

# REPORT DOCUMENTATION PAGE

*Form Approved*  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

<b>1. REPORT DATE</b> (DD-MM-YYYY) <b>14-02-2005</b>		<b>2. REPORT TYPE</b> <p style="text-align: center;">FINAL</p>		<b>3. DATES COVERED</b> (From - To)	
<b>4. TITLE AND SUBTITLE</b> <b>Lethal Autonomous Weapons – Ethical and Doctrinal Implications</b>				<b>5a. CONTRACT NUMBER</b>	
				<b>5b. GRANT NUMBER</b>	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
<b>6. AUTHOR(S)</b>  <b>Guetlein, Michael A., Major, United States Air Force</b>  Paper Advisor (if Any): <b>Grassey, Thomas, Professor, Naval War College</b>				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
				<b>5f. WORK UNIT NUMBER</b>	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b>  Joint Military Operations Department Naval War College 686 Cushing Road Newport, RI 02841-1207				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>	
<b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b>				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b>	
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>	
<b>12. DISTRIBUTION / AVAILABILITY STATEMENT</b> Distribution Statement A: Approved for public release; Distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b> A paper submitted to the faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.					
<b>14. ABSTRACT</b>  <b>The use of unmanned autonomous weapons (robots and other unmanned weapon systems) on the battlefield is rapidly expanding. Autonomous weapons will influence the way the United States wages battles in the future. They are the springboard for a transformation that will eventually result in a Revolution in Military Affairs. However, there is a reluctance to arm them, which would exploit their full potential. Critics often cite the legal and ethical dimensions of fighting battles and killing humans with machines. The United States should begin capitalizing on the benefits autonomous weapons bring to the fight and should be preemptive in establishing joint war fighting doctrine and shaping international policy. This paper explores some of the operational benefits of autonomous weapons and the ethical and social barriers of fighting a war with autonomous weapons.</b>					
<b>15. SUBJECT TERMS</b> <b>Autonomous Weapon, Autonomous Warfare, Unmanned Weapon, Unmanned Vehicle, Robot, Ethics, Joint Vision 2020</b>					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>	<b>18. NUMBER OF PAGES</b>  <b>35</b>	<b>19a. NAME OF RESPONSIBLE PERSON</b> Chairman, JMO Dept
<b>a. REPORT</b> UNCLASSIFIED	<b>b. ABSTRACT</b> UNCLASSIFIED	<b>c. THIS PAGE</b> UNCLASSIFIED			<b>19b. TELEPHONE NUMBER</b> (include area code)  401-841-3556

**NAVAL WAR COLLEGE  
Newport, RI**

**LETHAL AUTONOMOUS WEAPONS — ETHICAL AND DOCTRINAL  
IMPLICATIONS**

By

Major Mike Guetlein  
Major, United States Air Force

A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: \_\_\_\_\_  
14 Feb 05

---

Thomas Grasse  
Professor of Leadership and Ethics  
Naval War College

## **Abstract**

The use of unmanned autonomous weapons (robots and other unmanned weapon systems) on the battlefield is rapidly expanding. Autonomous weapons will influence the way the United States wages battles in the future. They are the springboard for a transformation that will eventually result in a Revolution in Military Affairs. However, there is a reluctance to arm them, which would exploit their full potential. Critics often cite the legal and ethical dimensions of fighting battles and killing humans with machines. The United States should begin capitalizing on the benefits autonomous weapons bring to the fight and should be preemptive in establishing joint war fighting doctrine and shaping international policy. This paper explores some of the operational benefits of autonomous weapons and the ethical and social barriers of fighting a war with autonomous weapons.

# Table of Contents

<b>Table of Contents .....</b>	<b>i</b>
<b>Introduction .....</b>	<b>1</b>
<b>Autonomous Weapons Defined .....</b>	<b>2</b>
<b>Operational Utility of Autonomous Weapons.....</b>	<b>2</b>
<b>Application to Joint Vision 2020.....</b>	<b>3</b>
<b>Precision Engagement.....</b>	<b>4</b>
<b>Information Superiority.....</b>	<b>5</b>
<b>Command and Control.....</b>	<b>7</b>
<b>Barriers to the Use of Autonomous Weapons.....</b>	<b>8</b>
<b>Legal Framework .....</b>	<b>8</b>
<b>Ethical Guidelines.....</b>	<b>9</b>
<b>Law of Armed Conflict .....</b>	<b>9</b>
<b>Social Implications.....</b>	<b>12</b>
<b>Conclusions/Recommendations .....</b>	<b>14</b>
<b>Bibliography.....</b>	<b>23</b>

## Introduction

*We're entering an era in which unmanned vehicles of all kinds will take on greater importance—in space, on land, in the air, and at sea.*

*President George W. Bush, Citadel speech, 11 December 2001<sup>1</sup>*

The use of unmanned autonomous weapons (robots and other unmanned weapon systems) on the battlefield is rapidly expanding. “It’s going to change the fundamental equation of war. First, you had human beings without machines. Then you had human beings with machines. And finally you have machines without human beings.”<sup>2</sup> Autonomous weapons will influence the way the United States wages battles in the future. The United States should begin capitalizing on the benefits autonomous weapons bring to the fight and should be preemptive in establishing joint war fighting doctrine and shaping international policy.

“Decades of advances in robotics are making their way from the drawing board to the battlefield. Long considered too dumb, too flimsy and too experimental to be of much practical use, military robots are beginning to take on tasks deemed too dangerous or uncomfortable for flesh-and-blood soldiers.”<sup>3</sup> They are the springboard for a transformation that will eventually result in a Revolution in Military Affairs within the next two decades consisting of full spectrum dominance through information superiority and a cultural shift away from requiring dual target identification by a man-in-the-loop prior to target engagement. However, there is a reluctance to arm them, which would exploit their full potential by allowing them to autonomously seek out and destroy targets. Critics often cite the legal and ethical dimensions of fighting battles and killing humans with machines. This paper explores some of the operational benefits of autonomous weapons and the ethical and social barriers of fighting a war with autonomous weapons. This paper will not explore the current state of technology, but will assume the United States currently possesses at least a minimum capability of fielding autonomous weapons.

## **Autonomous Weapons Defined**

The Oxford Dictionary defines autonomous as “self-governing or independent,”<sup>4</sup> whereas the Merriam-Webster dictionary defines it as “existing or capable of existing independently” and “responding, reacting, or developing independently of the whole.”<sup>5</sup> For the purposes of this paper, I am defining autonomous weapons (AW) as weapons capable of accomplishing a mission with limited or no human intervention. These systems are capable of self-propulsion, independent processing of the environment, and independent response to the environment.

AW range from semi-autonomous to fully autonomous depending on the degree of involvement by a man-in-the-loop (MITL). In addition, they vary in lethality. Some AW operate fully autonomously in a non-lethal manner, such as surveillance and reconnaissance platforms. These systems do not possess the capability to engage targets without the consent or control of a man-in-the-loop. Future AW designs will be able to operate and lethally engage targets autonomously without a MITL. Examples include the Navy’s Unmanned Underwater Vehicle’s (UUV)<sup>6</sup> capability of autonomous underwater de-mining; the Air Force’s Unmanned Combat Aerial Vehicle (UCAV)<sup>7</sup> and Autonomous Wide Area Search Munition (AWASM);<sup>8</sup> the Army’s Future Combat System (FCS);<sup>9</sup> and the Marine Corps Gladiator.<sup>10</sup>

## **Operational Utility of Autonomous Weapons**

There are numerous advantages of AW. They have the potential of being the “faster, better, cheaper” systems of the future. Depending on the level of artificial intelligence, unmanned systems are one-third the cost of manned platforms and cost two-thirds as much to operate.<sup>11</sup> Designs are not constrained by the incorporation of life support systems, which frees up critical space and weight allowing for smaller and stealthier systems. Range, endurance, and persistence can be increased and the logistics footprint can be minimized. In addition, advanced computer processing can reduce the

decision cycle time and increase weapons accuracy. They are more versatile and can operate in environments where humans cannot, such as high threat, nuclear, chemical, or biological environments. Finally, AW can be more flexible by offering a commodity approach to mission management.<sup>12</sup> Communications, sensors, and weapons suites can be rapidly removed and replaced to meet mission requirements.

### **Application to Joint Vision 2020**

*One of the most unconventional aspects of the U.S. war in Afghanistan is that the commander usually has been on the other side of the planet. – General Franks<sup>13</sup>*

*Our information and our ability to see the battlefield as a result of things like the Predator (unmanned reconnaissance aircraft) and the communications off the battlefield have radically changed everything we know. The result is that Franks can sit in his headquarters in Tampa and watch on screens things you could not have seen 10 years ago by actually being on the ground.  
– A Senate aide involved in military affairs<sup>14</sup>*

Today's battles occur at an increasingly faster tempo and consist of numerous simultaneous attacks spread across a wider battlespace. In addition, today's forces are more technologically advanced and possess unprecedented levels of lethality and integration. The commander must be able to exploit technology in new and innovative ways in order to manage the complexity inherent in future wars.

