Colloquium Brief Strategic Studies Institute

U.S. Army War College,
Strategic Studies Institute

STRATEGIC IMPLICATIONS OF EMERGING TECHNOLOGIES

Complied by

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KEY INSIGHTS:

- The conference could only scratch the surface regarding the strategic implications of several important emerging technologies, namely, biogenetics, biometrics, nanotechnologies, robotics, artificial intelligence, alternative energies, and electromagnetic weaponry. More research is needed in the form of additional conferences, individual studies, and war games, comparing the development of these potentially game-changing technologies globally.
- While technical expertise appears plentiful within the U.S. Department of Defense and America's private sector, both would benefit from the addition of more "strategists" capable of assessing, without prejudice, how individual technologies, or combinations of them, might shift the strategic balance of power, and over what timeframe.
- The IT revolution is far from over, but it is no longer necessarily the most important one affecting national security; the defense community needs a means for providing greater awareness of technological advances, and on an ongoing basis.
- Ethical and legal guidelines must keep pace with, or even anticipate, technological innovations, particularly those that can change the way we think about armed conflict, combatants and noncombatants. The field of robotics, for instance, is already challenging traditional notions of what it means to be a combatant.
- Without policy changes and an increase in funding, the exploration of alternative fuels will not yield results capable of supplementing fossil fuels in any significant way over the next 2 decades.

The USAWC's Strategic Studies Institute held its 20th Annual Strategy Conference on April 14-16, 2009, at Carlisle Barracks. This year's focus, "Strategic Implications of Emerging Technologies," was intended to look beyond the noted importance of advances in the field of cyber and information technologies to raise awareness of other technology areas which thus far have received less visibility. The conference explored biogenetics, biometrics, nanotechnologies, robotics, artificial intelligence, alternative energies, electromagnetic weaponry, nuclear power, and global warming. Approximately 135 attendees along with 19 panelists and speakers participated. As anticipated, the conference brought together a diverse group of scholars and individuals from the defense community and academia.

Dr. John A. Parmentola, Director for Research and Laboratory Management, U.S. Army, opened the conference with his presentation, "Discovery, Invention and Innovation for Combating Irregular Warfare." He underscored the growing importance of irregular warfare, and how certain disruptive technologies can help defeat different forms of irregular warfare. He also pointed out that by investing in the emerging technologies discussed in the conference, the United States can stay ahead of its potential adversaries. Strategy and technology interface today much as they have in the past, but the science and technology community has developed the capability to respond more rapidly to short-term requirements. It is virtually impossible to predict which of the emerging technologies, or combination of them, holds the most potential. A system level analysis can help the United States best develop alternative energies to address its growing energy needs.

Other guest speakers included Dr. Harry Fair, Director of the Institute for Advanced Technology at the University of Texas, who gave a presentation on "Transforming to an Electric Army" and its implications in terms of weaponry and vehicle propulsion; Dr. Richard A. Muller, University of California, Berkley, who offered insights from his best-selling book, Physics for Future Presidents, which exploded some of the myths regarding nuclear weapons' development, alternative energy sources, and global warming; Mr. Dennis M. Bushnell, NASA Langley Research Center, who gave a presentation on "The Enemy After Next," which raised awareness of the number of threats, human and otherwise, the United States is already facing or is likely to face over the next 2 decades; and Mr. Peter A. Wilson of RAND, who gave a talk on "Military Revolutions as Ways of War: 1914-2014," which discussed military revolutions and their influence upon force structure and the conduct of war.

Panel I—Biotechnologies: Genetic Engineering and MolecuLar Biology.

This panel explored the broad field of biotechnology, which includes biometrics and genetic engineering, among others. Dr. J. Robert Kokoska of the Army Research Office introduced the audience to aspects of the controversial field of genetic engineering, and the effort to translate the performance and efficiency of biological systems into engineered systems. In particular, he discussed several projects underway with the Institute for Collaborative Biotechnologies, which has the mission of accelerating Army Transformation through biotechnology. Of special note was a project investigating ways to convert celluloid waste into "distributed in-theater fuel production." Ms. Lisa Swan from the Biometrics Task Force discussed initiatives underway in the field of biometrics, many of which are helping to provide the forensic evidence, such as DNA traces, necessary to prosecute terrorists and other criminals in Iraq and elsewhere. Dr. Christopher MacDonald discussed the ethical ramifications of some of the potential advances in biotechnology, stressing the possible obsolescence of combatant and noncombatant identities.

Panel II—Nanotechnologies and National Security.

Panel II considered the fast-developing field of nanotechnology which, simply defined, is "the imaging, measuring, modeling, and manipulating of matter at dimensions between approximately 1 and 100 nanometers." At such small scales, unusual physical, chemical, and biological properties can emerge, and some of the limitations of Newtonian physics do not obtain; that, in turn, creates new possibilities for solving biological and mechanical problems, leading to potentially revolutionary military capabilities.

Mr. Kevin Cogan introduced the panel and laid the framework for discussion by showing how technology innovations tend to mature along an "S" curve, from initial rupture to saturation. Unfortunately, as he noted, it is difficult to know where one is on the curve with respect to a given technology; in fact, where a particular technology innovation is may matter little if it is rendered obsolete by another one. Dr. James Murday of the University of Southern California Naval Research Laboratory and NSET, talked about how nano-enabled technology can, and in some cases already is, contributing to security, both at home and abroad. Nano-enabled technology, for instance, can be found in many applications having to do with defense against weapons of mass de-

struction, due mainly to enhanced detection and decontamination capabilities. Nanofibers are also being tested for use in the uniforms and equipment for tomorrow's soldiers to protect them better from chemical, biological, radiological, nuclear, and high-yield explosive (CBRNE) weapons, but also to provide compact power sources, and human performance monitoring and injury diagnosis and treatment. Dr. David Bishop of Lucent Technologies addressed how nanotechnology will revolutionize handheld radio-frequency appliances, in part because they require low power, are cheaper, and lighter. The market is there now and growing rapidly. In a word, it appears that nanotechnology "will live up to the hype."

