part One: DoW Policy

The Department of War has a history of developing and employing weapons with autonomous characteristics. Whereas this technological movement slowed during the peace dividend that followed the end of the Persian Gulf War, the Iraq War and the Afghanistan War highlighted a new need to augment humans in warfare. In 2005, the Department of War outlined a long-term, 25-year strategy for incorporating unmanned aircraft systems. At the time, achieving lethal autonomy was not the objective. Instead, with the transition to counterinsurgency, the focus was on enhancing human capabilities while reducing the burden on the limited number of available forces—primarily through intelligence, surveillance, and reconnaissance. Still, the 2005 strategy provided a valuable framework for understanding the military benefit of unmanned systems, highlighting the fact machines are best suited to supporting missions that are dull, dirty, or dangerous.⁴ Less than two years later, in 2007, the Department of War recognized the need to expand the scope of its road map to incorporate all unmanned systems. The new road map noted, “[t]he operational utility and potential of unmanned systems are growing at an accelerating rate,” adding “unmanned systems will inevitably have a continued and greater presence within the force structure over the foreseeable future.”⁵ But the framework remained.

Many missions are dull. That is, some missions are monotonous, repetitive, and time-consuming. Machines can augment humans during these missions, as they are often straightforward. For example, a dull mission may involve flying on a designated flight path and collecting electromagnetic data. Machine augmentation provides humans with additional time to rest or allows for crews to be repurposed for more dynamic missions. Additionally, “the better sustained alertness of machines over that of humans” makes dull missions ideal for machines.⁶

Most combat missions are dangerous. But when the individuals conducting the action face an extreme risk, not needlessly endangering humans presents a political and military benefit. Examples of dangerous missions include an operation that requires flying directly through highly contested airspace or an operation that involves examining a potential improvised explosive device.

The military must be prepared for missions that are dirty. The presence of chemical and biological weapons is a distinct reality on modern battlefields. Machines may provide a means of limiting human exposure to dirty environments.

In addition to the tangible tactical and operational benefits unmanned systems provided the US military in Iraq and Afghanistan, the dull, dangerous, and dirty framework set the conditions for a reinvigorated DoW effort to develop systems with autonomous characteristics. But rapid technological advancements raised potential ethical and moral questions about what precise actions should be delegated to machines. In turn, the department made a concerted effort to create a shared understanding of the implications of autonomy in weapon systems.

A Directive for Autonomy in Weapon Systems

The Department of War published its policy on LAWS in a 2012 directive entitled *Autonomy in Weapon Systems*, to which the department made minor adjustments in 2017 and again in 2023.⁷ The directive establishes the department's "policy and assigns responsibilities for developing and using autonomous and semi-autonomous functions in weapon systems."⁸ The directive prescribes the process for obtaining approval to develop LAWS, but its guidance on employment is limited.

Overall, the policy is highly restrictive, emphasizing the attainment of safety, experimentation, and explicit senior authorization before LAWS can be developed. In fact, development approval is routed through numerous undersecretaries of defense and the vice chairman of the Joint Chiefs of Staff. The policy prioritizes mitigating any loss of control, accidental or malicious. The policy instructs the department to incorporate technical safeguards to prevent hacking and requires stringent testing standards that prove the weapon could "[f]unction as anticipated in realistic operational environments against adaptive adversaries taking realistic and practicable countermeasures."⁹ Additionally, the policy reinforces the Department of War's AI ethical principles and highlights similar concepts for LAWS. This emphasis means the US military's use of LAWS will be responsible, the employment of LAWS will be equitable and absent bias, the systems' creation or purchase in the United States will be traceable and transparent, all prototypes will be tested for reliability, and the development of LAWS will be governable by the Department of War.¹⁰

One notable aspect of the directive is the requirement systems be "transparent to, auditable by, and explainable by relevant personnel."¹¹ An underlying benefit and sense of comfort comes from requiring operators to be able to explain how and why the machine takes an action, both in real time and retrospectively. Dr. C. Anthony Pfaff, the director of the US Army War College Strategic Studies Institute, comments on the importance of incorporating explainability into the

process of building trust in machines: “Explainable AI lessens the black-box nature of algorithms and enables humans to judge accuracy, risk, and fairness, recognizing even highly accurate models will get some decisions wrong. In the life-or-death decisions that accompany AI-enabled targeting, explainability is likely a more important characteristic of trustworthiness than accuracy because explainability enables commanders to assess risk and implement control measures according to changing conditions.”¹² Still, this explanatory requirement is ambitious, due to the nature of contemporary machine learning systems. A requirement for explainability is likely designed to help build institutional trust in LAWS and support a gradual integration of the new systems as their presence becomes normalized on the modern battlefield. But as technology advances, achieving explainability may not be as feasible as some expect, or the requirement for explainability will at least need to allow for exceptions. Consequently, the policy may need to shift toward post hoc auditing or accountability mechanisms, likely involving an increase in reporting requirements when using LAWS.

The DoW directive provides explicit guidance for essential offices and actors within the Department of War, including the chairman of the Joint Chiefs of Staff, the service secretaries, and combatant commanders. The directive tasks the chairman with assessing the military requirements for LAWS and with developing and implementing any corresponding “joint employment concepts, doctrine, experimentation strategies, TTPs, training, and logistics support.”¹³ The document highlights the need for combatant commanders to “identify warfighter priorities and operational needs that may be met by autonomous and semi-autonomous weapon systems,” and to begin integrating these potential systems “into operational mission planning as appropriate.”¹⁴ In addition to planning considerations, some of the guidance directly addresses the employment of weapons.

The directive instructs the military services to “[d]esign and develop autonomous and semi-autonomous weapon systems that allow commanders and operators to exercise appropriate levels of human judgment over the use of force.”¹⁵ It also highlights the need for the services to “[e]stablish and periodically review training, TTPs, and doctrine to ensure operators and commanders understand the functioning, capabilities, and limitations of a system’s autonomy under realistic operational conditions, including as a result of possible adversary actions.”¹⁶ Finally, the directive establishes LAWS must “[c]omplete engagements within a timeframe and geographic area, as well as other relevant environmental and operational constraints, consistent with commander and operator intentions.”¹⁷ This scoping ensures LAWS operate within human parameters. If the system is unable to accomplish its mission within the established parameters, the system will not be authorized to change its mission or continue operating under a broader intent. Instead, to change their missions, all US systems must be able to gain

additional guidance from a human operator; if they cannot obtain guidance, they must self-destruct or return to base. This restriction creates an extra burden for units that may rely on LAWS in communication-degraded environments.

Although restrictive, the collective DoW guidance establishes a clear path forward for the development and operational integration of LAWS. But the guidance lacks the specificity required to enable employment. Notably, the word “appropriate” appears in the short *Autonomy in Weapon Systems* directive nearly two dozen times; the document’s ambiguity does not convey the actual requirements for employment. In one of its only employment considerations, the directive states operators must employ the systems “with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement.”¹⁸ Although important, this general statement could be applied to any weapon. Consequently, DoW policy must go further to prepare the military for the eventual integration and employment of LAWS.

Toward a New Framework: Employment Principles and Human Judgment

Although the official DoW directive on lethal autonomy provides essential guidance, the directive is limited in scope. The document provides direction for the development, testing, and acquisition of new systems but fails to offer tangible employment considerations beyond broad and ambiguous statements. In his efforts to create practical principles for employing LAWS, former Deputy Secretary of Defense Robert O. Work challenged, “existing policies are not specific enough,” adding the DoW directive on autonomy in weapon systems “does not delve deeply into the connection between a human decision to employ a weapon with autonomous functionalities and its subsequent actions.”¹⁹ This missing component is the emphasis on the human decisionmaker vice the machine itself.²⁰ To address the necessary shift in DoW policy, this monograph proposes a human-centric mindset that captures tangible employment principles and uses unambiguous language.

To manage LAWS as an emerging technology, the Department of War must understand each military service’s requirements. In turn, the services must identify where autonomy could enable war fighters on the battlefield, within current and emerging doctrine, while mitigating any risk of an unintended engagement. The Department of War defines an unintended engagement as “[t]he use of force against persons or objects that commanders or operators did not intend to be the targets of U.S. military operations, including unacceptable levels of collateral damage beyond those consistent with the law of war, ROE, and commander’s intent.”²¹ Achieving this balance may mean imposing restrictive usage parameters, at least initially. These early restrictions will likely be particularly pronounced for the

US Army, as the land domain is where the employment of LAWS is most likely to put the machines in potentially morally ambiguous situations.

Some of the more prominent arguments against LAWS revolve around the idea robots will fail to be able to distinguish between combatants and noncombatants. Leonard Kahn, a philosophy professor at Loyola University, explains, “there is no algorithm for determining whether someone is a combatant,” arguing LAWS will struggle to make determinations such as whether someone is a civilian or whether an adversary is retreating, surrendering, or wounded and no longer a threat.²² Additionally, Robert Sparrow, a philosophy professor at Monash University, argues, “[e]ven if a weapon system could reliably distinguish combatants from noncombatants, this is not the same as being able to distinguish between legitimate and illegitimate *targets*.”²³ Sparrow goes on to add: “Discrimination is a matter of context, and often of political context. It will be extremely difficult to program robots to be able to make this kind of judgment.”²⁴ These arguments identify technical challenges for existing systems.