Joint Vision 2020 (JV 2020) recognizes the changing dimensions of warfare and provides a roadmap for the transformation of America's military in order to make it "faster, more lethal, and more precise," through the investment and development of new capabilities.<sup>15</sup> JV 2020 focuses on achieving full spectrum dominance through the operational concepts of dominant maneuver, precision engagement, focused logistics, and full dimension protection.<sup>16</sup> In order to meld the operational concepts into full spectrum dominance, the commander must achieve information superiority and possess superior command and control. While AW can be an enabler in all four operational concepts, they can really make an impact in precision engagement and contribute to information superiority.

However, in order to maximize their full potential, the commander needs superior command and control mechanisms.

### **Precision Engagement**

*Precision Engagement is the ability of joint forces to locate, surveil, discern, and track objectives or targets; select, organize, and use the correct systems; generate desired effects; assess results; and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations. – JV 2020<sup>17</sup>*

Joint doctrine is built on the classical principles of war as developed by theorists like Clausewitz and Sun Tzu. It attempts to confuse and overwhelm the enemy through simultaneous attacks on multiple decisive points. United States war fighting doctrine relies heavily on the integration and synchronization of our joint forces. Through Network Centric Warfare,<sup>18</sup> the operational commander is able to integrate numerous stand-alone entities into a common network. However, the United States' insistence on "eyes on target" and dual target identification fails to exploit the full capability AW bring to the fight.

AW provide the capability to reduce the kill chain (find, fix, track, target, engage, assess) from hours to minutes and ultimately from minutes to seconds. They facilitate this reduction in four key areas. First, they can be pre-positioned across the globe or pre-packaged for rapid global mobility without the large logistics footprints required by current manned weapon systems. Second, they are not mission specific. They can be deployed in support of regional conflicts, peacekeeping, peace enforcement, or other military-operations-other-than-war (MOOTW). They are very versatile and can accommodate numerous intelligence, surveillance, and reconnaissance (ISR) payloads, which can be integrated or rapidly interchanged, using a commodity approach, depending on mission requirements. Through the synergistic application of sensors, information systems, and weapons technology, AW can be a stand-alone weapon system.



Third, they are persistent. AW can stay on station for extended periods in all types of conditions. Fuel efficiency, combined with stealth technology and the latest electronic warfare capability, make the weapon system almost invisible to the enemy. Persistence allows the continuous monitoring of the battlefield and enables all links in the kill chain.

Fourth, AW are capable of precision strike. They can be equipped with the latest in precision guided munitions and can rapidly engage a target in multiple scenarios. In addition, target planners spend countless hours performing “elaborate evaluations of the blast effects on the kind of buildings found near the weapon’s estimated impact point. The results are interpolated with known population distributions to make casualty projections.”<sup>19</sup> These calculations are far too complex for the warfighter to make in real time. AW could perform hundreds of these same calculations in real time, increasing the lethality of the engagement while simultaneously reducing the probability of collateral damage.

### **Information Superiority**

*Information superiority – the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary’s ability to do the same. (JP1-02) Information superiority is achieved in a noncombat situation or one in which there are no clearly defined adversaries when friendly forces have the information necessary to achieve operational objectives. – JV 2020<sup>20</sup>*

In order to effectively couple precision engagement with dominant maneuver, focused logistics, and full dimension protection, the commander needs to achieve information superiority. AW can provide commanders with a real time perspective of the battlefield from numerous independent locations. Unmanned weapon systems are rapidly becoming a key enabler of Network Centric Warfare. The military plans to invest \$200 billion over the next 25 years into UCAVs alone.<sup>21</sup> Over the next 25 years, the military will continue to migrate away from platform centric warfare to asymmetric warfare, where multiple weapon systems will be integrated into a harmonized environment providing the war fighter with a superior understanding of the battlespace and reducing the fog of war.

This real time access to information has its pros and cons. First, the increase in information will significantly enhance the commander's common operational picture (COP) and reduce the fog of war. Commanders will be presented with this data in real time and will be able to respond faster to changing conditions on the battlefield. However, the warfighter is already inundated with too much information and may not be able to process all the information provided by these systems. Second, the high demand for high-resolution data, coupled with the increased demand for bandwidth by emerging weapon systems, is draining available communications bandwidth. In Operation Enduring freedom, 60 percent of the military bandwidth was provided by commercial sources.<sup>22</sup> AW reduce the bandwidth requirements because they do not rely on a constant control link with MITL. Third, AW offer the capability for post mortem analysis by keeping a detailed record of the decision logic that led to an engagement, a detailed transcript of the engagement, and a detailed battle damage assessment after the engagement. A major tenet of warfare is accountability. AW offer a clear record of accountability. Unfortunately, real time communications allow the data to be beamed instantaneously to parties not normally involved in the business of waging war. We may find ourselves in more battles similar to Vietnam where politicians choose the targets. In addition, the detailed accounting of engagements also allows for more "Monday morning quarterbacking" from critics.

The business of collecting, communicating, and processing information will become its own dimension of warfare. Information systems combined with rapid decision support tools integrated onto a single platform are already driving a revolution in military affairs (RMA). Unmanned systems are cost-effective platforms for integrating these systems and are a means of rapidly transitioning new technology to the battlefield. They serve as independent platforms capable of integrating multiple sensors, data processors, and weapons into a single unmanned weapon system with a total capability greater than the sum of its individual systems.

## Command and Control

*Command and control – the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. (JP1-02) – JV 2020<sup>2,3</sup>*

Information superiority does not guarantee decision superiority. AW will need to be interoperable with existing weapon systems and governed by common doctrine and superior command and control. “Sound command and control should ensure unity of effort, provide for centralized direction and decentralized execution, provide an environment for applying common doctrine, and ensure interoperability.”<sup>24</sup>

Joint Doctrine is structured around unity of effort through centralized direction and decentralized execution. AW will be capable of Network Centric Warfare, which is envisioned to facilitate unity of effort and decentralized execution. AW can be networked with other manned and unmanned systems, which will allow for information sharing and increased situational awareness. “Shared situational awareness enables collaboration and self-synchronization and enhances sustainability and speed of command.”<sup>25</sup> Recent operations have demonstrated an increase in situational awareness with the commander’s ability to observe and influence operations from thousands of miles away. However, while this increases the commander’s situational awareness, the trend has been towards over centralized decision-making at the operational and strategic levels and reduced effectiveness at the tactical levels.<sup>26</sup>

Joint Doctrine emphasizes unity of effort across the full spectrum of operations. Unity of effort is achieved through sound command and control mechanisms, which include integration and synchronization of manned and unmanned forces. Eventually, manned and unmanned weapon systems will fight side by side. Until AW gain the trust of the commander, the battlespace will have to be

subdivided into manned and unmanned operating areas. In addition, the military has a strong history and culture of requiring MITL and demanding accountability. As the complexity of war continues to increase, the MITL will start to be the weakest link in the kill chain. Eventually, the operational commander will be forced to allow AW to operate without a MITL. Before this happens, Joint doctrine needs to develop the ROE and the joint tactics techniques, and procedures (TTP) necessary to allow manned and unmanned systems to co-operate throughout the battlespace.

AW can be a significant force multiplier; however, there are potential legal, ethical, and social barriers to their use. Critics contend the use of machines to kill people is unethical, socially unacceptable, and should be illegal. The rest of this paper will explore these arguments.

## **Barriers to the Use of Autonomous Weapons**

### **Legal Framework**

Nations are constrained in the way they wage war by international law, the treaties they are a signatory to, and other legal devices. Examples include Protocol II to the 1980 Conventional Weapons Treaty, which “bans the indiscriminate use of mines, and requires the marking of minefields and their post-hostilities removal so as to limit noncombatant casualties”;<sup>27</sup> and the Ottawa Treaty of 1998, which prohibits the production, stockpiling, transfer, and use of antipersonnel mines.<sup>28</sup> These two laws in particular are mentioned because critics often draw parallels between anti-personnel mines and AW. New laws are continually surfacing that could affect the employment of AW. It is not the purpose of this paper to explore all the dimensions of the law or argue the legality of AW. However, this paper assumes the development of AW will be in accordance with Article 36 of the 1977 Additional Protocol I to the Geneva Conventions of 1949.<sup>29</sup> Article 36 obligates a nation to assess the legality of all “new weapons, methods or means of warfare.”<sup>30</sup>

International law is built upon a set generally accepted moral and ethical principles that govern the way we fight. If AW pass the litmus test of these ethical guidelines, then this author argues AW should be an acceptable form of warfare.

### **Ethical Guidelines**

“The subject of ethics is about moral choices, about the values that underpin these choices, the reasoning behind them, and the language used to describe moral decisions.”<sup>31</sup> The ethical dimensions of AW are straightforward and deal with the killing of humans by machines.

