United States House of Representatives

Subcommittee on National Security

And Foreign Affairs

Statement prepared for the Hearing:

"Rise of the Drones:

Unmanned Systems and the Future of War"

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Room 2154

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This testimony reflects the personal views of the author and does not represent

the official views of the Naval War College or the Department of the Navy.

Thank-you Mr. Chairman, and thank-you to the rest of the Subcommittee members for this opportunity to speak on two subjects about which I am passionate: The education of our dedicated warriors, and the role that unmanned systems can and should play in future military operations.

I am privileged to currently serve as a professor at the U.S. Naval War College in Newport, Rhode Island. In the fall of 1884 (just over 125 years ago) the College was formed as a place *"…of original research on all questions relating to war… or the prevention of war"*. At the time of the College's founding the flagship of the U.S. Navy's North Atlantic Squadron was *USS Tennessee*, a wooden-hulled steam-ship that also carried 22,000 square feet of sail as a back-up propulsion system! The young military officers who comprised the College's first class spent many long hours considering the ways in which evolving technologies, like wireless communications, electrical equipment, and long-range naval guns, would change the nature of warfare at the close of the 19th century.

Now… a century-and-a-quarter later, our students are still engaged in serious contemplation of the ways in which technology will alter the battlefield, this time in the form of a robotics revolution.

To be clear, the Naval War College is not a technical school, and issues of systems design and software architecture are better suited to the more junior officers attending the Naval Postgraduate School in Monterey, California where innovative research is being conducted at their Center for Autonomous Vehicle Research (CAVR). Rather, the mission of the Naval War College is to improve the ability of its students

to make sound decisions in highly complex and stressful maritime and joint environments. If trends in computer science and robotics engineering continue, it is conceivable that autonomous systems could soon be developed that are capable of making life-and-death decisions without direct human intervention. The purpose of the new elective course entitled **"Unmanned Systems and Conflict in the 21st Century"** is to provide a forum for the consideration of the scientific, ethical and operational issues inherent in the employment of unmanned/robotic systems in the national security context.

The course provides the opportunity for students to study contemporary cases, trends, and issues in the development and use of unmanned systems in twenty-first century warfare. The students study and evaluate these systems from the tactical, operational, and strategic dimensions of war. In the course of their studies, they:

- Develop an appreciation for the current state of development in the field of unmanned/robotic systems in the air, ground and maritime domains.

- Understand the unique issues, opportunities, and challenges associated with the operational employment of unmanned/robotic systems.

- Appreciate the degree to which the use of unmanned/robotic systems could change the character of warfare in the 21st century.

- Assess the diverse ethical issues and attitudes relevant to the use of unmanned systems.

- Assess the unique leadership challenges that arise in the utilization of unmanned systems.

- Assess the diverse elements and key drivers affecting the decision-making process with regard to unmanned systems.

- Analyze the use of unmanned systems within the context of international law, the law of armed conflict, and the just war tradition.

In order to provide a more detailed overview of the course, a copy of the current syllabus is attached to this statement. In brief, the course looks at hardware issues in the air, land, and maritime environments and provides hands-on exposure to state-of-the-art systems. It then considers the issues of command and control, personnel manning, and the legal and ethical issues of employing these systems in national security situations. Students ultimately demonstrate their mastery of the subject through research requiring both written and verbal presentations (a sample of recent paper topics is attached). The course supports two specific Areas of Study (AOS): Leadership and Ethics and Strategy, Operations, and Military History.

It should be noted that significant support for the course has been provided by the Association for Unmanned Vehicle Systems International (AUVSI); a number of manufactures of unmanned systems; educational institutions including the Massachusetts Institute of Technology (MIT) and the U.S. Army War College; the Department of Defense; and Navy leaders and engineers from various program management offices and the Navy Undersea Warfare Center.

LESSONS LEARNED AND OBSERVATIONS

The following observations result from direct contact with the several dozen students who have taken the newly-established course during the current academic year, as well from discussions I have had with scores of military officers and other practitioners at meetings, symposia and conferences.

- I have found that military officers are generally well informed about the exponential growth in the use of unmanned systems throughout the Department of Defense; and they are highly motivated to probe beyond the headlines and promotional hype to ascertain the true capabilities and limitations of current technology.

- They have a keen interest in understanding the full range of research and development activities now underway, particularly with regard to those systems that could be fielded in the near-term that could impact on their critical war-fighting abilities.