The Department of War must address the distinction concern when implementing new employment considerations. This concern is limited to the employment of LAWS against human beings. Whereas targeting dismounted fighters may lead to rapid changes in a given situation (such as a foe surrendering), no technological reason exists to assume machines could not be programmed to identify the typical actions of a fighter, such as carrying a weapon, wearing an enemy uniform, and being in an enemy-controlled area. As technology progresses, the contextual nuances of surrender will likely also be addressed. But dismounted fighters do not have to be targets. In a separate article, Sparrow concedes: “In several other types of warfare, the conventions regarding surrender make it much more plausible to think that robots could recognize surrender with a high degree of accuracy.”²⁵ Sparrow takes his argument even further, acknowledging, “A lack of the capacity to reliably recognize surrender would not rule out the ethical use of [L]AWS in certain roles where the question of surrender recognition seldom, if ever, arises.”²⁶ In this context, an updated policy could use cross-service concepts to address controversial situations that could arise in land warfare.

The following discussion is not intended to be an exhaustive framework. Instead, it acts as an analytical tool to help direct the focus of a necessary conversation about employment considerations. The objective of the proposed pillars is to encourage the Department of War to update its policy, enabling military organizations to begin preparing for future technology now. The DoW policy update should also foster the requisite preconflict discourse and experimentation to integrate LAWS successfully as they proliferate, instead of simply fielding LAWS as new

munitions. Moving forward, a DoW structure for managing LAWS as an emerging technology should be built on the four pillars of certification, authority, restrictions, and accountability.

1. Certification. A prerequisite for employing LAWS responsibly is understanding them. Work challenges, “[c]lear doctrine, tactics, techniques, and procedures and adequate training are necessary for commanders and operators to understand the functions, capabilities, and limitations of a weapon system’s autonomy in realistic operational conditions.”²⁷ But commanders and operators cannot base this understanding only on their on-the-job experience and treat LAWS simply as an extension of existing fires capabilities. Employments of various munitions already in the arsenal are distinctly different; dropping a bomb differs from firing rocket artillery, which is different from shooting mortars. Similarly, LAWS are bound to have nuanced operational intricacies. In 2021, the US delegation to the UN highlighted the importance of training with LAWS, noting, “personnel should properly understand weapons systems” they employ and “be certified by relevant authorities.”²⁸ Stated another way, the official US stance on LAWS highlighted the importance of certification. This emphasis on training was consistent throughout the international debates on LAWS.

In 2018, the Group of Governmental Experts received presentations on different types of currently fielded or developing weapon systems with autonomous characteristics. In discussing the presented cases, some delegates raised concerns about employment considerations, highlighting the importance of human operators possessing subject matter expertise. The delegations noted, to activate and monitor the weapons safely “would require that the operator know the characteristics of the weapons system, is assured that they are appropriate to the environment in which it would be deployed and has sufficient and reliable information on them in order to make conscious decisions and ensure legal compliance.”²⁹ These sentiments were echoed again in 2021, when the chair of the Group of Governmental Experts provided guiding questions to facilitate conversations about definitions, ethics, and—most importantly for this research project—human-machine integration. These questions covered topics including how to “clarify the quality and extend [sic] of human-machine interaction/human control,” how to “evaluate the minimum level of human control,” and whether establishing clear “limits and constraints” on the use of a weapon system is a valuable endeavor.³⁰ The delegates made a concerted effort to clarify the level and extent of human involvement needed to employ autonomous systems. Whereas few considerations reached the final report, the document noted and accepted the practice of ensuring “[h]uman commanders and operators and other relevant personnel are trained” on the specifics of the LAWS they plan to employ so personnel are “able to properly assess the effects of using

a weapons system . . . prior to use.”³¹ This training component is an essential aspect of any framework that focuses on the predeployment of LAWS.

Therefore, the Department of War should identify an overarching LAWS proponent—or delegate the task of identification to the respective services—to own the doctrine and training for emerging LAWS technology. For the Army, or for landpower in a broader sense, this proponent could be the US Army’s Fires Center of Excellence or the US Army Aviation Center of Excellence, which, between themselves, split the Army’s various Joint fires requirements.³² Appointing a proponent today does not preclude shifting responsibility in the future, should the Department of War identify or create a more appropriate agency. Instead, emphasizing a proponent now will ensure the US military can begin to manage emerging technology within its current structure.

A critical aspect of establishing a LAWS proponent is ensuring oversight of operators’ credentialing through the development of an Army additional skill identifier (ASI) for LAWS operators, or a Joint or service equivalent. This additional ASI would be distinct from the existing autonomous systems engineer (2W) ASI managed by the US Army Futures Command’s Artificial Intelligence Integration Center. Instead, the certification process required to receive an employment-focused ASI for LAWS could be conducted similarly to the Army’s Joint fires observer program, which balances academic requirements with evaluated, simulated missions designed to develop and test servicemembers’ expertise and flexibility in complex situations. The certified LAWS operator could also be augmented by servicemembers who are trained and certified as AI users and technicians, providing commanders with additional technical expertise to help enable employment decisions. Still, this employment decision must be underwritten by a commander’s explicit authority.

2. Authority. Policy must identify the requirements a commander must meet before employing LAWS. Current DoW policy outlines weapon systems will be designed to allow “commanders and operators to exercise appropriate levels of human judgment over the use of force.”³³ But defining the necessary levels of human involvement has become the crux of many international conversations concerning the use of LAWS.

Two similar terms have arisen from these controversial discussions surrounding humans’ involvement in LAWS: meaningful human control (a focus on human involvement throughout the entire kill chain) and appropriate human judgment (a less tangible and more permissive idea concerning a human’s involvement in critical parts of the kill chain). The delegates to the Convention on Certain Conventional Weapons have challenged these terms, arguing they are “too vague,

subjective and unclear.”³⁴ Recently, in 2024, Russia asserted: “We consider it inappropriate to introduce the concepts of ‘meaningful human control’ and ‘form and degree of human involvement’ promoted by individual States into the discussion, since such categories have no general relation to law and lead only to the politicization of discussions.”³⁵ This monograph does not attempt to rehash the detailed debates regarding the nuances of and distinctions between meaningful human control and appropriate human judgment.³⁶ Instead, it challenges the Department of War to codify unambiguously the predeployment requirements that, if fulfilled, are considered to constitute an appropriate level of human judgment. This monograph also challenges the department to redefine the loop as the whole set of considerations about the design and use of LAWS, precluding the possibility of a weapon not being under human control.

Policy currently covers the processes involved in conceiving and fielding LAWS, ensuring humans are involved in creating a weapon. Moving forward, a human-centric approach to employing LAWS can focus specifically on defining human judgment by creating criteria an organization must meet before activating a weapon. Work argues, if the decision to use LAWS “occurs as part of a sequence of actions tied directly to a deliberate human decision to carry out a lawful attack, the standard of appropriate human judgment over the use of lethal force is met.”³⁷ Work adds, mandating direct human control over every aspect of an engagement “would be impractical and would impose undue burdens on operators engaged in combat.”³⁸ This sentiment accounts for the practical aspects of fighting in a war in which systems with autonomous characteristics are a necessity.

Consequently, policy should articulate the required threshold of human-machine interaction along the lines of Work’s proposed principle. Like the release authority for other destructive munitions, policy should also affirm the planning process for a legal military engagement conducted by a staff trained and certified on LAWS satisfies the appropriate judgment required to launch the munition. Moving forward, DoW and service-specific policy should concisely and unambiguously codify the authority commanders at various levels have to employ LAWS.

Although restricting the authority to release these controversial weapons to individuals at the highest levels (like the secretary of war or a combatant commander) would be easy, such an overly restrictive policy would turn a tactical tool into a strategic weapon, limiting employments. Instead, release authority should vary by theater and weapon type, modeling existing structures used for weapons like the Army Tactical Missile System or the Family of Scatterable Mines. For example, the most controversial systems, which would operate deep in enemy territory, could be managed at the Joint task force or division levels, whereas the authorities for less controversial systems could be pushed down to the brigade or even

battalion levels. But policy does not have to grant a *carte blanche* release authority. Instead, the same policy could establish restrictions on the use of LAWS.

3. Restrictions. The overarching conversation about LAWS lacks the necessary context for when, how, and why a military might employ this emerging technology. Therefore, in addition to outlining release authority and ensuring operators are trained, an updated DoW policy should account for employment restrictions. As the military services and combatant commands begin identifying what types of military missions LAWS could supplement, the Department of War can shape initial employment considerations by publishing overarching restrictions on the use of LAWS and expected planning considerations.