Just War Theory is the ethical reflection of war. Throughout time, societies have attempted to humanize war and make it morally acceptable. Just War Theory deals with “why” nations go to war, and “how” nations fight wars. From the Just War Theory, theorists distinguish between the rules that govern the rationale for war (*jus ad bellum*) and those that govern just and fair conduct in war (*jus in bello*). The two are not mutually exclusive, but are a set of moral principles for waging war. The difficulty for the operational commander is adhering to these principles in war. The principles of *jus ad bellum* are having just cause, being declared by a proper authority, possessing the right intention, having a reasonable chance of success, and the ends being proportional to the means used. The principles of *jus in bello* fall under the principles of discrimination, proportionality, and responsibility. For the purpose of this paper, I am assuming the litmus test of *jus ad bellum*, or “why” nations go to war, has already been met. The AW debate focuses on the principles of *jus in bello*, or “how” wars are fought. The principles of *jus in bello* have been codified in the Law of Armed Conflict.

### **Law of Armed Conflict**

The Law of Armed Conflict (LOAC) is that subset of international law addressing generally accepted practices for waging a “Just” or humane war.<sup>32</sup> The foundation of LOAC is a set of moral

standards generally accepted by the international community. This paper focuses on the three main principles of LOAC: military necessity, proportionality, and discrimination.<sup>33</sup>

Military necessity is “the principle which justifies measures of regulated force not forbidden by international law which are indispensable for securing the prompt submission of the enemy, with the least possible expenditures of economic and human resources.”<sup>34</sup> Military necessity prevents the use of weapons which cause excessive damage or suffering in excess of the benefits being gained.<sup>35</sup>

The principle of proportionality states “the loss of life and damage to property incidental to attacks must not be excessive in relation to the concrete and direct military advantage expected to be gained.” The law of proportionality requires the military advantage be weighed against the potential for collateral damage. The military benefits gained must exceed the probability of collateral damage. Attacks cannot be indiscriminate and must limit the amount of collateral damage “in relation to the concrete and direct military advantage anticipated.”<sup>36</sup>

The principle of discrimination or distinction requires the attack to be focused on the military objective and prohibits indiscriminate attacks against non-military objectives. For example, the principle prohibits “carpet bombing” of entire cities and requires an attack be capable of discriminating between military and civilian targets. However, discrimination does not prohibit damage to non-military targets, but the effects must not exceed the military advantage gained from the attack.

A nation that fights a war unjustly undermines the legitimacy of the cause and (in a democracy) jeopardizes public support for the effort. In addition, there is the threat the struggle will escalate into inhumane dimensions, therefore increasing the suffering of non-combatants as well as combatants. To counter this threat, “command authorities issue [Rules of Engagement] (ROE) that describe the circumstances and limitations under which we can start or continue military operations. You will find ROE incorporated in almost every operations plan and operational order. Commanders use ROE to

ensure operations follow national policy goals, mission requirements, and the rule of law. . . . In armed conflict, the LOAC and ROE [are] specifically tailored for each mission or area of responsibility [and] provide guidance on the use of force. . . . Failure to comply with the ROEs may be punishable under the Uniform Code of Military Justice.”<sup>37</sup>

AW can preserve the legitimacy of the cause because the use of force is constrained by a rigid set of heuristics preprogrammed to comply with the ROEs and the LOAC. AW can better discriminate targets and calculate the impacts of an engagement in real time to insure the impact is proportional to the military advantage gained. Emotions and adrenaline cease to affect the decision to engage. Instead, the decision becomes one of probabilities. If the probability of success is low, or the probability of excessive collateral damage is high, then the weapon system will not engage. Instead, the system can be preprogrammed to ask “mother-may-I” prior to engaging the objective. The thresholds for these probabilities will be predetermined by the operational commander based on the operating environment. For example, aUCAV can be programmed to destroy any vehicle matching the heuristics of a tank. If theUCAV is flying over a heavily populated center, then the commander may constrain the attack to a high probability of target recognition and low collateral damage. If the sameUCAV is flying over the open desert known to be unpopulated by civilians or friendly forces, then the commander may lower the probability thresholds.

Due to AW logic constraints, it can be easily argued that autonomous weapons will be more proportional. However, discrimination is highly dependent on technology and how the weapons are employed. The issue centers around one of probabilities. Without probabilities, AW lose the ability to discriminate. If the probability of correct identification is set too high, then the enemy will be at an advantage. If the probability is set too low, then the AW will make mistakes and engage the wrong targets. The potential is there, but the

ultimate responsibility will lie with the military and the methods in which the operational commanders choose to employ AW. These decisions will be based on warfighting doctrine and the rules of engagement. Both of these already incorporate the legal, moral, and ethical constraints of waging a “Just War.”

### **Social Implications**

*I do not think you will ever witness a nation that has worked so hard to avoid civilian casualties as the United States has. – Ari Fleischer, with respect to Operation Enduring Freedom<sup>38</sup>*

Allowing machines to independently target, engage, and kill humans will likely provoke public concerns that fall outside the legal and ethical dimensions of warfare and deal more with the humanity of warfare. Opponents argue AW remove humanity from the equation of war.

The advance of technology and America’s low tolerance for casualties is rapidly moving the trigger puller further and further away from the battlefield. AW exacerbate the situation. With AW, the trigger puller is a machine. Machines do not have the capacity for the military ethos of chivalry (courage, justice, mercy, generosity, faith, nobility, and hope).<sup>39</sup> They make determinations based on impassive logic functions. A machine is incapable of feeling the emotions of compassion, anger, or courage; or conducting a virtuous war for duty, honor, or country. The further the soldier gets from the fight, the less a psychological impact the fight has. Soldiers may be in jeopardy of losing sight of the horrors of war.

Clausewitz contended “war is a mere continuation of policy by other means” and the soldier is a tool of the state. The soldier makes a conscious decision that he is willing to risk his life for his nation. A soldier possesses the cognitive ability to wage war in a humane manner guided by deepest value of human life and learned social norms. There is a certain benevolence associated with soldiers going to war for their country. Not so with machines. Machines are incapable of emotion and are governed by a



complex set of equations. Tomorrows' battles risk being won through technological superiority alone, without regard to humanity.

Opponents argue that technology makes war more likely and increases the lethality to epic proportions. As the warrior continues to be further moved out of harm's way, wars may become more likely because it becomes easier and more politically palatable for the state to wage war. A state's willingness to sacrifice human lives in the pursuit of political goals shows resolve and commitment to the cause. The decision to go to war is a critical one that should not be taken lightly by a nation. If the politician, the citizen, and the soldier are removed from the horrors of war, then there is a real threat of war losing its awful appeal and we may find ourselves involved in more battles instead of less. In addition, we may lose our ability to influence other nations if they perceive the United States is unwilling to commit human lives and intends to fight our battles with technology alone.

Finally, opponents argue, "eyes on target" are required to prevent mistakes. When something goes wrong, society wants to know who is responsible. In the military, responsibility always falls to the commander. Standing ROEs put the burden on the commander. AW blur the lines of responsibility. Who is responsible when an AW inadvertently makes a mistake? Is it the commander who ordered the deployment of AW, the soldier who deployed the weapon, or the software programmer who wrote the logic code? Society is intolerant of mistakes and these issues will need to be resolved.

Proponents of AW argue society has an obligation to exploit technology in order to reduce the horrors of war. The "use it if you got it" approach argues that warfare is such a horrible affair and we should strive to wage it in the least bloody manner possible. AW reduce the number of troops placed in harm's way and they reduce collateral damage. In addition, as argued above, AW can be more discriminate and proportionate than manned systems.

A captured, wounded, or dead soldier is a political liability. The “CNN factor” alone is enough to deplete the popular support for the mission.<sup>40</sup> CNN’s graphic footage of noncombatants (civilians and contractors) being beheaded by Iraqi insurgents; of American soldiers coming home in body bags; or of U.S. Marines shooting wounded Iraqis in order to neutralize the threat of being bushwhacked; all had a repulsive effect on the worldwide audience and continue to erode political will in support of the war in Iraq. To counter this liability, the United States is relying on technology to move the American soldier further and further from the fight. Technology continues to reduce collateral damage and reduce the number of friendly forces placed in “harm’s way.” The more successful we are, the more the public begins to expect and demand wars with zero friendly casualties and limited collateral damage.

Finally, proponents argue if we do not exploit technology, someone else will. It is just a matter of time until other nations possess the capability to produce AW. Nuclear weapons are a great example of how nations will stop at nothing to gain a perceived technological advantage. They are also a great example of how society will adapt to technology and trust the operational commander to make the right choices in the employment of technology.