Panel III—Robotics and Contemporary/Future Warfare.

This panel confronted a familiar, yet increasingly important topic, one that in recent decades has moved from science fiction to military reality. Various types of robots have been at work performing a multitude of military tasks, such as reconnaissance and engagement, thereby greatly reducing the risks to and workloads for military personnel.

Dr. Robert Finkelstein, President of Robotic Technology Inc., defined the contemporary or emerging "robot" as "a machine with sensors, processors, and effectors able to perceive the environment, have situational awareness, make appropriate decisions, and act upon the environment." He elaborated upon the various domains in which robots can operate, as well as the rationale for using them, which includes that they are expendable and at the same time survivable and tireless. He distinguished between "first order impacts" of employing robots, namely, that they are faster, better, and cheaper than humans, and "second order impacts," specifically, that they will engender tactical, organizational, and structural changes so that their utility can be fully optimized. Finkelstein went so far as to say that robots will become ubiquitous in peace and war, requiring the development of a code of moral behavior for intelligent (cognitive) robots. The question as to whether this ubiquity will result in more peace or more war was, however, left unanswered. Mr. John Schuster of the Johns Hopkins University Applied Physics Laboratory focused on the growing field of undersea robotics. This environment poses unique challenges due to its density and opacity, high pressures, and limited amounts of oxygen. Nonetheless, there are a number of unmanned underwater vessels (UUV) now under development which can function despite these challenges. At this point, commercial interests are driving UUV development, though the U.S. Navy's interests appear to be increasing. Dr. Peter W. Singer, Director of the 21st Century Defense Initiative at the Brookings Institution, offered insights from his new book, Wired for War: The Robotics Revolution and Conflict in the 21st Century. Specifically, Dr. Singer asked how will we control weapons designed to have ever more autonomy? How will such weapons distinguish friend from foe in a reliable way? What laws and ethical codes will be needed to govern the use of such weapons? What signal or "message" do we send to those on the other side or to the international community when we send machines—rather than our own blood—to protect our interests in wartime?

Panel IV—Artificial Intelligence and Defense Strategy.

This panel addressed artificial intelligence (AI), or the manufacturing and use of intelligent machines. Although the definition of "intelligent" is still controversial, important developments have occurred in this field, and these are altering defense capabilities and requirements. Dr. Brian Shaw from National Defense Intelligence College offered that intelligence is being able to discern, not just perform. An example would be distinguishing between ethical and unethical behavior. This is intelligence, pure and simple. Artificial intelligence has gone beyond computation and understanding concepts, to include identity creation or formulation. However, it is not clear that computers have gotten to that point. Dr. Christopher Coker from the London School of Economics and Political Science argued that they probably never will; programming a warrior code into machines is hardly feasible, given that they lack the emotional and cultural "wiring" that humans have.

Panel V—Alternative Energies and America's Security.

With access to fossil fuels becoming more difficult and more costly, alternative energy sources continue to grow in importance. The U.S. Government has recently committed to exploring alternative energies. This panel discussed initiatives already underway, as well as other areas which warrant development. Mr. Jerry Warner reminded the audience that fossil fuels are not renewable. While many oil sources remain untapped due to accessibility, even these are finite. Without more development of alternative energies, the world faces an increasing demand with a diminishing supply. Mr. Joe Sartiano from the Power Surety Task Force described a number of energy-saving, fuel efficient initiatives underway within the Department of Defense. Such efforts include spray-foam insulation, increased use of solar power, and the development of hybrid energy technology. Mr. Eric Kreil from the U.S. Energy Information Administration pointed out the need for serious policy changes with regard to America's reliance on fossil fuels, particularly oil. Without drastic changes, alternative energy sources will not be developed to the point that they can replace oil and coal in any meaningful way. Among other implications, many of the world's oil supply areas—such as the Caspian and Caucasus, Indonesia, Iran and Iraq, Nigeria, Saudi Arabia, Sudan, and Venezuela—will remain of strategic concern for the foreseeable future.

Panel VI—Implications for Defense Policymakers.

This panel, consisting of five top-tier strategy and technology experts, assessed several of the more significant issues raised by each panel. It also offered tentative observations about each of the emerging technologies, but not necessarily mentioned or alluded to by the previous panelists and speakers. First, this panel noted that a significant gap exists between technologists, who have immense expertise in their areas of research, and those policymakers and strategists who need to understand the importance of each of the emerging technologies in order to craft policies that both protect the research and facilitate the implementation of it. Second, the panel also pointed out that the most important technology in the inventory of the Department of Defense is the individual service member. Efforts to educate and train U.S. personnel to function in high-tech and low-tech environments must continue to receive a high priority. Third, no technology can serve as a substitute for sound policy and flexible strategy.

For some, strategic implications refer to a long-term view. Others see strategic implications in terms of regional considerations, whether or how the balance of power might shift, once a particular kind of technology is introduced, and for how long. Still others think of strategic implications in terms of how they might affect force structure and planning. It is impossible in a single, 2-day conference, particularly one covering such broad array of emerging technologies, to address the strategic implications of each. This is especially true given that, as mentioned earlier, so many individuals see strategic concerns differently. Nonetheless, the primary aim of the conference, which was to heighten awareness of important technologies outside information and cyber systems, was fulfilled.

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