For example, the Department of War could restrict the types of targets organizations can engage using LAWS. Larry Lewis, the director of the Center for Autonomy and Artificial Intelligence, contends: “There are some environments where civilians will be rarely encountered or can easily be identified. . . . [and] target types that are easier to differentiate between military and civilian.”³⁹ In this context, an employment policy could prevent organizations from using LAWS to engage human beings or wheeled military vehicles that could easily be confused with civilian vehicles. Similarly, the use of LAWS could be restricted when organizations establish restrictive fire areas over dense urban centers or when an unintended engagement could have strategic implications. Whereas the department could address the most pressing international concerns regarding LAWS by only allowing organizations to use LAWS to target specific, easily distinguishable military targets like air defense systems or tracked vehicles, this approach would ultimately limit the usefulness of the weapons. Instead, focusing on explicitly forbidding certain actions leaves room for commanders to make contextual assessments of the mission at hand.

As opposed to sweeping constraints that limit employability, most restrictions must be considered in the context of a given operation. Accordingly, service-level policy could establish planning expectations for responsible commanders. These additional expectations could include a checklist command staffs must incorporate into the process of planning a LAWS employment. First, the checklist could outline operational parameters, including designated flight paths, engagement areas, and the length of time a system can operate without making human contact. Second, though the Department of War can establish broad target restrictions, the checklist could encourage operational commanders to refine these restrictions further according to the system and the operational phase. These target refinements could be modeled on the attack-guidance matrix that is currently used to coordinate fire support and that provides instructions by phase and munition type. Finally, the Department of War could require responsible commanders to identify tactical considerations that warrant employing LAWS in unit operational orders.

These considerations may encompass whether a unit is operating in communication-degraded environments, without air support, or in extremis. These three examples are just a starting point. Overall, requiring organizations to make certain employment considerations forces them to account for and implement mission-specific restrictions, providing the requisite context for employment while avoiding excessive restrictions that do not account for the situation an organization may be facing.

In 2018, the US delegation to the UN offered a working paper that highlighted the importance of establishing mission-specific parameters. The position outlined, if organizations can ensure machines are able to operate within a ground commander's intent, then missions can avoid most of the controversy associated with employing LAWS. The US working paper makes this point by providing a realistic scenario: "For example, an autonomous system might be programmed to operate only within certain geographic boundaries. If deployed and limited to an area that was a military objective, such as an enemy military headquarters complex, then its use would be analogous to the use of other weapons, like artillery, that are used to target areas of land that qualify as military objectives."⁴⁰ This sentiment alone clearly conveys the fact the United States envisioned specific circumstances in which LAWS could be employed ethically. But ethical employment is predicated on mission-specific parameters. In 2023, the final report of the Group of Governmental Experts challenged, when states develop LAWS, they should set parameters that limit the types of targets a system can engage; limit "the duration, geographical scope, and scale of the operation of the weapon system"; and sufficiently train human operators.⁴¹ These conclusions highlight the importance of emphasizing both restriction and certification when developing employment guidance.

4. Accountability. The final pillar addresses military commanders' responsibility for unintended engagements. Humans, not machines, bear the responsibility for deciding to initiate a mission. Whereas the international community was unable to reach any binding agreements on LAWS, in 2019, the Group of Governmental Experts agreed on a set of guiding principles. One of these principles limits nations' ability to delegate the responsibility of taking human lives. The principle reads: "Human responsibility for decisions on the use of weapons systems must be retained since accountability cannot be transferred to machines," adding the responsibility "should be considered across the entire life cycle of the weapons system."⁴² This principle nests within this monograph's underlying argument: The human is always in the loop, with employment considerations being a critical, yet absent, component of existing LAWS frameworks.

One of the most significant aspects of emphasizing accountability in the employment of LAWS is addressing what happens when a mission goes wrong.

Notably, all weapons have the potential to err, which testing and development standards often account for or acknowledge. The technology associated with machine-led target identification is progressing rapidly, and though this technology is not yet perfect, neither are human beings. Still, if a system is not sufficiently capable of identifying targets, that system is unlikely to be fielded or employed. At the same time, chaotic situations require less certainty when identifying targets, regardless of whether a human has terminal control of the munition. Preplanned target areas with the potential for civilian casualties demand a high level of certainty. Scenarios in which enemy forces are overwhelming a position or the mission is in danger of failure require less certainty. These varying levels of risk are as present when firing artillery as when employing LAWS.

Although the DoW directive on autonomy in weapon systems outlines numerous mitigative efforts to prevent unintended engagements, an unintended engagement may still occur. In fact, if LAWS are integrated into the future battlefield, a mission that includes the use of LAWS will inevitably involve an incident: a truism in incorporating emerging technology. An unintended engagement could occur for numerous reasons. Work highlights the potential for “faulty weapon design, inadequate testing of possible failure modes, operator error/improper weapon employment, poor operator training, faulty intelligence, target misidentification, weapon malfunction, or adversary action.”⁴³ But the potential for unintended engagements does not necessarily mean the Army must fire a commander or an operator if a mission goes amiss.

In the US military, when a firing incident occurs, an investigation follows, which improves systems and processes. Accountability for a LAWS firing incident, as in all incidents, would be determined based on the circumstances at hand. An investigation would account for the entire mission, including processing, identifying targets, selecting a munition, and making final decisions. Given the complexity surrounding the use of LAWS, if an autonomous weapon does not perform as expected, military units must investigate the incident to identify the issue. Conducting these investigations reinforces the international guiding principles concerning humans’ accountability for their actions and may help prevent future issues.

In 2021, the US delegation to the UN outlined general concepts of accountability for LAWS in a working paper. The team proposed nations can hold humans accountable for LAWS missions by “[e]stablishing and using procedures for the reporting of incidents”; “[c]onducting assessments, investigations, or other reviews of incidents”; and employing “[d]isciplinary and punitive measures as appropriate.”⁴⁴ Therefore, in addition to reinforcing existing processes that hold commanders and operators accountable for conducting strikes with more conventional weapons like

artillery and aircraft, DoW and service-specific policy can capture two critical components that enhance accountability when employing LAWS.

First, policy can codify reporting and investigative procedures to ensure external organizations such as the LAWS proponent understand the importance of, and responsibilities involved in, conducting an investigation. For example, an investigative team should be armed with the expertise required to identify potential technical issues. Investigative procedures could be as straightforward as routing mission reports when LAWS are used, conducting detailed after action reviews of the impact of LAWS on a given operation, and establishing LAWS-based commander's critical information requirements.

Second, the Department of War can create a lessons-learned feedback mechanism by establishing reporting processes that distribute critical information to all parties invested in the development, training, and employment of LAWS. Given the concern surrounding the use of LAWS, the Department of War could go as far as creating a formal database of reported mishaps, including an enterprise view of the incidents. Such a database could mirror the way the Department of War manages aviation safety. This deliberate effort to identify who should be held accountable and to ensure organizations learn from incidents would establish a culture that could help appease actors that are critical of LAWS.

Moving Forward

Combined, the four pillars of certification, authority, restrictions, and accountability create a human-centric framework that can offer an unambiguous means of understanding humans' role in the kill chain and set a tangible precedent for what constitutes appropriate human judgment when employing LAWS. Moving forward, these pillars can be a building block for updated guidance on the employment of LAWS, which will be required as the systems proliferate. Still, to move from theory to practice, employment considerations must first be applied to mission types that have historically needed weapon systems with autonomous characteristics. Therefore, the second part of this monograph evaluates how the four pillars could be applied to modern-day missions that may require weapons with autonomous characteristics.

Part Two: The Military Application of LAWS

For generations, technological innovations have led to the creation of machines that enable and augment humans in warfare. Whereas rampaging robots like those in *The Terminator* have not made their warfare debut, the US military has used machines that leverage autonomous characteristics as an integral part of warfare

for decades. The incorporation of such machines is based on the fact autonomy has a historical role on the battlefield, including systems that can act instantaneously to neutralize an attack or operate in an environment not suited to humans. Lethal autonomy is a natural evolution of these autonomous characteristics.

Levels of lethal autonomy or, more broadly stated, autonomous characteristics, vary according to the technological limitations of the era and the mission requirements. Some historical systems fall outside the scope of the characteristics that would be considered autonomous today; are uncontroversial, semiautonomous systems; or have a purpose so simple the systems are dismissed as not having autonomous characteristics. But instead of focusing on weapons' characteristics, the subsequent analysis highlights aspects of employment considerations and human judgment that are tied to mission types. This approach shifts the narrative away from the weapons themselves and onto the employers, which, at the end of the day, are the responsible parties. The missions discussed in this section can broadly be categorized as critical-target prosecution, protection, and terrain denial.

This section first analyzes each mission type historically, with the intent to demonstrate a DoW precedent for outsourcing an aspect of lethality to machines without direct human supervision.⁴⁵ This precedent gives credence to the importance of incorporating preparation and human input before deciding to engage a potential target. After each historical analysis, this section presents a hypothetical scenario occurring during the same type of mission in which LAWS would enable operations on the future battlefield. Each hypothetical mission is briefly detailed, followed by a short analysis of how the lead organization could have justified its mission by accounting for the pillars of certification, authority, restrictions, and accountability.

This thought experiment is designed to add nuance to the proposed paradigm shift, as each scenario highlights how the Department of War could apply a human-centric, theoretical framework to otherwise controversial missions. These practical applications are not all-encompassing; instead, they are crafted to emphasize the proposed employment considerations, adding a contextual application to the theoretical framing. This approach provides an illustration of—and an opportunity to specify further—the requirements of certified operators, the importance of establishing mission restrictions, and the need to articulate execution authorities clearly.