- The intense desire for knowledge about unmanned systems is evident across all branches of the armed services, within many government agencies, and it extends to our international partners and allies.

- Students are acutely aware of the ethical and legal issues associated with the employment of robotic systems in combat. Of particular concern is the possibility that unmanned/robotic systems could be programmed to make lethal decisions in combat situations without active human participation in the "kill chain".

- They are keenly aware that unmanned/robotic systems could represent a true "revolution in military affairs" that has the potential to alter career fields, training pipelines, and combat tactics. They don't "fear" the future, but are mindful of the need to skillfully manage the impact of this disruptive technology.

My final observations pertain to the professionalism and vision of the many people I have encountered while developing and teaching this course. At Navy Headquarters the Chief of Naval Operations, Admiral Gary Roughead, has been a strong and vocal advocate for unmanned systems, about which he has said: *"This is the right way, this is where we have to go, and it will make us much, much more effective".* (Remarks at Brookings Institution, 2 November 2009)*.* I believe the message is getting through at all levels of the Navy, and whenever I have sought information, or requested senior leaders to travel to the College to speak with students, or when I have participated in conferences and symposia, I have received immediate and unqualified support. Additionally, I have been particularly impressed with the people I have met from academia, the scientific/engineering communities, and industry, all of whom are working tirelessly to bring the potential of unmanned systems to fruition. Finally, I salute our elected officials, as represented by the members of this subcommittee, who seek to ensure that neither organizational inertia nor the tendency to protect the status-quo will keep America from using the drive and genius of her people to devise and utilize technology and science as necessary to protect our citizens, our economy, and our nation.

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Newport, Rhode Island   March 2010

UNMANNED SYSTEMS
AND CONFLICT IN THE 21ST CENTURY

Course Number SE-720

U.S. Naval War College

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Spring Trimester, 2009-2010

Member: Association for
Unmanned Vehicle Systems
International (AUVSI)

UNMANNED SYSTEMS AND CONFLICT IN THE 21ST CENTURY

1. Course Description:

The technological advances in the areas of computer science, artificial intelligence (AI) and robotics engineering achieved in the past decade have created the capacity for unmanned/robotic systems to move from the realm of science fiction onto the current battlefields of the 21st century. In 2009 there were over 5,300 unmanned aircraft systems in America's inventory, and the inventory of unmanned ground systems deployed to Iraq and Afghanistan exceeded 12,000. Sea-based unmanned/robotic systems are less fully developed, due in part to the demanding operating environment, but research and development is well underway on systems to be deployed in the air, on the surface, and under-seas. Critical design considerations for the Littoral Combat Ship, for example, have been made to accommodate the use of a variety of unmanned vehicles. One further indicator of Navy interest in this subject was the Chief of Naval Operations' October 2008 tasking to Strategic Studies Group XXVIII to study all aspects of the integration of unmanned systems into Navy force structure.

Many observers believe that the combination of super-computing technology and robotics engineering will drive changes within the military environment equal to the impact the wide-spread use of gunpowder had in the 16th/17th centuries and steam propulsion for ships had in the 19th and 20th centuries. These changes relate not only to the development and manufacture of highly-capable future systems, but also to issues regarding the ethics of their use, and the manner in which command and control will be exercised. The purpose of this course will be to acquaint students with the scientific, ethical and operational issues inherent in the employment of unmanned/robotic systems in the national security context.

2. Student Learning Outcomes:

This course provides the opportunity for students to study contemporary cases, trends, and issues in the use and development of unmanned systems in twenty-first century warfare. Students will study and evaluate these systems from the tactical, operational, and strategic dimensions of war looking at the multifaceted issues of their development and use. Graduates will be able to:

a. Develop an appreciation for the current state of development in the field of unmanned/robotic systems in the air, ground and sea domains.

b. Understand the unique issues, opportunities, and challenges associated with employment of unmanned/robotic systems.

c. Appreciate the degree to which the use of unmanned/robotic systems could change the nature of warfare in the 21st century.

d. Describe and assess the diverse ethical issues and attitudes in the use of unmanned systems.

e. Describe and assess the unique leadership challenges that arise in the utilization of unmanned systems.

f. Describe and assess the diverse elements and key drivers affecting the decision-making process with regard to unmanned systems.

g. Describe the use of unmanned systems within the context of international law, the law of armed conflict, and the just war tradition.

h. Describe the various legal issues and concerns with respect to the utilization of unmanned systems.