### **Conclusions/Recommendations**

*“Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur” — Giulio Douhet*

Science fiction writers have always been drawn towards killing machines. In a 1965 Star Trek episode, Captain Kirk encounters a world where war is waged by computers and probabilities. The worlds of Eminiar VII and Vendikar have been at war for over 500 years. The two planets have learned to avoid the horrors of war by the use of computers. When computers score a “hit,” casualty estimations are made, and people are ordered to the disintegration chambers to be atomized. Captain

Kirk is appalled by the cold scientific approach to warfare. *They have made this war too easy and until they experience the horrors of war, there will never be any incentive to make peace.*

As the United States continues to draw down its force while simultaneously increasing the operational tempo, it will be forced to pursue more and more high technology solutions that allow the military to do more with less. The military is continually seeking to replace manpower with high technology solutions such as AW. AW may offer the solution to waging “zero casualty” warfare. As the United States pursues more and more unmanned weapons systems and incorporates increasing intelligence into these systems, it will inch closer and closer to waging war without human intervention.

The potential advantages of AW are numerous. They will be “faster, better, and cheaper” than manned systems. They offer increased range, endurance, and persistence while keeping the warfighter out of harms way. They reduce the military’s operational tempo because fewer troops are required to deploy to the theater of operations. They are versatile and can be adapted to fit a wide array of missions. In addition, they offer the commander a means of overwhelming the enemy with asymmetrical effects.

Today’s commander is constantly seeking the holy grail of full spectrum dominance and information superiority. Technology is the key enabler, and the operational commander of tomorrow will need to know how to exploit those technological capabilities. Human reasoning is too slow for tomorrow’s fast-paced Network Centric Warfare. The commander will continue to be inundated with more information than can be comprehended. “Eventually the man-in-the-loop will be the weakest part of the weapon system.”<sup>41</sup> In addition, as the military continues to field more and more unmanned systems, the communications bandwidth requirements will continue to exceed capacity. By removing MITL, the capabilities of AW can be maximized and the overall bandwidth requirements reduced.

The operational commander will need to decide when to employ AW, the level of autonomy, the lethality, and the amount of MITL oversight. The determination will be made based on a proven

track record of AW, the probabilities of successful engagements of the correct targets, and the commander's application of the operational art of war. For example, AW would not be the preferred weapon against dual-use targets where the target has both a military and a civilian use. In order to engage these targets, the warfighter has to make the complicated determination if the military value of the target far outweighs the potential for collateral damage.

Currently, the United States Air Force (USAF) is leading the way in AW with UAVs. However, "USAF doctrine currently does not allow for autonomous delivery."<sup>42</sup> Joint doctrine is based on unity of effort through centralized direction and decentralized execution. Joint doctrine needs to embrace the capabilities AW bring to the fight. We need doctrine that recognizes the inherent capabilities of AW, allows for decentralized execution, and resists the current trend toward over centralizing command at the highest levels.

We are still a long way from the ability to wage "zero casualty" warfare. No matter how sophisticated AW get, they will never be able to accomplish every mission, and we will eventually be forced to commit human beings to the fight. Even if AW evolved to a state of perfection and nation-states were able to wage wars by machines alone, eventually the AW assets will be depleted without the goals of the nation-state having been met. When this happens, nation-states will be forced to return to sacrificing human lives in pursuit of their objectives.

As Clausewitz and Sun Tzu have repeatedly pointed out, warfare is an art and not a science reducible to the sterile algorithms of ones and zeros. No matter how sophisticated our weapon systems get, the fog of war will always be present and the operational commander will be required to exercise human intellect to wage war. The enemy will continue to adapt and overcome our capabilities in new and imaginative ways. As we are seeing in Iraq today, "intimate knowledge of the enemy's motivation,

intent, will, tactical method, and cultural environment” are far more important for success than high technology weapons.<sup>43</sup>

The decision to develop AW will be one of policy. The intellectual discussions surrounding the legal, ethical, and social implications of AW are lagging. The ethical concerns appear straightforward and can be dealt with through rules of engagement that comply with the Just War Theory and the LOAC. The legal barriers may prove more difficult. To date, there are no international laws banning the use of AW in war. However, laws may surface which could be detrimental to AW. For example, the international community could take a position on AW that is similar to the one taken on land mines. There is no end to the number of organizations seeking to control emerging technology in war. The United States needs to step up to the plate and control the discussions. If the United States is not preemptive, laws will be created that may constrain technological capabilities.

As technology matures, fears and social barriers should diminish through “social conditioning.” Society is likely to welcome some aspects of AW. We have become intolerant of human casualties and collateral damage and tend to embrace technology that alleviates our concerns. Public opinion seems to approve of aerial and naval AW as demonstrated by its acceptance of UAVs, cruise missiles, and torpedoes. All of these are already forms of semi-autonomous weapons. Removing MITL altogether could be seen as the next step in the evolutionary development of weapons. We are rapidly approaching fully AW in the air with armed UAVs. The next generation UAVs and UUVs will be capable of autonomous warfare. It is only a matter of time until AW technology is available for land warfare. Will society be as willing to accept AW in land warfare where machine and man fight hand-in-hand, or will autonomous land warfare be considered inhumane? The United States needs to engage in these issues.

The United States should pursue the exploitation of AW in an evolutionary fashion. Over time, AW will gain the trust of the commander and the level of MITL will progressively diminish. Until then, the United States should open discussions surrounding the legal, ethical, and social implications of AW. The intellectual discussions need to occur, the doctrine tested in battle labs and war games; and the tactics, techniques, and procedures (TTP) need to be written.<sup>44</sup> It is not a matter of “will” we employ AW; it is a matter of “when” we employ them. As AW gain the trust of the commander, they will proliferate in every aspect of warfare.

---

## Notes

<sup>1</sup> "U.S. President George W. Bush Addresses the Corps of Cadets," The Citadel, 11 December 2001, <<http://citadel.edu/pao/addresses/presbush01.html>> [13 February 2005].

<sup>2</sup> Reed, Fred. "Robotic Warfare Drawing Nearer," Washington Times, 10 February 2005, p. C7. Quote made by John Pike from GlobalSecurity.org, an organization based in Washington D.C. that focuses on innovative approaches to emerging security challenges.

<sup>3</sup> Herper, Mathew. "Robots of War," Forbes.com - Forbes Magazine, 7 February 2005.

<[http://www.forbes.com/technology/2005/02/07/cx\\_mh\\_0207robots.html](http://www.forbes.com/technology/2005/02/07/cx_mh_0207robots.html)> [13 February 2005], Examples of current robots used on the battlefield can be found at

<[http://www.forbes.com/finance/2005/02/04/cx\\_mh\\_0207robotsslide.html?thisSpeed=25000',800,700](http://www.forbes.com/finance/2005/02/04/cx_mh_0207robotsslide.html?thisSpeed=25000',800,700)> [13 February 2005].

<sup>4</sup> "Compact Oxford English Dictionary, Autonomous," AskOxford.com.

<[http://www.askoxford.com/concise\\_oed/autonomous?view=uk](http://www.askoxford.com/concise_oed/autonomous?view=uk)> [13 February 2005].

<sup>5</sup> "Merriam-Webster Online Dictionary, Autonomous," Merriam Webster Online, <<http://www.m-w.com>> [13 February 2005].

<sup>6</sup> United States Navy, The Navy Unmanned Undersea Vehicle (UUV) Master Plan, 27 March 2001

<<http://www.auvsi.org/resources/UUVMPPubRelease.pdf>> [13 February 2005]. p. ES-1, "An Unmanned Undersea Vehicle [UUV] is defined as a self-propelled submersible whose operation is either fully autonomous (pre-programmed or real-time adaptive mission control) or under minimal supervisory control and is untethered except for data links such as a fiber optic cable."

<sup>7</sup> Clark, Rickard M., "Uninhabited Combat Aerial Vehicles, Airpower by the People, For the People, But Not with the People," U.S. Air University, Maxwell AFB, AL: Air University Press, 2000. (UG 1242.D7 C53 2000) pp. 3-4, Unmanned Combat Aerial Vehicle (UCAV) is "a self-propelled aircraft that sustains flight through aerodynamic lift. It is designed to be returned and reused, and it does not have a human on board." UCAVs are UAVs capable of autonomous lethal action.

<sup>8</sup> Autonomous Wide-Area Search Munition (AWASM) is a small powered autonomous missile launched from an aircraft. The missile carries a laser-radar seeker and flies autonomously (for almost an hour) over the target area scanning for a preprogrammed target. Once it finds the target, the system destroys it.

<sup>9</sup> Karp, Jonathan. "Smarter People, Weapons and Networks," Wall Street Journal, 31 January 2005, p. R7. The Army's Future Combat System (FCS) "comprises an array of unmanned vehicles, robotic sensors and a wireless communications network to give troops greater battlefield awareness and speed."

<sup>10</sup> The Gladiator Tactical Unmanned Ground Vehicle (TUGV) is a "tele-operated/semi-autonomous ground vehicle for remote reconnaissance, surveillance and target acquisition, as well as nuclear, biological and chemical reconnaissance obstacle breaching and firing capabilities."