Three assumptions must be highlighted before the thought experiment begins. First, to avoid unintended engagements and build confidence in lethal autonomy, the services' initial systems will likely stay far away from friendly forces and civilians. This decision may seem counterintuitive, as many analysts probably assume the

Army's LAWS would mirror its current land capabilities and the Army would place LAWS near similar units by creating automated tanks or self-propelled artillery systems. Instead, if LAWS are going to support military operations, they will likely require system characteristics more akin to those of loitering munitions or submarines than tanks. Second, though emerging systems still have numerous limitations in range, endurance, payload, and targeting capabilities, technological advances are bound to continue increasing the sheer capability of small drones. In turn, the presented scenarios are not constrained to the limited technology of existing systems. Rather, these hypothetical scenarios present situations that require significant technological advancements related to targeting, counterdrone operations, and swarm management. This future projection is necessary to evaluate how the human-centric framework can adapt alongside the technology the framework is designed to support. Finally, LAWS are bound to proliferate over the next few years, as highlighted by the Department of War's Replicator initiative: an effort to expedite the production of thousands of autonomous systems.⁴⁶ In turn, the potential mass production of LAWS around the globe will likely reduce the cost per system, making expending LAWS en masse a more fiscally feasible option.

Critical-Target Prosecution: A Historical Need to Hunt

Weapon systems with offensive, autonomous characteristics are at the forefront of the ethical debate surrounding LAWS. Complicating matters, the distinguishing characteristics of different weapon types are not always clear, which creates more confusion when one hyperfocuses on the final moments of a strike. These offensive systems comprise two categories. The simpler of the two categories, which currently includes systems defined as semiautonomous, can home in on a specific target or target group.⁴⁷ The most straightforward examples of the first type of offensive system are artillery rounds or aircraft bombs that release submunitions capable of seeking specific targets—like armored formations—as they descend, allowing each munition to change course and strike the intended targets. Work explains these “fire-and-forget guided munitions are designed to engage specific groups of concentrated targets selected by human operators,” with the submunitions then selecting and engaging individual targets “without human intervention.”⁴⁸ The US Army has leveraged this type of munition when developing modern, antiarmor artillery rounds and has employed some variants in combat.

For example, after the Persian Gulf War, the Army designed the Sense and Destroy Armor munition—the service's first target-locating, indirect-fire munition—to identify and engage lightly armored vehicles. Each 155mm projectile ejected two parachute-dropped submunitions that could use infrared and millimeter-wave sensors to scan an area with a roughly 150-meter diameter and then strike downward with an explosively formed projectile that devastated any vehicle it struck.⁴⁹

Whereas the munition was never fully funded, the Army decided to use its limited quantity of produced Sense and Destroy Armor artillery rounds during the 2003 invasion of Iraq, and the first fired rounds of the semiautonomous munition destroyed an Iraqi T-55 tank.⁵⁰ After destroying nearly 50 enemy vehicles, Brigadier General Lloyd Austin, who served as the 3rd Infantry Division deputy commander during the invasion, described the new munition as “incredible” and “a keeper.”⁵¹

Around the same period, the Department of War experimented with a similar munition called the brilliant antiarmor submunition. Numerous delivery platforms could launch this submunition, with the Army developing a specific variant of its Army Tactical Missile System to carry 13 brilliant antiarmor submunitions. The brilliant antiarmor submunition was designed to leverage onboard acoustic and infrared sensors to seek, identify, and strike moving vehicles.⁵² But this homing submunition met a fate similar to that of many emerging munitions, and the Army never fielded it.

The services have developed and deployed numerous types of homing systems. Regardless of the level of autonomy prescribed to these more commonplace weapons, their development and subsequent use in combat highlight the US military’s willingness to surrender an aspect of terminal control to a machine in an enemy-saturated area.

Weapons designed to hunt targets are an expansion of the limited authority militaries have given to homing munitions. The earliest examples of hunter weapons were airborne, with each munition being capable of searching an area for potential targets. The primary distinguishing factor that elevates the level of autonomy is the ability to loiter in a designated search area, which eventually led to the common name for modern variants: loitering munitions. Whereas these early loitering munitions were not prevalent, and few were ever fielded, these systems arguably represent the birth of genuine lethal autonomy.

The US Department of War showed ample interest in developing autonomous systems in the 1980s and 1990s, as the technological advancements of the time made new weapons significantly more feasible than they were in decades past. A 1983 Defense Advanced Research Projects Agency report entitled *Strategic Computing* analyzed the rapid technological advancements of the time, and the potential impact technology would have on the battlefield. The authors concluded, “[t]he possibilities are quite startling, and suggest that new generation computing could fundamentally change the nature of future conflicts.”⁵³ Specifically, the authors challenged, on the future battlefield, “instead of fielding simple guided missiles or remotely piloted vehicles, we might launch completely autonomous land, sea, and air vehicles capable of complex, far-ranging reconnaissance and attack missions.”⁵⁴ In turn, in the latter

years of the Cold War, the Department of War made a concerted effort to research and develop weapon systems that could be categorized as LAWS.

The US Navy developed one of the earliest hunter-type weapon systems near the end of the Cold War to help engage enemy ships beyond the horizon. The creation of the Tomahawk anti-ship missile (TASM) in the 1980s had the potential to change the character of surface naval battles. The Navy designed the TASM to be fired in the general direction and within the estimated range of an enemy ship that was out of sight. But what made the munition unique was, upon reaching its engagement area, the missile activated a radar search that allowed it to hunt within a vast area to which the enemy vessel might have transited during the missile's flight.⁵⁵ Stated simply, the missile was fired in the enemy's direction, then the missile searched for, identified, and engaged a target without human intervention. Whereas the US military never employed the TASM against enemy forces, Paul Scharre, author of *Army of None: Autonomous Weapons and the Future of War*, contends the missile "has the distinction being the first operational fully autonomous weapon, a significance that was not recognized at the time."⁵⁶ The TASM is one of numerous projects conducted during the 1980s and 1990s, most of which failed for various reasons.

Another example was the Air Force–Army joint venture to build a more versatile autonomous weapon that, by today's standards, would be categorized as a controversial human-out-of-the-loop LAWS: the Low Cost Autonomous Attack Submunition. This project had a purpose similar to that of the homing munitions the Army was developing at the time (which included submunitions released from an aircraft bomb or an Army missile), except the addition of loiter time meant the engaging element did not have to identify a target. Instead, by simply identifying a target area and establishing parameters, the human operators trusted the weapon to hunt its own targets.⁵⁷ Eventually, the Air Force pursued a powered variant, dramatically increasing the weapon's loitering time and coverage area. The service aimed to design "a miniature, autonomous, powered munition capable of broad area search, identification, and destruction of a range of mobile ground targets."⁵⁸ The system could engage a multitude of targets and relied on a specially developed Laser Detection and Ranging seeker and Automatic Target Recognition algorithms.⁵⁹

The development of these hunter-type weapon systems demonstrates the US military's desire to leverage lethal autonomy and its willingness to surrender an aspect of control, albeit in limited target areas with specific parameters. This historical precedent likely stems from the challenge of facing a near-peer adversary—a scenario in which US forces may be limited in their ability to control or communicate with their assets directly or may struggle to identify enemy forces.

Still, LAWS did not proliferate during the 1980s and 1990s because of a fundamental priority in seeking new technology: the pursuit of a favorable cost-benefit ratio. A favorable balance is achieved when the lowest possible cost produces the greatest possible benefit. For autonomous weapon systems in the 1980s and 1990s, the inherently high cost of new systems was not worth the perceived benefit. Scharre argues, “[d]ue to their expensive cost, even highly advanced loitering munitions are likely to fall into the same trap as TASM, with commanders hesitant to fire them unless targets are clearly known.”⁶⁰ But the whole point of developing hunter-type autonomous weapons is gaining the ability to launch a munition into a large engagement area with limited target information. Scharre adds, a primary reason loitering-munition LAWS did not proliferate is “the advantage they bring—the ability to launch a weapon without precise targeting data in advance—may not be of much value if the weapon is not reusable, since the weapon could be wasted.”⁶¹ To overcome this potential waste of critical assets, the Department of War needed systems that were either able to return to base for reuse if they did not engage a target, or were inexpensive enough military leaders could expend them by the hundreds. Both options are becoming feasible with modern technological advancements.

In addition to their high cost, the perceived benefit of LAWS was minimal. One aspect of this perception was a lack of confidence the systems could perform as desired. Scharre contends the “usefulness of fully autonomous weapons” remained limited because “the target identification algorithms used in autonomous and semiautonomous weapons have been fairly simple.”⁶² Consequently, a technological inability to identify and engage the intended targets leads to wasted resources and could lead to striking an unintended target. Work argued this potential for an incident to occur is the reason the Low Cost Autonomous Attack Submunition failed: “Although the LOCAAS [Low Cost Autonomous Attack Submunition] was developed and successfully tested, it never was fielded because DoD leadership worried the risks of unintended engagements were too high, especially as the search area expanded or the duration of the mission was extended.”⁶³ But the rise of AI and the mass production of small drones over the last few years have inverted this poor cost-benefit ratio for LAWS, setting the stage for the development of modern systems.