3. **Methodology and Student Requirements:**

Each student will complete a mini-research project requiring a written paper of 6-8 pages in length combined with a formal 10-15 minute presentation on a subject of their choice related to course themes. All work will be graded High Pass, Pass, or Fail. Successful completion of all course requirements will result in the award of two-hours of graduate credit.

4. **Required Readings**:

Wired for War: The Robotics Revolution and Conflict in the 21st Century by Dr. P.W. Singer, Penguin Press, New York, 2009.

Unmanned Systems Integrated Roadmap FY2009-2034, Department of Defense, Pentagon, Washington, D.C., 2009.

United States Air Force Unmanned Aircraft Systems Flight Plan 2009-2047, Headquarters, U.S. Air Force, Washington, D.C., 2009.

"Ethical and Legal Issues Associated with the Use of Unmanned/Robotic Systems" by Raul Pedroza, U.S. Naval War College, 2009.

5. Seminar and Reading Schedule:

Session 1:   Thursday, 11 March 2010

Title: <u>Introduction to the Course</u>

Session summary:

> This will be the kick-off session for the course. We will review the plan for the 10-weeks of
> instruction, and will make introductions.
>
> This session will also introduce the DOD Unmanned Systems Integrated Road Map, and the Air Force Unmanned Systems Flight Plan. A review of robotics in literature and cinema will also be conducted.

Readings:

- <u>Wired</u>, pp 19-93. Scan as much of entire book as possible prior to class.

- <u>Roadmap</u>, pp. xiii-15.

- <u>Flight Plan</u>, pp.14-19

Session 2:   Thursday, 18 March 2010

Title: <u>Coming Soon to a Battlefield Near You: The Next Wave of WarBots</u>

Session Summary:

> Part 1: Static display of Unmanned Undersea Systems from Bluefin Robotics.
>
> Part 2: VTC lecture by Brookings Senior Fellow Dr. P.W. Singer.
>
> We will spend the second half of the class in a VTC discussion with Dr. P.W. Singer, Senior Fellow at Brookings Institute, and author of the course's primary text <u>Wired for War: The Robotics Revolution and Conflict in the 21st Century</u>. Dr.

Singer will touch-upon many of the issues that will be addressed in subsequent sessions.

Readings:

- Wired, pp 109-123.

Session 3:   Thursday, 25 March 2010

Title: Review and demonstration of unmanned/robotic air systems.

Guest lecturer #1: RDML Terry Kraft, USN, Director of ISR Capabilities, OPNAV Staff N2/N6

Guest Lecturer #2: MAJ Joe Campo, USAF, Predator pilot

Session summary:

This session will focus primarily on unmanned airborne systems being used by DOD and other government agencies.

Part 1: Static Display of ScanEagle and Hummingbird unmanned air systems courtesy of Boeing/Insitu.

Part 2: Briefing by RDML Terry Kraft on status of Navy UAS development.

Part 3: Briefing by MAJ Joe Campo about his experiences as a Predator pilot.

Readings:

- Wired, pp. 116-120.

- Roadmap, pp. 51-103.

- Flight Plan, scan pp 25-51.

Session 4:   Thursday, 1 April 2010

Title: Review and demonstration of unmanned/robotic maritime systems.

Session summary:

This session will be conducted as a site-visit to the Navy Undersea Warfare Center (NUWC) Unmanned Systems Laboratory in Newport, Rhode Island.

Readings:

- Wired, pp. 114-116.

- Roadmap, 135-143.

- Other readings TBD

Session 5:   Thursday, 8 April 2010

Title: Ethical and legal issues with the use of unmanned/robotic systems

Session summary:

Professors from the NWC International Law Department and the College of Operational and Strategic Leadership (Stockdale Chair of Military Ethics) will lead discussions of the many legal and ethical issues related to the use of unmanned systems.

Readings:

- Wired, pp. 413-427; pp. 382-412.

- Selected Reading: "Ethical and Legal Issues Associated with the use of Unmanned/Robotic Systems" by Raul Pedroza.

- Selected Reading: "The Predator War: What are the Risks of the CIA's Covert Drone Program?" by Jane Meyer, The New Yorker, October 26, 2009.

Session 6:   Thursday, 15 April 2010

Title: Review and demonstration of unmanned/robotic ground systems.

Session Summary:

This session will focus on the various unmanned systems being used and/or developed to support ground operations. This will include a live demonstration of robotic systems provided by iRobot/Boeing and by Foster-Miller/QinetiQ Corporation.