[http://www.missilesandfirecontrol.com/our\\_products/groundvehiclesystems/TUGV/product-TUGV.html](http://www.missilesandfirecontrol.com/our_products/groundvehiclesystems/TUGV/product-TUGV.html) [13 February 2005].

<sup>11</sup> Holmes, Stanley. "Planes That Know What to Bomb: Smart Robotic Jet Fighters May be Delivered by 2008," Business Week, 12 November 2001, Iss. 3757, pp. 91-94.

<sup>12</sup> Huber, Arthur F. "Death by A Thousand Cuts, Micro-Air Vehicles in the Service of Air Force Missions," U.S. Air University, Maxwell Air Force Base, AL: Air University Press, 2002. (UG 1242.D7 H83 2002)

<sup>13</sup> Picks, Thomas E. Picks "A War That's Commanded at a Distance," Washington Post, 27 December 2001, p.

16

<sup>14</sup> Ibid. 16.

<sup>15</sup> Joint Chiefs of Staff, Joint Vision 2020, U.S. Government Printing Office, Washington D.C., June 2000, <<http://www.dtic.mil/jointvision/jvpub2.htm>> [13 February 2005].

<sup>16</sup> Ibid. 20-27. Below are the definitions directly out of JV 2020:

Dominant Maneuver is the ability of joint forces to gain positional advantage with decisive speed and overwhelming operational tempo in the achievement of assigned military tasks. Widely dispersed joint air, land, sea, amphibious, special operations and space forces, capable of scaling and massing force or forces and the effects of fires as required for either combat or noncombat operations, will secure

---

advantage across the range of military operations through the application of information, deception, engagement, mobility and counter-mobility capabilities.

Precision Engagement is the ability of joint forces to locate, surveil, discern, and track objectives or targets; select, organize, and use the correct systems; generate desired effects; assess results; and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations.

Focused Logistics is the ability to provide the joint force the right personnel, equipment, and supplies in the right place, at the right time, and in the right quantity, across the full range of military operations. This will be made possible through a real-time, web-based information system providing total asset visibility as part of a common relevant operational picture, effectively linking the operator and logistician across Services and support agencies. Through transformational innovations to organizations and processes, focused logistics will provide the joint warfighter with support for all functions.

Full Dimensional Protection is the ability of the joint force to protect its personnel and other assets required to decisively execute assigned tasks. Full dimensional protection is achieved through the tailored selection and application of multilayered active and passive measures, within the domains of air, land, sea, space, and information across the range of military operations with an acceptable level of risk.

<sup>17</sup> Ibid. 22

<sup>18</sup> Department of Defense. Report to Congress, Network Centric Warfare, April 2002, <<http://www.dod.mil/nii/NCW/>> [13 February 2005]. Network Centric Warfare “represents a powerful set of warfighting concepts and associated military capabilities that allow warfighters to take full advantage of all available information and bring all available assets to bear in a rapid and flexible manner. The tenets of NCW are: A robustly networked force improves information sharing, information sharing enhances the quality of information and shared situational awareness, shared situational awareness enables collaboration and self-synchronization, and enhances sustainability and speed of command, these, in turn, dramatically increase mission effectiveness.”

<sup>19</sup> Dunlap, Charles J. Colonel, USAF, "Law and Military Interventions: Preserving Humanitarian Values in 21st Century Conflicts," Harvard University, Kennedy School of Government, Washington, D.C.: n.p. 29 November 2001, <<http://www.duke.edu/~pfeaver/dunlap.pdf>> [13 February 2005].

<sup>20</sup> Ibid. 8

<sup>21</sup> Holmes.

<sup>22</sup> United States Air Force. Satellite Communications Support, Air Force Space Command Quick Look Report, January 2003.

<sup>23</sup> Chairman of the Joint Chiefs of Staff JV 2020, p. 31.

<sup>24</sup> Vego, Milan N. Operational Warfare, U.S. Naval War College, Newport RI: 2000.

<sup>25</sup> Department of Defense, Report to Congress, Network Centric Warfare, p. i.

<sup>26</sup> Vego, Milan N. "Operational Command and Control in the Information Age," Joint Forces Quarterly, October 2004, Iss. 35, pp. 100-107.

<sup>27</sup> Dunlap p. 28. "The U.S. and most other nations are parties to the relevant provisions."

<sup>28</sup> Although the United States is not a signatory to the Ottawa Treaty, it still influences the commander's decision to employ anti-personnel mines. In addition, some critics of AW contend the Ottawa treaty should be expanded to include any type of autonomous weapon used to kill people. That argument is outside the scope of this paper.

<sup>29</sup> McClelland, Justin. "The Review of Weapons In Accordance With Article 36 of Additional Protocol I," IRRC, June 2003, Vol. 85, no. 850, pp. 387-415, <[http://www.icrc.org/Web/eng/siteeng0.nsf/htmlall/5PXET2/\\$File/irc\\_850\\_McClelland.pdf](http://www.icrc.org/Web/eng/siteeng0.nsf/htmlall/5PXET2/$File/irc_850_McClelland.pdf)> [13 February 2005].

<sup>30</sup> "New Weapons," Advisory Service on International Humanitarian Law, International Committee of the Red Cross, <[http://www.icrc.org/web/eng/siteeng0.nsf/htmlall/57JRHA/\\$FILE/New\\_Weapons.pdf](http://www.icrc.org/web/eng/siteeng0.nsf/htmlall/57JRHA/$FILE/New_Weapons.pdf)> [13 February 2005]. "Additional Protocol I does not specify how determination of the legality of weapons, means and methods of warfare is to be carried out. It is thus the responsibility of every State Party to adopt the administrative, regulatory and other measures needed to fulfil its obligations under Article 36."

<sup>31</sup> Baird, A. M. "The Ethics of Autonomous Weapons Systems," Royal College of Defence Studies, Seaford House Papers, London: Royal College of Defence Studies, 2000,



---

<<https://da.mod.uk/RCDS/Information/Library/ResearchPapers/Seaford2000/Abstracts/Baird>> [13 February 2005].

<sup>32</sup> Kaszuba, Karl A. Lt Col, USAF, “Military Technology: Has It Changed The Rules Of Warfare?,” U.S. Air University, Air War College, Maxwell Air Force Base, AL: n.p. April 1997.

<<http://www.au.af.mil/au/awc/awcgate/awc/97-103.pdf>> [13 February 2005].

<sup>33</sup> Bill, Brian J. and others, “Law Of War Workshop Deskbook,” U.S. Army, The Judge Advocate General’s School, International and Operational Law Department, Charlottesville, VA: June 2000, <<http://www.au.af.mil/au/awc/awcgate/law/low-workbook.pdf>> [13 February 2005]. p. 154-156. Below are the definitions directly out of the “Law of War Workshop Deskbook”:

#### Principle of Proportionality

1. The Test. The loss of life and damage to property incidental to attacks must not be excessive in relation to the concrete and direct military advantage expected to be gained. (FM 27-10, para. 41, change 1.)  
The U.S. test is taken, in part, from Article 51(5)b of Protocol I. “An attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.”
2. Protocol I. Under GP I, Article 51 (Protection of the civilian population), paragraph 5(b) prohibits “indiscriminate attacks”, defined in part as an attack where incidental injury to civilians or incidental damage to civilian objects would be “excessive in relation to the concrete and direct military advantage anticipated.” Under GP I, Article 57 (Precautions in the attack), paragraph (2)(b) requires planners to cancel an attack in the same circumstances. The U.S. considers these provisions customary international law.
3. Incidental Injury and Collateral Damage. Unavoidable and unplanned damage to civilian personnel and property incurred while attacking a military objective. Incidental (a/k/a collateral) damage is not a violation of international law. While no law of war treaty defines this concept, its inherent lawfulness is implicit in treaties referencing the concept. As stated Chapter 7, Methods and Means of Warfare, 155 above, GP I, Article 51(5) describes indiscriminate attacks as those causing “incidental loss of civilian life excessive to the military advantage anticipated.” Id. Caution, however, the law of proportionality still applies.

Principle of Discrimination or Distinction. GP I prohibits “indiscriminate attacks.” Under Article 51, paragraph 4, these are attacks that:

- a. are “not directed against a specific military objective”, (e.g., SCUD missiles during Persian Gulf War);
- b. “employ a method or means of combat the effects of which cannot be directed at a specified military objective”, [e.g., might prohibit area bombing in certain populous areas, such as a bombardment “which treats as a single military objective a number of clearly separated and distinct military objectives in a city, town, or village...”(GP I, art. 51, para. 5(a))]; or
- c. “employ a method or means of combat the effects of which cannot be limited as required” by the protocol (e.g., release of dangerous forces – GP I, art. 56 or incidental effect excessive in relation to concrete and direct military advantage - GP I, art. 51, para. 5(b); and
- d. “consequently, in each case are of a nature to strike military objectives and civilians or civilian objects without distinction.” (See, A.P.V. Rodgers, Law on the Battlefield, 19-24 (1996).)