The Future of Critical-Target Prosecution: Coordinating Attacks

Sometimes, sending machines off to hunt enemy targets is legitimately necessary. The most straightforward mission in this category is the mission to suppress enemy air defenses. Most nations are already pursuing this path with their emerging LAWS. This mission requires systems that can detect the unique radar signatures of air defense systems: an essential target in the Army’s multidomain doctrine.

The radars are difficult to find and can cover large areas, requiring long loiter times and the freedom to search deep in enemy-controlled territory. Although essential, enemy air defense systems are not the only systems that need to be removed from the battlefield to enable mission success.

Other systems, like enemy long-range fire systems or command-and-control nodes, may be foundational to enemy courses of action. Similar to air defense systems, these targets are often critical, valuable, and require an immense amount of effort and time to find and target. Complicating matters, long-range fire systems and command-and-control nodes have less distinct signatures and may be widely dispersed yet still able to influence the fight. In turn, the ability to interdict such targets from across the battlefield and through a coordinated attack could deal the enemy a critical blow at a decisive time.

By using LAWS, the commanding headquarters could simultaneously influence numerous targeted areas of interest. Suppose the organization surveils a few target areas with its intelligence, surveillance, and reconnaissance assets, and organic strike assets are allocated to targets within those areas. The organization has a limited amount of manpower and assets and can commit a limited amount of manpower and assets to the engagement. Therefore, the organization could also have designated areas in which LAWS could find and engage targets without additional human intervention. Whereas the target-identification criteria for high-value targets like a command center or a long-range artillery system are more nuanced, these targets still have unique attributes. For example, LAWS could be programmed to hunt for tentage with heavy electromagnetic-spectrum emissions or hunt for the distinguishable traits of a rocket pod. Additionally, because LAWS are inherently expendable, the systems could monitor areas deep in enemy-controlled territory and in communication-degraded areas, without organizations fearing the possibility of losing exquisite platforms to enemy air defenses. By dedicating LAWS to a few swathes of land that could be harboring the adversary's most important systems, the controlling organization would dramatically increase the potential impact of its coordinated attack.

Conceptually, the certified personnel would be the planners at the headquarters responsible for the coordinated attack. Planners could limit the autonomous function of the mission to suspected enemy areas, tie the function to operational timelines, or connect the function to essential times when friendly aircraft may be vulnerable. These limitations could synchronize the autonomous aspects of the mission with the manpower-intensive coordination required to support and battle track the accomplishment of other mission-critical objectives. If needed, the systems sent to support operations could also be programmed to self-destruct or return to base if they cannot identify a target within the given parameters. The authority to

create these kill-box adaptations could mirror existing procedures and be outlined in standing theater orders or rules of engagement. Coordinating organizations would need to establish reporting procedures to identify LAWS that behave irregularly and put in place a process to track the systems scattered around the battlefield. These actions would ensure the coordinating organization could account for all employed munitions. Given the nature of the coordinated attack, many strikes would likely go unobserved, and the responsible organization may struggle to conduct timely battle damage assessments.

Protection: A Historical Need for Rapid Response

In general, defensive lethal autonomy carries less controversy than its offensive counterpart. Even though militaries may grant defensive machines similar authorities, neutralizing an aggressor or protecting people and property are goals that feel inherently acceptable. Consequently, conversations about lethal autonomy often leave out or diminish the importance of defensive, autonomous characteristics. But the willingness of the US military and, more broadly, the international community, to accept these characteristics in warfare suggests future conversations concerning lethal autonomy will be fluid, particularly conversations focusing on limiting weapon employment criteria instead of limiting capability development.

The most accepted characteristic of defensive autonomy is the rapid response required to stop an incoming missile attack. Distinct from the other categories, these unique, defensive actions are better understood as human-machine teaming than as employing autonomous weapons. Whereas the weapon systems are turned on or set to engage, they remain inactive unless a target comes into view. The human, who is directly involved in the system, monitors and validates the targets the machine might identify. During most of the time the system is turned on, it will not find any targets, and the operators will eventually revert the system back to a semiautonomous role or shut it down. In certain modes, when the system identifies a target, the machine has the authority to strike without human approval.

At the same time, humans can override the target and intervene before launch. Scharre coined the term centaur war fighting to refer to this type of relationship, challenging readers to visualize the mythical creature whose top half is human (the brain leading the operation) and whose bottom half is horse (the machine amplifying the human's attributes). Scharre argues the partnership is stronger than either element alone, noting "[h]ybrid human-machine cognition can leverage the precision and reliability of automation, without sacrificing the robustness and flexibility of human intelligence."⁶⁴ Although Scharre's assertion is true in theory, this centaur-teaming model for human-machine integration is not without faults that must be addressed to understand how it relates to LAWS.

The first issue with Scharre's version of meaningful human interactions with machines is its potential to include automation bias, where human operators simply accept the information a machine provides because the human assumes the machine is correct. A recent US Army War College Press publication examined the process of building trust in AI and highlighted the challenge of automation bias: "humans must be able to trust the information they receive. Sometimes, this trust can be taken too far, and humans may inappropriately subordinate their judgment to that of a less capable machine."⁶⁵ Many factors can lead to trust in systems and the potential for automation bias, including prolonged use of a system, historical performance metrics, and organizational culture.

The second issue with Scharre's model of human-machine teaming is, to be effective, the machine must respond rapidly. Artificial intelligence (AI) analysts Kobi Leins and Anja Kaspersen contend, "[t]he complexity, speed, and scale of many autonomous, and even automatic, systems do not allow time to challenge them," adding the machine's requirement to act near-instantaneously "will often render a potential appropriate human intervention impossible."⁶⁶ Leins and Kaspersen's assertion raises the question: To what extent is a human operator involved in the engagement process while a protective system is active?

To update Scharre's model, Sparrow and Adam Henschke, a philosophy professor at the University of Twente, Netherlands, flipped the metaphor. Instead of a human-led centaur model, the authors propose an AI-led minotaur model, with an animal head on a human body. Sparrow and Henschke note, because "[a]rtificial intelligences are arguably already more capable of performing the cognitive tasks most relevant to warfighting. . . . shifting some functions of battlefield command to AI will help prevent friendly fire incidents and enhance the survivability of human warfighters."⁶⁷ As the minotaur model pertains specifically to the protective systems that rely on autonomous characteristics, the authors challenge the model is already in effect, with the human being subordinate to the machine instead of providing the espoused oversight. In this context, humans have substantial responsibilities before the system is activated and have a minimal role after the system is activated.

Protective platforms with autonomous characteristics have been in use for decades, with various levels of human involvement. For example, the US Patriot missile defense system—which includes radars, command-and-control technology, and interceptors—has been in service and modernized for over 30 years. To date, 19 countries own and operate the Patriot system, and Raytheon Company, the manufacturer, boasts: "Since it was first fielded, Patriot has been used by five nations in more than 250 combat engagements against manned and unmanned aircraft, cruise missiles, and tactical ballistic missiles."⁶⁸ One of the most successful

examples of human-machine teaming is the Navy's Aegis Combat System. Its developer, the Lockheed Martin Corporation, claims the Aegis Combat System is "the most capable multi-mission combat system deployed in the world today," describing it as "a centralized, automated, command-and-control (C2) and weapons control system designed as a total weapon system, from detection to kill."⁶⁹ The system has been a staple on US Navy ships for decades. The system's various modes allow human operators to set parameters and conditions for the machine, and the machine subsequently has various levels of authority to engage based on the circumstances.⁷⁰

In terms of this research project, autonomy in the protective mission has historically been accepted and is not controversial, despite numerous high-profile incidents that killed friendly forces and civilians.⁷¹ This precedent was likely established for two main reasons. First, the time that elapses between acquiring an incoming target and striking that target may be measured in seconds, requiring a rapid response that is often beyond the capabilities of a human. In turn, the autonomous characteristics involved in self-protection were, and still are, accepted as necessities on a modern battlefield. Notably, as the pace of the battlefield intensifies, military analysts will likely make a similar argument for the employment of offensive capabilities, shifting the conversation to the role humans play before activating LAWS.⁷²

Second, some observers believe the protective systems are subject to human oversight and humans are meaningfully involved in engagements. But as noted, this human involvement might not be as meaningful as advertised, given the potential for automation bias and the sheer speed required to intervene. In reality, as highlighted throughout this monograph, the most important aspect of human involvement comes before the engagement, through the establishment of employment parameters, restrictions on weapons' positions, and the decision to activate the machine.

The protective mission is not going away. On the contrary, as the battlefield becomes increasingly complex and belligerents are increasingly able to identify, target, and strike vulnerable or critical systems, the emphasis on protection will likely increase.