Readings:

- <u>Wired</u>, pp. 110-114.

- <u>Roadmap</u>: pp 111-133.

- Other readings TBD

Session 7:   Thursday, 29 April 2010

Title: <u>Artificial Intelligence, How Much is Too Much</u>?

Session summary: This session will investigate the state of development of artificially intelligent systems and will consider the potential for such systems to become superior to the human mind. We will discuss the "Terminator-syndrome" and the threat (if any) a malevolent AI system might create for humanity.

Session 8:   Thursday, 6 May 2010

Title: <u>Issues of Command and Control of unmanned/robotic systems</u>

Session summary:

> This session will focus on issues of command and control, and will also review the CNO's Strategic Studies Group report on the integration of unmanned systems into naval operations in the 2025 and beyond timeframe.

Reading:

- <u>Wired</u>, pp. 123-134; pp. 205-236; pp. 344-359.

- Other readings TBD

Session 9:   Thursday, 13 May 2010

Student Presentations on research topics.

Session 10:   Thursday, 20 May 2010
Student Presentations and Course Wrap-up

Selected Bibliography

Arkin, Ronald C. *Governing Lethal Behavior in Autonomous Robots*. Boca Raton, FL: CRC
    Press, 2009

Axe, David. *Warbots*. Ann Arbor, MI: Nimble Books LLC. 2008.

Bar-Cohen, Yoseph and Hanson, David. *The Coming Robot Revolution*. New York:
    Springer Science and Business Media, Inc, 2009.

Bekey, George. *Robotics: State of the Art and Future Challenges*. London, England: Imperial
    College Press, 2008.

Krishnan, Armin. *Killer Robots: Legality and Ethicality of Autonomous Weapons*. Surrey,
    England: Ashgate Publishing, 2009.

Mets, David R. *Airpower and Technology: Smart and Unmanned Weapons*. Westport, CT:
    Praeger Security International, 2009.

Newcome, Laurence. *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*.
    Reston, VA: American Institute of Aeronautics and Astronautics,   2004.

Wallach, Wendell and Allen, Colin. *Moral Machines: Teaching Robots Right from Wrong.*
    Oxford: Oxford University Press. 2009.

Yenne, Bill. *Attack of the Drones: A History on Unmanned Aerial Combat*. St. Paul, MN: Zenith
    Press. 2004.

Fiction

Asimov, Issac. *The Robot Series #1: The Caves of Steel*. New York: Bantam.1991.

_____. *The Robot Series #2*: *The Naked Sun.* New York: Bantam.1991.

_____. *The Robot Series #3*: *The Robots of Dawn.* New York: Bantam.1994.

_____, *The Robot Series #4: Robots and Empire.* London: Harper Collins.1996.

_____, *I, Robot.* New York: Bantam.1991.

Capek, Karel. *R.U.R: Rossum's Universal Robots*. New York: Penguin Books, 2004. (First
    published 1921).

Internet Resources

www.uvs-info.com   UVS International (Paris). A superb site with a tremendous amount of data. No charge, but must register for use. Sign-up for monthly "UVS News Flash".

www.auvsi.org   Site of the Association for Unmanned Vehicle Systems International. Many links available without joining, full resources available to registered members.

Sample Research Paper Topics: Winter Trimester 2009-2010

- "Bionics: Robotics in the Human Body"

- "Clausewitz vs. Unmanned Systems: When Theory and Technology Collide"

- "Defense Acquisition: Effects on the Future Unmanned Force Structure"

- "Do the Benefits of UCAS in a SEAD/DEAD Role Outweigh the Ethical Concerns?"

- "Gamers and Remotely Piloted Aircraft: Implications of the Video Game Generation in RPAs"

- "Is there a Requirement for Robotic Ethical and Moral Guidelines?"

- "Powering Unmanned Ground Vehicles"

- "Satellites and Remotely Piloted Vehicles: Two Remotely Operated Ships Passing In the Fight"

- "Swimming in Sensors, Drowning in Data"

- "Sensor Overload"

- "Tactical Application of Unmanned Systems"

- "The Singularity: The End of Humanity (NLT 2040)"

- "Unmanned Airships: Extreme Persistence"

- The Rise of the Machines: Ethics and Responsibility for Robots"

- "Unmanned Air Systems in Ballistic Missile Defense"

- "Unmanned Vehicles: A Viable Tool for the Marine Corps Logistician"