<sup>34</sup> United States Air Force, Air Force Pamphlet 110-31, International Law—The Conduct of Armed Conflict and Air Operations, November 1976, para1-5, referenced in Kaszuba, Karl A. Lt Col, USAF, “Military Technology: Has It Changed The Rules Of Warfare?,” U.S. Air University, Air War College, Maxwell Air Force Base, AL: n.p. April 1997. <<http://www.au.af.mil/au/awc/awcgate/awc/97-103.pdf>> [13 February 2005].

<sup>35</sup> Gutman, Roy and Kuttub, Daoud. “Indiscriminate Attack,” Crimes of War, The Book, <<http://www.crimesofwar.org/thebook/indiscriminate-attack.html>> [13 February 2005]. “Military objectives are limited to ‘those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage.’ ”

---

<sup>36</sup> Ibid. “An indiscriminate is one in which the attacker does not take measures to avoid hitting non-military objectives, that is, civilians and civilian objects. Protocol I states: “Parties to the conflict shall at all times distinguish between civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives.”

<sup>37</sup> United States Air Force, AFMAN 10-100, Airman’s Manual, 1 June 2004, < <http://www.e-publishing.af.mil/pubfiles/af/10/afman10-100/afman10-100.pdf>> [13 February 2005].

<sup>38</sup> Dunlap p. 34, as quoted by Rowan Scarborough in “Change of Target Saved Hundreds of Taliban Soldiers,” Washington Times, November 21, 2001, p. 10.

<sup>39</sup> Farrell, Scott. “The Seven Knightly Virtues: Essential Elements of Today’s Code of Chivalry,” Chivalry Today, 2002, <<http://www.chivalrytoday.com/Farrell/Knightly-Virtues.html>> [13 February 2005].

<sup>40</sup> “CNN factor” is the effect the news media, enabled by robust real-time communications, has on the perceptions and decisions of the general population and its influence on government decisions at all levels including national security, military strategy, and operational levels of war.

<sup>41</sup> Beal, Clifford. “Briefing – Autonomous Weapons, Brave New World,” Jane’s Defence Weekly, 9 February 2000. Vol. 33, No 6., Quote by Lt Col Tom Ehrhard, a planner for the United States Air Force

<sup>42</sup> Ibid. p. 2.

<sup>43</sup> Scales, Robert H. “Human Intel Vs. Technology,” Washington Times, 3 February 2005, p. 21.

<sup>44</sup> Beal p 2.

## Bibliography

### Articles:

- Baard, Erik. "Make Robots Not War," The Village Voice, 10-16 September 2003, <<http://www.villagevoice.com/print/issues/0337/baard.php>> [13 February 2005].
- Beal, Clifford. "Briefing – Autonomous Weapons, Brave New World," Jane's Defence Weekly, 9 February 2000. Vol. 33, No 6.
- Burger, Kin. "US DOD in Move to Exploit Robot Potential," Jane's Defence Weekly, 31 July 2002.
- "DARPA, Army Select First Round of UCAR Contractors," Aerospace Daily, 29 May 2002, Vol. 202, Iss42; p. 5.
- DeBose, Brian. "Lawmakers Resist Efforts to Reduce Defense Spending," Washington Times, 28 January 2005, p. 6.
- "Early FCS Concepts Focusing on NetFires," C4I News, Copyright Phillips Business Information Corporation, 1 Feb 2001, p. 1
- Fletcher, Michael A. "Bush Speech to Focus on Budget," The Washington Post, 2 February 2005, p. 11.
- Giambastiani, Edmund P. Jr. "An Investment Portfolio For the Navy After Next," Sea Power Magazine, April 2001, <[http://www.navyleague.org/seapower\\_mag/april2001/Giambastiani.html](http://www.navyleague.org/seapower_mag/april2001/Giambastiani.html)> [13 February 2005].
- Gingras, Jeffrey L. and Ruby, Tomislav. "Morality and Modern Air War," Joint Forces Quarterly, Summer 2000, p. 107-111.
- Holmes, Stanley. "Planes That Know What to Bomb: Smart Robotic Jet Fighters May be Delivered by 2008," Business Week, 12 November 2001, Iss. 3757, pp. 91-94.
- Johnson, Clifford. "Towards an Effective Definition of "Autonomous" Weapons," The Risk Digest, 24 September 1986, Vol. 3, Iss. 64, <<http://catless.ncl.ac.uk/Risks/3.64.htm>> [13 February 2005].
- Joy, Bill. "Why the Future Doesn't Need Us," Wired, April 2000, Iss 8.04, <[http://www.wired.com/wired/archive/8.04/joy\\_pr.htm](http://www.wired.com/wired/archive/8.04/joy_pr.htm)> [13 February 2005].
- Kankey, Roland D., Jan P. Muczyk, Neal M. Ely, "Focused Graduate Education: An Invisible But Real Competitive Edge," Acquisition Review Quarterly, Fall 1997, p. 367-382, <<http://www.dau.mil/pubs/arq/97arq/kanke.pdf>> [13 February 2005].
- Karp, Jonathan. "Smarter People, Weapons and Networks," Wall Street Journal, 31 January 2005, p. R7.
- Karp, Jonathan. "Smarter People, Weapons and Networks," Wall Street Journal, 31 January

- 2005, p. R7.
- Lamb, Gregory M., "Battle bot: the future of war?," The Christian Science Monitor, 27 January 2005, <<http://www.csmonitor.com/2005/0127/p14s02-stct.htm>> [13 February 2005].
- Mann, Paul. "Bush Sees Long Future For Autonomous Weapons," Aviation Week & Space Technology, 17 December 2001, Vol. 155, Iss 25, pp. 28-29.
- "MAV – Combat Lessons Learned," Defense Update, 2004, Iss. 2, <<http://www.defense-update.com/features/du-2-04/mav-oif.htm>> [13 February 2005].
- McClelland, Justin. "The Review of Weapons In Accordance With Article 36 of Additional Protocol I," IRRC, June 2003, Vol. 85, no. 850, pp. 387-415, <[http://www.icrc.org/Web/eng/siteeng0.nsf/htmlall/5PXET2/\\$File/irrc\\_850\\_McClelland.pdf](http://www.icrc.org/Web/eng/siteeng0.nsf/htmlall/5PXET2/$File/irrc_850_McClelland.pdf)> [13 February 2005].
- "Mobile Short Range Air Defense Systems," Defense Update, 2004, Iss. 2, <<http://www.defense-update.com/features/du-2-04/feature-shorad.htm>> [13 February 2005].
- Picks, Thomas E. Picks "A War That's Commanded at a Distance," Washington Post, 27 December 2001, p. 16.
- Reed, Fred. "Robotic Warfare Drawing Nearer," Washington Times, 10 February 2005, p. C7.
- Rogers, A. P. V. "Zero-Casualty Warfare," International Review of the Red Cross, 31 March 2000, No. 387, pp. 165-181, <<http://www.icrc.org/Web/Eng/siteeng0.nsf/iwpList74/A41F49D9F3CE3756C1256B66005E3594>> [13 February 2005].
- Scales, Robert H. "Human Intel Vs. Technology," Washington Times, 3 February 2005, p. 21.
- Sirak, Michael. "USAF Ponders Level of Autonomy in Weapons," Jane's Defence Weekly, 4 September 2002.
- Strass, Marc. "Army, DARPA Continue to Move Forward on UGV Development for FCS," C4I News, 28 February 2002, p. 1.
- Tiron, Roxana. "Marine Gladiator Charges Ahead," National Defense, May 2004. Vol. 88, Iss. 606, p. 28.
- Trimble, Stephen. "Lockheed Martin Wins Contract for Autonomous Weapon Demo," Aerospace Daily, 27 June 2003, Vol. 206, Iss. 63, p. 1.
- Trimble, Stephen. "U.S. Air Force Seeks Proposals For 'Near-Autonomous' Munition Design," Aerospace Daily, 6 February 2003, Vol. 205, Iss 25, p. 1.
- Vego, Milan N. "Operational Command and Control in the Information Age," Joint Forces Quarterly, October 2004, Iss. 35, pp. 100-107.
- Waldrop, M. Mitchell, "A Question of Responsibility," The AI Magazine, Spring 1987, Vol. 8, no. 1, pp. 28-39., <<http://www.aaai.org/Library/Magazine/Vol08/08->

01/Papers/AIMag08-01-002.pdf> [13 February 2003].

Wolk, Aviva. "Protector - Spear In The Naval Arena," Naval Forces, 2004. Vol. 25, Iss. 5, pp. 125-127.

### **Books:**

Gehring, Verna V. War After September 11, Rowman and Littlefield Publishers Inc., Lanham, MD: February, 2003.