The Future of Protection: A Drone Bubble

The role of widely accepted, protective capabilities, such as the Patriot missile defense system, is unlikely to change, and the systems are not worth evaluating further. But the changing characteristics of the modern battlefield have given way to new protective requirements that are inexpensive enough to address dozens of tactical targets. Operations in Armenia and Ukraine have highlighted how

effective advanced drone technology can be against ground forces, increasing the inherent danger enemy rotor and fixed-wing aircraft pose to land forces. In response, inexpensive drones flying en masse could provide an aerial, protective bubble around critical assets or move in front of maneuver forces, in tandem with systems designed to strike surface targets. In the same vein as the kamikaze drone that dives into its target, small LAWS could create an aerial minefield, with each system being prepared to fly directly into enemy systems. These attacks could disable enemy systems that attempt to conduct reconnaissance or record strikes for subsequent information campaigns. This aerial coverage would add a new wrinkle to the already-complicated battle for airspace and provide the Army with a new protective tool—an often-underappreciated war-fighting function.

Notably, this aerial denial mission would inevitably lead to drone-on-drone engagements, as small, unmanned systems with conflicting tasks are bound to clash in contested skies. But if neither of the combatants in an engagement is human, the consequences of a ground commander's decision to employ such systems are inherently different; losing an expendable resource is not the same as losing a life. A nonhuman engagement raises its own kinds of concerns about delegating aspects of battle to machines. Whether the transition toward machine engagement is for better or for worse remains unclear.

Conceptually, the unit conducting the mission or tasked with guarding critical infrastructure would need a certified operator to be either part of the team or embedded in the mission. Additionally, the mission commander would need clear authority over when the operator could activate the aerial denial swarm. This authority could be based on time, the enemy situation, or the phase of the operation, and the commander should dictate the authority in their order. Authorities at various echelons could restrict the operating zone the swarm would be allowed to traverse and could specify a secondary zone for scanning and engagement. Planning restrictions could similarly account for other friendly air assets that may traverse the area, as distinguishing between friends or foes may prove challenging, especially if the enemy has electronic countermeasures.

Similar to the Patriot system, the individual operator on the ground would be able to supervise the drones using a tablet and be ready to shift or terminate the mission. But the commander on the ground could alleviate this supervisory responsibility if the unit came under attack or was in danger of being overrun, or if loose restrictions were in place for certain phases of the operation. Shifting away from control would allow the certified operator to stay in the tactical ground fight when necessary. At the same time, the machine teammates could continue the aerial denial mission, limiting the enemy forces' ability to use drones or air support to complicate the situation any further. The planning process could

identify the tactical or mission requirements that warranted transitioning the system away from direct human involvement.

Finally, simple instructions to establish the required process for reporting unintended engagements or LAWS acting outside their expected behavioral patterns would need to be published. Additionally, detailed mission debriefs to capture lessons learned from employing the systems would need to be conducted.

Terrain Denial: A Historical Need for Mines

Some of the oldest weapons with autonomous characteristics are mines. Mines are simple military munitions that can be set in place to wait for an unsuspecting target. Military forces often place these weapons clandestinely, setting a trap to inflict damage on any target that comes across them. Sadly, these targets are not always enemies, and sometimes the targets are not even military forces at all. This nondiscriminate trigger is the inherent danger of setting up a trap. At the same time, mines can be part of an overt operation to deter enemies from moving through a particular area, with signs and messages declaring to enter the dangerous area is to risk death.

Mines come in all shapes and sizes and have had various roles in warfare, from simply denying an enemy a piece of terrain to being an instrumental part of a nation's theory of victory. For example, David Hambling, author of *Swarm Troopers: How Small Drones Will Conquer the World*, comments: "It is easy to forget that in WWII, mines sank more ships than guns, torpedoes or bombs."⁷³ Militaries have designed mines to serve an array of purposes, including acting as antiarmor systems, encapsulated undersea torpedoes, and indiscriminate explosives.

One of the technological drawbacks of mines compared to a modern war analyst's concept of a lethal autonomous weapon is the mine's limited ability to move once activated. For Scharre, mines are missing a critical component of the kill chain, reducing the level of autonomy he attributes to the static munition: "While mines are automatic devices that will detonate on their own once triggered, they have no freedom to maneuver and search for targets. . . . [mines] have limited methods for 'deciding' whether or not to fire."⁷⁴ But Scharre's framing focuses exclusively on the weapon's characteristics, vice the human operator. Notably, no consensus exists on the weapon's categorization. T. X. Hammes, an author of works on future warfare, contends, "mines are essentially autonomous," noting the systems "are unattended weapons that kill humans without another human making that decision."⁷⁵ This distinction is not as clearly applicable to more sophisticated variants.

In his attempt to create DoW guidelines for LAWS, Work highlights the Cold War-era anti-submarine mine known as the Mark 60 CAPTOR,

or encapsulated torpedo, as a prime example of a friendly weapon system that leveraged autonomous characteristics. The Mark 60 CAPTOR mine could be dropped from aircraft, surface ships, and submarines; the mine was designed to rest on the seafloor and use passive sonar to detect submarines, launching its torpedo when it acquired a target.⁷⁶ The mine served a terrain-denial purpose during the Cold War, preventing Soviet submarines from using the Greenland–Iceland–United Kingdom gap.⁷⁷

The Mark 60 CAPTOR mine would not activate if surface ships transited the area. This target discrimination is an example of humans placing specific parameters on autonomous systems through the systems' design. Work explains, "once the mine was emplaced and activated, the weapon system could detect, classify, and attack its own target without any further human oversight or intervention."⁷⁸ Essentially, Work is claiming mines, particularly advanced mines with sensors, have long been autonomous weapons. Similarly, Hambling contends, "[w]hile autonomous weapons are an issue elsewhere, naval mines have always been effectively autonomous."⁷⁹ In this context, mines provide a historical precedent for the US military trusting in a weapon that, once placed and activated, could strike at a time not determined by a human and could make a final target selection without human control.

The historical acceptance of the use of mines is not based solely on the weapon's lack of mobility. Instead, such acceptance is influenced by the meaningful input humans contribute before the system can engage a target. Hammes explains: "A human designed the detonators to require a certain amount of weight to activate the mine. A human selects where to place them based on an estimation of the likelihood they will kill or maim the right humans. . . . a human sets the initial conditions and then allows the weapon to function automatically."⁸⁰ Therefore, similar to the protective mission, if the framing shifts away from the moment the target is struck and toward preengagement employment considerations and human involvement, the conversation regarding the weapon's usage shifts as well.

The need to deny adversarial forces operationally significant terrain will likely remain an essential aspect of war fighting for the foreseeable future. Technology may both undermine current approaches to terrain denial and create adaptive opportunities, allowing organizations to employ tried-and-true concepts in novel ways.

The Future of Terrain Denial: A Minefield from the Sky

The Army can leverage autonomous lethality in numerous ways to deny the enemy a piece of terrain. One example of a future terrain-denial mission is establishing an aerial minefield. A minefield from the sky could be a formal

minefield marked and in compliance with international law, or such a minefield could be a makeshift feature resulting from a battlefield decision, remaining in place for a brief but decisive period. The loitering munitions covering this modern-day no-man's-land would be set according to specific boundaries and target types. Operators could shut down or return these airborne mines to a semiautonomous setting when tactically necessary. This shift would allow the responsible commander to turn off the airborne minefield without the underlying fear of leaving behind unexploded ordnance. Commanders could thus shut down the minefield when it was no longer needed or could shut down the minefield temporarily to allow friendly and neutral traffic to pass. Additionally, compared to conventional mines, the emplacement and displacement requirements would be minimal, and the operators could instantaneously repurpose the systems for another minefield a fair distance away, or for a completely different type of mission. This flexibility would drastically reduce the number of resources required to deny terrain.

Conceptually, certified operators would need to be within the minefield-coordinating headquarters during the planning process. If able, these operators could monitor the drones from a station inside the tactical operations center. If distance, degraded communications, or sheer manpower requirements made direct involvement infeasible, the minefield would meet the tactical requirements for activating LAWS. The authority to establish the minefield would be clearly authorized and published in an order.

The established targeting criteria provided to LAWS for an aerial-minefield mission would be essential in preventing a potential unintended engagement. These restrictions could include parameters that allow the systems to target only armored or tracked vehicles in the designated area, reducing the odds of LAWS targeting civilian traffic.

Another example of an aerial-minefield mission is confining loitering munitions to observing a main supply route enemy forces must use to transport ammunition and fuel. Human operators would need to set the engagement parameters for munitions to target convoys. Such parameters may allow munitions to engage targets if three or more vehicles were present or if LAWS identified a bulk fuel system. The parameters may also include time restrictions in line with friendly, offensive operations. In setting these parameters, human operators could observe the weapons as needed or allow the machine to continue operating autonomously if communications were degraded or if the operations extended deep into enemy territory. This type of employment would allow LAWS to interdict enemy supply operations across a large area and free up resources by allowing Army forces to focus on other aspects of the battle.

Finally, a reporting process needs to be established. Distinct from an aerial-minefield mission, the engagements could happen without humans even being aware a strike has occurred. Follow-up assessments through intelligence, surveillance, and reconnaissance could be used to validate strikes for battle damage assessments and ensure LAWS functioned as expected. As future missions move farther from the range in which humans can track engagements, digital systems must be created to account for all activated systems. This adjustment could guide the machines that did not engage targets to disengage, with established parameters directing machines to report to the originating headquarters for further instructions, head to a designated self-destruct area, or return to base.