Johnson, Stuart, Martin Libicki, and others, Dominant Battlespace Knowledge, National Defense University. Institute for National Defense Studies, National Defense University Press, Washington D.C., October 1995, <<http://www.ndu.edu/inss/books/Books%20-%201990%20to%201995/Dominant%20Battlespace%20Knowledge%20-%20Oct%2095/dbkch07.htm>> [13 February 2005].

Seabury, Paul and Angelo Codevilla, War, Ends & Means, Basic Books Inc. Publishers, New York, 1989.

Vego, Milan N. Operational Warfare, U.S. Naval War College, Newport RI: 2000.

### **Government Documents:**

Defense Airborne Reconnaissance Office. UAV Annual Report, FY1997. Washington DC: 1997. (UG 1242.D7 U563 1997a)

Department of Defense. Report to Congress, Network Centric Warfare, April 2002, <<http://www.dod.mil/nii/NCW/>> [13 February 2005].

Department of Defense. U.S. Aviation Science and Technology Roadmap, Joint Aeronautical Commander's Group, Science and Technology Group, <<https://jacg.wpafb.af.mil/jacg.htm> > [13 February 2005].

Joint Chiefs of Staff, Joint Publication 3-0: Doctrine for Joint Operations, U.S. Government Printing Office, Washington D.C., 10 September 2001.

Joint Chiefs of Staff, Joint Vision 2020, U.S. Government Printing Office, Washington D.C., June 2000, <<http://www.dtic.mil/jointvision/jvpub2.htm>> [13 February 2005].

Joint Chiefs of Staff. Joint Publication 0-2: Unified Action Armed Forces (UNAAF), U.S. Government Printing Office, Washington D.C., 10 July 2001.

United States Air Force, AFMAN 10-100, Airman's Manual, 1 June 2004, < <http://www.e-publishing.af.mil/pubfiles/af/10/afman10-100/afman10-100.pdf>> [13 February 2005].

United States Air Force, Air Force Pamphlet 110-31, International Law—The Conduct of Armed Conflict and Air Operations, November 1976

United States Air Force. Satellite Communications Support, Air Force Space Command Quick Look Report, January 2003.

United States Congress. Senate. Armed Services Committee. Fiscal Year 2001 Air Force Science and technology. Presentation to the Subcommittee on Emerging Threats and Capabilities by Dr. Lawrence J. Delaney, Assistant Secretary of the Air Force. March 2000, <<http://armed-services.senate.gov/statemnt/2000/000321ld.pdf>> [13 February 2005].

United States Navy, The Navy Unmanned Undersea Vehicle (UUV) Master Plan, 27 March 2001 <<http://www.auvsi.org/resources/UUVMPPubRelease.pdf>> [13 February 2005].

### **Internet Resources:**

Addicott, Jeffrey. "The Yemen Attack: Illegal Assassination or Lawful Killing?," Jurist, Legal Intelligence website, 7 November 2002, <<http://jurist.law.pitt.edu/forum/forumnew68.php>> [13 February 2005].

"Autonomous Weapons," ABC Radio National: The Buzz, Interview with Robert Sparrow, Philosopher at the University of Melbourne, 14 October 2002, <<http://www.abc.net.au/rn/science/buzz/stories/s701060.htm>> [13 February 2005].

"Autonomous Weapons," Stanford University, < <http://www-cse.stanford.edu/classes/cs201/Projects/autonomous-weapons/>> [13 February 2005].

Ball, Philip. "Robot Wars," Nature.com, 8 February 2005, <[http://www.nature.com/news/2005/050207/pf/050207-7\\_pf.html](http://www.nature.com/news/2005/050207/pf/050207-7_pf.html)> [13 February 2005].

Behar, Michael. "Interview with Michael Behar for a Story in WIRED on Tactical Mobile Robots," KurzweilAI.Net, <<http://www.kurzweilai.net/articles/art0411.html>> [13 February 2005].

Carnahan, Burrus. "Weapons," Crimes of War, The Book, <<http://www.crimesofwar.org/thebook/weapons.html>> [13 February 2005].

Chapman, Gary. "Thinking About 'Autonomous' Weapons," Computer Professionals for Social Responsibility, Fall 1987, <<http://archive.cpsr.net/publications/newsletters/old/19802/Fall1987.txt>> [13 February 2005].

"Compact Oxford English Dictionary, Autonomous," AskOxford.com, <[http://www.askoxford.com/concise\\_oed/autonomous?view=uk](http://www.askoxford.com/concise_oed/autonomous?view=uk)> [13 February 2005].

"Coping with the Weapons of Tomorrow", Annual debate, jointly organized by the ICRC, the London School of Economics and Political Science (LSE) and the BBC World Service, 8 May 2003, <<http://www.icrc.org/web/eng/siteeng0.nsf/iwpList379/6A659B807AF74D4AC125>>

- 6D340058F71A> [13 February 2005].
- De Garis, Hugo. "The Artilect War," Stanford University, <<http://www.cs.usu.edu/~degaris/artilectwarshort.htm>> [13 February 2005].
- "Defense Update," International Online Defense Magazine, <<http://www.defense-update.com/site-map.htm>> & <<http://www.defense-update.com/features/du-2-04/feature-shorad.htm>> [13 February 2005].
- "Ethical and Social Implications," American Association for Artificial Intelligence, <<http://www.aaai.org/AITopics/html/ethics.htm>> [13 February 2005].
- Farrell, Scott. "The Seven Knightly Virtues: Essential Elements of Today's Code of Chivalry," Chivalry Today, 2002, <<http://www.chivalrytoday.com/Farrell/Knightly-Virtues.html>> [13 February 2005].
- Gutman, Roy and Kuttab, Daoud. "Indiscriminate Attack," Crimes of War, The Book, <<http://www.crimesofwar.org/thebook/indiscriminate-attack.html>> [13 February 2005].
- Herper, Mathew. "Robots of War," Forbes.com - Forbes Magazine, 7 February 2005, <[http://www.forbes.com/technology/2005/02/07/cx\\_mh\\_0207robots.html](http://www.forbes.com/technology/2005/02/07/cx_mh_0207robots.html)> [13 February 2005], Examples of current robots used on the battlefield can be found at <[http://www.forbes.com/finance/2005/02/04/cx\\_mh\\_0207robotsslide.html?thisSpeed=25000',800,700](http://www.forbes.com/finance/2005/02/04/cx_mh_0207robotsslide.html?thisSpeed=25000',800,700)> [13 February 2005].
- "I, Robot (2004)," Yahoo Movies, <<http://movies.yahoo.com/shop?d=hp&id=1808461628&cf=prev>> [13 February 2005].
- Kosan, Keith J. "United States Air Force Precision Engagement against Mobile Targets, Is Man In or Out?," School of Advanced Airpower Studies, Air University, Maxwell, AL, November 2001, <[http://www.maxwell.af.mil/au/aul/aupress/SAAS\\_Theses/Kosan/kosan.pdf](http://www.maxwell.af.mil/au/aul/aupress/SAAS_Theses/Kosan/kosan.pdf)> [13 February 2005].
- "Merriam-Webster Online Dictionary, Autonomous," Merriam Webster Online, <<http://www.m-w.com>> [13 February 2005].
- Moseley, Alex. "Just War Theory," The Internet Encyclopedia of Philosophy, 2004. <<http://www.utm.edu/research/iep/j/justwar.htm>> [13 February 2005].
- "New Weapons and International Humanitarian Law," International Committee of the Red Cross, <[http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/section\\_ihl\\_new\\_weapons?OpenDocument](http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/section_ihl_new_weapons?OpenDocument)> [13 February 2005].
- "New Weapons," Advisory Service on International Humanitarian Law, International Committee of the Red Cross, <[http://www.icrc.org/web/eng/siteeng0.nsf/htmlall/57JRHA/\\$FILE/New\\_Weapons.pdf](http://www.icrc.org/web/eng/siteeng0.nsf/htmlall/57JRHA/$FILE/New_Weapons.pdf)> [13 February 2005].
- Pollack, Jordan B. "Seven Questions for the Age of Robots," Yale University Bioethics Seminar, January 2004, <<http://jordanpollack.com/sevenlaws.pdf>> [13 February 2005].

2005].

“Priorities and Risks—What We Have Left to Lose,” Computer Professionals for Social Responsibility, Spring 2001,  
<<http://archive.cpsr.net/publications/newsletters/issues/2001/Spring/prior.htm>> [13 February 2005].

Roth, Bernard. “Robots and the Military, Do they Really Need Each Other?,” Computer Professionals for Social Responsibility, Fall 1987,  
<<http://archive.cpsr.net/publications/newsletters/old/19802/Fall1987.txt>> [13 February 2005].

Ryle, John. “Mines,” Crimes of War, The Book,  
<<http://www.crimesofwar.org/thebook/mines.html>> [13 February 2005].

Simons, Lewis M. “Free Fire Zones,” Crimes of War, The Book,  
<<http://www.crimesofwar.org/thebook/free-fire-zones.html>> [13 February 2005].

“U.S. President George W. Bush Addresses the Corps of Cadets,” The Citadel, 11 December 2001, <<http://citadel.edu/pao/addresses/presbush01.html>> [13 February 2005].

“Warfighters’ Edge: Using Intelligent Agents To Solve Warfighter Problems,” IDA Research Summaries,  
<<http://www.ida.org/IDANew/Research/Previous/vol9no1.pdf>> [13 February 2005].

### **Internet Sites:**

“Air Force 2025,” Air University, Maxwell AFB, AL. <http://www.au.af.mil/au/2025/> [13 February 2005]

Air Force Doctrine Center, <<https://www.doctrine.af.mil/Main.asp>> [13 February 2005].

“Autonomous Vehicles,” American Association for Artificial Intelligence,  
<<http://www.aaai.org/AITopics/html/autveh.htm>> [13 February 2005].

Computer Professionals for Social Responsibility (CPSR), <<http://www.cpsr.net/>> [13 February 2005].

Crimes of War, The Book, <<http://www.crimesofwar.org/thebook/book.htm>> [13 February 2005].

Defense Advanced Research Projects Agency (DARPA), <<http://www.darpa.gov/>> [13 February 2005].

KurzweilAI.Net, Artificial Intelligence Website,  
<<http://www.kurzweilai.net/about/frame.html>> [13 February 2005].

“Military Law and Legal Links,” Air University, Maxwell AFB, AL,  
<<http://www.au.af.mil/au/awc/awcgate/awc-law.htm>> [13 February 2005].

RAND, <<http://www.rand.org/publications/>> [13 February 2005].

“United States Weapon Systems,” Military Analysis Network,



<<http://www.fas.org/man/dod-101/sys/index.html>> [13 February 2005].

“Welcome to AI Topics, a dynamic library of introductory information about Artificial Intelligence,” American Association for Artificial Intelligence (AAAI), <<http://www.aaai.org/AITopics/>> [13 February 2005].

### **Published Papers:**

Arnall, Alexander H. “Future Technologies, Today’s Choices,” London: Greenpeace Environmental Trust, July 2003, <[www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/5886.pdf](http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/5886.pdf)> [13 February 2005].

Baird, A. M. “The Ethics of Autonomous Weapons Systems,” Royal College of Defence Studies, Seaford House Papers, London: Royal College of Defence Studies, 2000, <<https://da.mod.uk/RCDS/Information/Library/ResearchPapers/Seaford2000/Abstracts/Baird>> [13 February 2005].

Beene, Eric A. “An Enduring Framework for Assessing the Contributions of Force Structure to a Coercive Strategy,” U.S. Air University, Maxwell Air Force Base, AL: Air University Press, 2002. (UG 1242.D7 B337 2002)

Bill, Brian J. and others, “Law Of War Workshop Deskbook,” U.S. Army, The Judge Advocate General’s School, International and Operational Law Department, Charlottesville, VA: June 2000, <<http://www.au.af.mil/au/awc/awcgate/law/low-workbook.pdf>> [13 February 2005].

Cameron, Bud. “When Robots Kill,” Canadian Forces Colleges, Canada: Canadian Forces College, 2004 <<http://198.231.69.12/papers/csc30/exnh/cameron.htm>> [13 February 2005].

Clark, Rickard M., “Uninhabited Combat Aerial Vehicles, Airpower by the People, For the People, But Not with the People,” U.S. Air University, Maxwell AFB, AL: Air University Press, 2000. (UG 1242.D7 C53 2000)

Dunlap, Charles J. Colonel, USAF, “Law and Military Interventions: Preserving Humanitarian Values in 21<sup>st</sup> Century Conflicts,” Harvard University, Kennedy School of Government, Washington, D.C.: n.p. 29 November 2001, <<http://www.duke.edu/~pfeaver/dunlap.pdf>> [13 February 2005].

Ennett, Jimmy. “The Impact of Emerging Technologies on Future Air Capabilities,” Defence Science and Technology Organisation, Melbourne, Australia: n.p. December 1999, <<http://www.dsto.defence.gov.au/corporate/reports/DSTO-GD-0186.pdf>> [13 February 2005].

Frelinger, David, Joel Kvitky, William Stanley, “Proliferated Autonomous Weapons: An Application of Cooperative Behavior,” RAND, Project Air Force Documented Briefing, <<http://www.rand.org/publications/DB/DB239/DB239.pdf>> [13 February 2005].

- Glade, David. "Unmanned Aerial Vehicles, Implications for Military Operations," Air University, Maxwell Air Force Base, AL: Air University Press, 2000. (UG 1242.D7 G533 2000)
- Huber, Arthur F. "Death by A Thousand Cuts, Micro-Air Vehicles in the Service of Air Force Missions," U.S. Air University, Maxwell Air Force Base, AL: Air University Press, 2002. (UG 1242.D7 H83 2002)
- Kaszuba, Karl A. Lt Col, USAF, "Military Technology: Has It Changed The Rules Of Warfare?," U.S. Air University, Air War College, Maxwell Air Force Base, AL: n.p. April 1997. <<http://www.au.af.mil/au/awc/awcgate/awc/97-103.pdf>> [13 February 2005].
- Lazarski, Anthony J. "Legal Implications of the Uninhabited Combat Aerial Vehicle." Air & Space Power Chronicles. AL: Air and Space Power Journal, 27 March 01. <<http://www.airpower.maxwell.af.mil/airchronicles/cc/lazarski.html>> [13 February 2005].
- Lewis, William K. "UCAV – The Next Generation Air-Superiority Fighter?," U.S. Air University, School of Advanced Airpower Studies, Maxwell AFB, AL: n.p., June 2002, <<http://handle.dtic.mil/100.2/ADA420631>> [13 February 2005].
- Renehan, Jeffrey N. "Unmanned Aerial Vehicles and Weapons of Mass," U.S. Air University, Maxwell AFB, AL: Air University Press, 1997. (UG 1242.D7 U55 1998)
- Wall, Andru E. and others, "Legal and Ethical Lessons of NATO's Kosovo Campaign," U.S. Naval War College, International Law Studies, Newport, RI: Naval War College, Vol. 78, 2002 <[http://www.au.af.mil/au/awc/awcgate/navy/kosovo\\_legal.pdf](http://www.au.af.mil/au/awc/awcgate/navy/kosovo_legal.pdf)> [13 February 2005].

#### **Unpublished Papers:**

- Davidson, William G. "Marching Up Country: Autonomous Warfare, a New Doctrine." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 11 May 2001 (N 429 F98 2001 no.3)
- Fingal, Tod R. "Determining If the United States Military is Ready to Eliminate Its Pilots: Use of Combat Unmanned Aerial Vehicles." Unpublished Research Paper, U.S. Army Command and Staff College, Fort Leavenworth, KS: 2001. (UG1242.D7 F564 2001a)
- Flade, John W. "Teaching a New Dog Old Tricks: Replacing Man with Artificial Intelligence in Combat Aircraft." Unpublished Research Paper, Army War College, Carlisle Barracks, PA: 2000. (UG1242.D7 F623 2000a)
- Green, John K. "Lethal Unmanned Air Vehicle Feasibility Study/Lethal UAV Feasibility Study." Unpublished Research Paper, Naval Post Graduate School, Monterey, CA: 1995. (UG1242.D7 G744 1995a)

- Holms, Sharon L. "The New Close Air Support Weapon: Unmanned Combat Aerial Vehicle in 2010 and Beyond." Unpublished Research Paper, U.S. Army Command and Staff College, Fort Leavenworth, KS: 1999. (UG1242.D7 H656 1999a)
- James, Gregory K. "Unmanned Aerial Vehicles and Special Operations: Future Directions." Unpublished Research Paper, Naval Post Graduate School, Monterey, CA: 2000. (UG1242.D7 J364 2000)
- Klein, John J. "Strategic Implementation of Navy and Marine Corps Unmanned Combat Air Vehicles with Respect to Military Transformation." Unpublished Research Paper, U.S. Naval War College, Newport, RI: 10 May 2002 (N 429 F98 2002 no.5)
- Lester, Rick W. and others, "Counterair: The Cutting Edge," Unpublished Research Paper, United States Air Force, August 1996,  
<<http://www.au.af.mil/au/2025/volume3/chap08/vol3ch08.pdf>> [13 February 2005].
- Thieret, Jeffrey, Steven J. Depalmer, Frederick I. Guendel Jr., Michael A. Silver, "Hit'em Where It Hurts: Strategic Attack in 2025," Unpublished Research Paper, United States Air Force, August 1996,  
<<http://www.au.af.mil/au/2025/volume3/chap06/vol3ch06.pdf>> [13 February 2005].
- Tluchowski, Michael A. "The UAV and the Operational Commander," Unpublished Research Paper, U.S. Naval War College, Newport, RI: 4 February 2002 (N 420 F95 2002 no.76)