Overall, this application of the human-centric framework to real-world situations is not meant to represent an all-inclusive list of potential missions for LAWS. Instead, the framework is designed to scratch the surface of LAWS employment considerations in the land domain. These proposed missions attempt to spark an overdue conversation about employment considerations for new LAWS technology. This conversation must still include a debate about the ethical concerns associated with lethal autonomy, with a focus on employing LAWS justly and embracing their military application.

Conclusion

Whether the Department of War is ready or not, the technology to enable lethal autonomy exists and is progressing rapidly. Whereas international law or US government policy may still restrict the use of this emerging technology, such restrictions are unlikely to emerge. To date, the UN has only reached a consensus on basic developmental guidelines, failing to implement restrictive policies. The presence of LAWS will soon become a battlefield reality the US military must address.

Historical precedent exists for missions that rely on machines with various levels of autonomous capabilities to engage critical targets, protect friendly forces, and deny enemy terrain. These mission requirements, and others like them, will remain fundamental components of conflict for the foreseeable future. In turn, LAWS are a unique tool to adapt current techniques or conduct operations in a novel way.

Consequently, the Department of War must move beyond developmental guidelines and ethical platitudes to help the services prepare to integrate LAWS as if they are a battlefield inevitability. This shift requires the department to codify guidance on the future employment of LAWS in a way that avoids ambiguous language and strives to provide intentions that are not open to interpretation.

To codify clear employment guidance, the Department of War should embrace a human-centric framework that emphasizes and defines human judgment. This policy adjustment can add crucial, contextual employment considerations by establishing a proponent that will own doctrine and certification training, articulating weapon-release authorities, outlining general restrictions, and creating reporting processes. When applied to realistic scenarios, these employment considerations demonstrate processes can be put in place to ensure accountability for action remains with the employing agent (the human). Such employment considerations can also help ensure the machine is simply an extension of the commander's intent; the machine can be restricted in ways that ensure military operations are conducted according to international humanitarian law; and essential, contextual circumstances are weighed by human judgment.

Embracing a human-centric mindset built on the employment pillars of certification, authority, restrictions, and accountability would allow the Department of War to reframe the conversation about human involvement by reinforcing the role of humans throughout the entire targeting process and establishing clear requirements for activating LAWS. This DoW policy update would highlight the fact LAWS can be employed ethically because the systems operate under specific parameters or restrictions provided by human operators. This change could provide commanders at all levels with the guidance needed to promote professional discourse on LAWS and begin experimenting, modeling, and wargaming to understand how this emerging technology will fit into future service-specific and Joint war-fighting concepts.

Endnotes

1. Department of Defense (DoD), *Autonomy in Weapon Systems*, DoD Directive 3000.09 (DoD, January 2023), 21; and Austin Wyatt, “So Just What Is a Killer Robot?: Detailing the Ongoing Debate around Defining Lethal Autonomous Weapon Systems,” *Wild Blue Yonder*, June 8, 2020, <https://www.airuniversity.af.edu/Wild-Blue-Yonder/Article-Display/Article/2208774/so-just-what-is-a-killer-robot-detailing-the-ongoing-debate-around-defining-let/>.
2. Joseph O. Chapa, “Please Stop Saying ‘Human-in-the-Loop,’” Institute for Future Conflict, September 3, 2024, <https://www.ifc.usafa.edu/articles/please-stop-saying-human-in-the-loop>.
3. This monograph does not provide a legal argument for accountability. These decisions have already been made by the international community. For a detailed argument concerning why accountability must remain with the operator, see Kelly Cass, “Autonomous Weapons and Accountability: Seeking Solutions in the Law of War,” *Loyola of Los Angeles Law Review* 48, no. 3 (Spring 2015): 1017–68.
4. DoD, *Unmanned Aircraft Systems Roadmap: 2005-2030* (Office of the Secretary of Defense, 2005), 1–2.
5. DoD, *Unmanned Systems Roadmap 2007-2032* (DoD, 2007), 6.
6. DoD, *Roadmap: 2005-2030*, 2.
7. DoD, *Autonomy in Weapon Systems*. The Department of Defense published the original directive in 2012. But because the changes in the 2023 version are minor, this research project exclusively uses the later version instead of comparing and contrasting the changes.
8. DoD, *Autonomy in Weapon Systems*, 1.
9. DoD, *Autonomy in Weapon Systems*, 4.
10. DoD, *Autonomy in Weapon Systems*, 6.
11. DoD, *Autonomy in Weapon Systems*, 4.
12. C. Anthony Pfaff et al., *Trusting AI: Integrating Artificial Intelligence into the Army’s Professional Expert Knowledge* (Strategic Studies Institute, US Army War College Press, February 2023), 21, <https://press.armywarcollege.edu/monographs/959/>.
13. DoD, *Autonomy in Weapon Systems*, 12.
14. DoD, *Autonomy in Weapon Systems*, 13.
15. DoD, *Autonomy in Weapon Systems*, 10.
16. DoD, *Autonomy in Weapon Systems*, 11.
17. DoD, *Autonomy in Weapon Systems*, 4.
18. DoD, *Autonomy in Weapon Systems*, 4.
19. Robert O. Work, *Principles for the Combat Employment of Weapon Systems with Autonomous Functionalities* (Center for a New American Security, April 2021).
20. This shift toward focusing on predeployment considerations is not novel, but it does merit further analysis and tangible recommendations. One concept, though not a tangible recommendation, was to add the idea of “starting the loop” to the existing loop framework. See T. X. Hammes, “Reality in Autonomous Systems: It Starts the Loop,” *The Cove*, November 15, 2018, <https://cove.army.gov.au/article/reality-autonomous-systems-it-starts-loop>.
21. DoD, *Autonomy in Weapon Systems*, DoD Directive 3000.09 (DoD, May 2017), 15.
22. Leonard Kahn, “Lethal Autonomous Weapon Systems and Respect for Human Dignity,” *Frontiers in Big Data* 5 (September 2022).
23. Robert Sparrow, “Robots and Respect: Assessing the Case against Autonomous Weapon Systems,” *Ethics & International Affairs* 30, no. 1 (Spring 2016): 99. This article provides a detailed analysis of the ethical case for developing lethal autonomous weapons systems (LAWS), specifically detailing arguments concerning the difficulty of discrimination.
24. Sparrow, “Robots and Respect,” 98.
25. Robert Sparrow, “Twenty Seconds to Comply: Autonomous Weapon Systems and the Recognition of Surrender,” *International Law Studies* 91 (2015): 717–18.

26. Sparrow, “Twenty Seconds to Comply,” 727.
27. Work, *Combat Employment*.
28. 2021 Sessions of the UN Group of Governmental Experts (GGE) on Emerging Technologies in the Area of LAWS, *Report of the 2021 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 5, UN Doc. CCW/GGE.1/2021/WP.3, annex IV (September 27, 2021).
29. 2018 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Report of the 2018 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 14, UN Doc. CCW/GGE.1/2018/3 (October 23, 2018).
30. Chair of the UN GGE on Emerging Technologies in the Area of LAWS, *Guiding Questions* (Reaching Critical Will, August 2021), 1.
31. 2021 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Draft Report of the 2021 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 12, UN Doc. CCW/GGE.1/2021/CRP.1 (December 8, 2021).
32. US Army, *Chapter 4: Skill Identifiers (SI)* (US Army, June 2022).
33. DoD, *Autonomy in Weapon Systems*, 10.
34. Meeting of the High Contracting Parties to the 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, *Report of the 2015 Informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)*, 11, UN Doc. CCW/MSP/2015/3 (June 2, 2015).
35. 2024 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Approaches of the Russian Federation to the Issue of Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 4, UN Doc. CCW/GGE.1/2024/WP.2 (March 1, 2024).
36. For a reference to the nuanced challenges of these ambiguous terms, see James Kraska, “Command Accountability for AI Weapon Systems in the Law of Armed Conflict,” *International Law Studies* 97 (2021): 407–47. Notably, the US government has already established it supports judgment over control. See: 2018 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Human-Machine Interaction in the Development, Deployment and Use of Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 2, UN Doc. CCW/GGE.2/2018/WP.4 (August 28, 2018).
37. Work, *Combat Employment*.
38. Work, *Combat Employment*.
39. Larry Lewis, *Redefining Human Control: Lessons from the Battlefield for Autonomous Weapons* (Center for Autonomy and Artificial Intelligence, March 2018), 19.
40. 2018 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Human-Machine Interaction*, 3.
41. 2023 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Report of the 2023 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 4, UN Doc. CCW/GGE.1/2023/CRP.2 (May 24, 2023).
42. 2019 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *Report of the 2019 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, 13, UN Doc. CCW/GGE.1/2019/3 (September 25, 2019).
43. Work, *Combat Employment*.
44. 2021 Sessions of the UN GGE on Emerging Technologies in the Area of LAWS, *2021 Session*, annex IV, 5.
45. This monograph is not a historical survey of lethal autonomy. The select historical examples are not all-encompassing, but they provide enough of a glimpse to establish context.
46. “Replicator,” Defense Innovation Unit, n.d., accessed June 8, 2025, <https://www.diu.mil/replicator>.
47. Notably, the term “target group,” referring to a certain type of engagement, appears in numerous definitions throughout the DoD directive and is critical for distinguishing between the US government’s definitions of semiautonomous and autonomous systems. The directive’s glossary clarifies the term “target group” with examples such as: “a particular flight of enemy aircraft, a particular formation of enemy tanks, or a particular flotilla of enemy vessels.” But the glossary also notes, “a general class of targets or a specific type of target, such as a particular model of tank or aircraft, does not constitute a specific target group.” In turn, a system sent to strike an artillery battery at a suspected location would be engaging a target group. In contrast, a system sent to an enemy-controlled area to hunt for artillery units would not be engaging a target group. These types

of distinctions create a level of nuance that can cause confusion, particularly when assessing target-seeking munitions. DoD, *Autonomy in Weapon Systems*, 23.

48. Work, *Combat Employment*.

49. DoD, *Annual Report FY2000* (Director, Operational Test and Evaluation, February 2001), 165–66.

50. Gregory Fontenot et al., *On Point: The United States Army in Operation Iraqi Freedom* (Combat Studies Institute Press, 2004), 118.

51. Robert W. Rooker, “Historical Recounting of Marne Thunder in OIF,” *Field Artillery: A Professional Bulletin for Redlegs* (September–October 2003): 17–22; and Patrecia Slayden Hollis, “3d ID in OIF: Fires for the Distributed Battlefield,” *Field Artillery: A Professional Bulletin for Redlegs* (September–October 2003): 11.

52. DoD, *FY 2002 Annual Report* (DoD, 2002).

53. Defense Advanced Research Projects Agency, *Strategic Computing: New-Generation Computing Technology* (Defense Advanced Research Projects Agency, October 1983), 1.

54. Defense Advanced Research Projects Agency, *Strategic Computing*, 1.

55. Work, *Combat Employment*.

56. Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (W. W. Norton & Company, 2018), 49.

57. DoD Office of the Inspector General, *Audit Report: Powered-Low Cost Autonomous Attack System Advanced Technology Demonstrator*, Report No. D-2001-106 (DoD Office of the Inspector General, May 2001), 2.

58. DoD Office of the Inspector General, *Audit Report*, 4.

59. “Lockheed Martin’s Low Cost Autonomous Attack System Named Finalist for 2004 Aerospace Industry Award,” Lockheed Martin, February 13, 2004, <https://investors.lockheedmartin.com/news-releases/news-release-details/lockheed-martins-low-cost-autonomous-attack-system-named/>.

60. Scharre, *Army of None*, 56.

61. Scharre, *Army of None*, 54.

62. Scharre, *Army of None*, 50.

63. Work, *Combat Employment*.

64. Paul Scharre, “Centaur Warfighting: The False Choice of Humans vs. Automation,” *Temple International & Comparative Law Journal* 30, no. 1 (Spring 2016): 152.

65. Pfaff et al., *Trusting AI*, 57.

66. Kobi Leins and Anja Kaspersen, “Seven Myths of Using the Term ‘Human on the Loop’: ‘Just What Do You Think You Are Doing, Dave?’” Carnegie Council for Ethics in International Affairs, November 9, 2021, <https://www.carnegiecouncil.org/media/article/7-myths-of-using-the-term-human-on-the-loop>.

67. Robert J. Sparrow and Adam Henschke, “Minotaurs, Not Centaurs: The Future of Manned-Unmanned Teaming,” *Parameters* 53, no. 1 (Spring 2023): 116, <https://press.armywarcollege.edu/parameters/vol53/iss1/14/>.

68. “Global Patriot,” Raytheon, n.d., accessed October 22, 2024, <https://www.rtx.com/raytheon/what-we-do/integrated-air-and-missile-defense/global-patriot-solutions>.

69. “Aegis,” Lockheed Martin, n.d., accessed January 8, 2025, <https://www.lockheedmartin.com/en-us/products/aegis-combat-system.html>.

70. Jovana Davidovic, “What’s Wrong with Wanting a ‘Human in the Loop’?,” *War on the Rocks*, June 23, 2022, <https://warontherocks.com/2022/06/whats-wrong-with-wanting-a-human-in-the-loop/>. This article describes the unique “doctrines” for Aegis Combat System employment, which the author contends allows commanders to translate their intent into the machine, emphasizing the importance of predeployment decisions.

71. The most prominent US air defense incidents are Iran Air flight 655—the flight of an Iranian passenger airliner that was shot down in 1988 during the Iran-Iraq War—and the shooting down of a British fighter jet in 2003 during the Iraq War.

72. The conversation regarding the diminishing capabilities of humans in technological warfare has been ongoing for decades. Originally published in 2001, see Thomas K. Adams, “Future Warfare and the Decline of Human Decisionmaking,” *Parameters* 41, no. 4 (Winter 2011–12): 1–15, <https://press.armywarcollege.edu/parameters/vol41/iss4/1/>.

73. David Hambling, "With Hammerhead Mine, U.S. Navy Plots New Style of Warfare to Tip Balance in South China Sea," *Forbes*, October 22, 2020, <https://www.forbes.com/sites/davidhambling/2020/10/22/us-navys-hammerhead-mine-aims-to-tip-balance-in-south-china-sea/>.
74. Scharre, *Army of None*, 50.
75. Hammes, "Reality in Autonomous Systems."
76. Work, *Combat Employment*.
77. Scott C. Truver, "Naval Mines and Mining: Innovating in the Face of Benign Neglect," Center for International Maritime Security, December 20, 2016, <https://cimsec.org/naval-mines-mining-innovating-face-benign-neglect/>.
78. Work, *Combat Employment*.
79. Hambling, "Hammerhead Mine."
80. Hammes, "Reality in Autonomous Systems."

About the Author

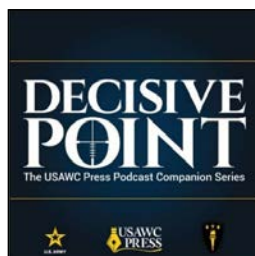
Major Brennan Deveraux is a US Army strategist serving as a national security researcher at the US Army War College Strategic Studies Institute. He has three defense-related master's degrees and focuses his research on military adaptation, emerging-technology management, and the characteristics of future warfare. Deveraux is the author of numerous books; his most recent book is the war memoir *Exterminating ISIS: Behind the Curtain of a Technological War* (Casemate Publishers, 2025).



The US Army War College Press supports the US Army War College by publishing monographs and a quarterly academic journal, *Parameters*, focused on geostrategic issues, national security, and Landpower. Press materials are distributed to key strategic leaders in the Army and the Department of Defense, the military educational system, Congress, the media, other think tanks and defense institutes, and major colleges and universities. The US Army War College Press serves as a bridge to the wider strategic community.

All US Army Strategic Studies Institute and US Army War College Press publications and podcasts may be downloaded free of charge from the US Army War College Press website. Hard copies of certain publications can also be obtained through the US Government Bookstore website at <https://bookstore.gpo.gov>. US Army Strategic Studies Institute and US Army War College publications may be quoted or reprinted in part or in full with permission and appropriate credit given to the US Army Strategic Studies Institute and the US Army War College Press, US Army War College, Carlisle, PA. Contact the US Army Strategic Studies Institute or the US Army War College Press by visiting the websites at: <https://ssi.armywarcollege.edu>, <https://press.armywarcollege.edu>, and <https://publications.armywarcollege.edu/USAWC-Press/>.

The US Army War College Press produces two podcast series. *Decisive Point*, the podcast companion series to the US Army War College Press, features authors discussing the research presented in their articles and publications. Visit the website at: <https://ssi.armywarcollege.edu/SSI-Media/Podcasts/Decisive-Point-Podcast/>. *Conversations on Strategy*, a *Decisive Point* podcast subseries, features distinguished authors and contributors who explore timely issues in national security affairs. Visit the website at: <https://ssi.armywarcollege.edu/SSI-Media/Podcasts/Conversations-on-Strategy/>.





UNITED STATES ARMY WAR COLLEGE

US ARMY WAR COLLEGE

Major General Trevor J. Bredenkamp
Commandant

STRATEGIC STUDIES INSTITUTE

**Director, Strategic Studies Institute and
US Army War College Press**
Dr. C. Anthony Pfaff

Director, China Landpower Studies Center
Colonel Michael B. Long

Director, Strategic Research and Analysis
Colonel Michael A. Shekleton

US ARMY WAR COLLEGE PRESS

Managing Editor
Ms. Lori K. Janning

Digital Media Manager
Mr. Richard K. Leach

Copy Editors
Ms. Stephanie Crider
Dr. Erin M. Forest

Visual Information Specialist
Ms. Kaitlyn Guettler

Composition
Mrs. Jennifer E. Nevil

<https://press.armywarcollege.edu>



U.S. ARMY

ISBN 1-58487-873-8



9 781584 878735