



## The Mad Scientist Initiative

*An Innovative Way of Understanding the Future Operational Environment*

### Introduction

The U.S. military remains the most technologically advanced fighting force in the world; however, it currently faces a strategic environment of unprecedented complexity and ambiguity. In the current era of globalization, data diffuses at an unprecedented rate, leading to information overload—the modern-day “fog of war.” Whereas traditional opponents have consisted primarily of nation-states, this current strategic environment features a more diverse set of adversaries and potential adversaries—nation-states such as Russia and China, rogue states such as Iran and North Korea, nonstate actors such as the Islamic State of Iraq and the Levant (ISIL) and individual “lone wolves.” Adversaries are employing a wider array of strategies—traditional, unconventional and hybrid—designed to avoid and disrupt U.S. advantages. Rogue states and nonstate actors have unprecedented and more affordable access to a wider array of capabilities—e.g., robotics, unmanned aerial or ground vehicles and weapons of mass destruction—once monopolized by nation-states. These trends threaten the U.S. military’s preeminence into the future.

The unprecedented and complex nature of this environment is compounded by fiscal pressures from the Budget Control Act of 2011 (sequestration) and the expensive nature of advanced technology. This pressure threatens the U.S. military and, specifically, the U.S. Army’s ability to guarantee overmatch against potential adversaries. Sequestration, in particular, forces the military to make budget- rather than strategy-based decisions among readiness, modernization and endstrength. While readiness, modernization and endstrength may appear mutually exclusive, they are actually interconnected. Without sufficient endstrength and modernization, the Army will not be able to field a ready force.

Innovation is the result of critical and creative thinking and the conversion of new ideas into valued outcomes; it leads to development of new tools or methods in the human and technological dimensions that ensure a modernized force. This allows the Army to anticipate future demands and deter and counter determined enemies. In this complex and



fiscally-constrained environment, the U.S. military will have to employ innovative and cost-effective methods at a faster rate than ever before to maintain the edge in both the human and technological dimensions of warfare. Fortunately, the Army is investing in innovation through initiatives such as Mad Scientist, which provides a forum to engage a wide array of stakeholders and incorporate their insights on the future threat environment and technological trends. This initiative promotes the innovation—and, therefore, the modernization—necessary to ensure Army readiness.

### The Mad Scientist Initiative

Mad Scientist, organized by the Army’s Training and Doctrine Command (TRADOC), provides a continuous dialogue with academia, industry and government on the innovations needed for the future operational environment. Through this initiative, the Army organizes conferences throughout the year which tap into a broad range of expertise about future trends in technology and the human dimension. These conferences result in key findings and recommendations that the Army incorporates into its concepts and capabilities documents and technology-based assessments to ensure superiority over potential adversaries. Through this initiative, the Army is shaping the face of future land operations and enhancing its brand as a thought leader in the future of warfare.

The Mad Scientist initiative rests on the notion that broad collaboration with non-traditional partners is critical to innovation. This collaboration is neces-

# The Mad Scientist Initiative: 2025 and Beyond

*Mad Scientist provides a continuous dialogue with academia, industry and government and has enhanced the Army Brand as a learning organization that not only thinks deeply about the future but is actively shaping the face of future land operations. Through cost-sharing partnerships with academia, Mad Scientist provides the Army a cost-effective vehicle to tap into expertise that would otherwise have no entry into Army efforts.*

Mad Scientist Event	Theme	Outcome	Partnership
April 2015, "Challenges in the Future World"	Event focused on the unique challenges of disruptive technologies and examined emerging technologies to mitigate potential overmatch areas.	Informed Army Capabilities Integration Center (ARCIC) science and technology needs, set the stage for focused Mad Scientist events centered on Human Dimension, Megacities, Cyber, Biomedical and other.	Georgetown University
October 2015, "Human Dimension in 2025 and Beyond"	Event examined how to optimize individual, team and organizational emerging concepts and capabilities that will disrupt current structures, systems and processes.	Informed Combined Arms Center Human Dimension Strategy.	Army University
April 2016, "Megacities and Dense Urban Areas in 2025 and Beyond"	Event looked at how future forces will gain situational understanding; freedom of movement and access; and the ability to conduct expeditionary operations. Discussed future training challenges in megacities and dense urban areas.	Informed ARCIC Megacities Information Paper; ARCIC science and technology needs; Maneuver Center of Excellence scenario development and material developer communities.	Arizona State University (ASU) and Army Intelligence Center of Excellence

*Source: Headquarters, U.S. Army Training and Doctrine Command*

sary to overcome blind spots and groupthink when considering the capabilities needed for the future operating environment; it specifically seeks to mitigate the phenomenon of "black swans." This concept, as described by scholar and statistician Nassim Nicholas Taleb, describes how organizations tend to plan for known and repeated events with minimal regard to "extreme events."<sup>1</sup> These extreme events are often unknown and improbable based on current understanding, but they can have a disproportionately high impact on outcomes. Thinking through the unfamiliar and the unlikely results in agile and adaptive solutions for a broad range of future contingencies.

## Army Innovation in the Human Dimension

Soldiers provide a competitive advantage that cannot be replaced by technology such as advanced weaponry and platforms. Without investments in the human dimension of warfare, the Army cannot build proficient and ready units that can achieve operational overmatch and seize, retain and exploit the initiative. Today's operating environment specifically requires leaders who are adaptive and, therefore, comfortable with ambiguity—and who thrive in conditions of chaos and uncertainty. These leaders must possess the mental, cognitive and physical agility to respond to new requirements or changes without a loss of functionality.

A recent Mad Scientist conference explored the "Human Dimension: 2025 and Beyond" and yielded the following insights:

- The optimization of the individual Soldier will be crucial for sustained Army cognitive and physical supremacy.
- Through advanced data computing and algorithms, the Army will recruit the Soldiers of 2025 and Beyond as world-class athletes.
- Commercial and governmental science and technology (S&T) investments will help to provide the tools and training for Soldiers to reach their full cognitive and physical potential.
- These tools include tailored diets, smart drugs and greater situational awareness enabled through a tactical Internet of Things (IoT) consisting of integrated soft sensors, processors and robotics.
- Through tailored training, the Army can develop cohesive teams who can thrive in a wide spectrum of complex environments and scenarios. This training will rely heavily on virtual- and game-based training environments and "brain gymnasiums"—individualized training to improve cognitive abilities—to enhance specialties while also enabling individual contributions to a team.

## Army Innovation in the Technological Dimension

Through innovations in existing technologies, the Army is working to ensure superiority into the future. This effort,

which focuses on the technological dimension of warfare and is part of the Department of Defense's (DoD's) Third Offset Strategy, covers the range of Army technologies and includes advancements in:

- human and cognitive sciences;
- communications and information processing technology;
- new, light-weight materials;
- power saving and generation;
- range, lethality and precision of surface-to-air, air-to-surface and surface-to-surface fires;
- autonomous and semi-autonomous operational capabilities; and
- vertical takeoff and landing aircraft combined with increased capabilities of unmanned aerial systems.<sup>3</sup>

Among the most prominent of these innovations are the Army's efforts to team Apache AH-64D/E helicopters with either MQ-1C Gray Eagle or RQ-7B Shadow drones<sup>4</sup> and to develop the High-Energy Laser Mobile Demonstrator, the electromagnetic railgun and third-generation forward-looking infrared systems.<sup>5</sup>

A recent Mad Scientist conference provided insights on several subjects related to the technical dimension, including the global technological landscape:

- Computing power and speed will provide a relative technological advantage through improved system design, modeling and simulation, gaming and general processing. The Army can accelerate this advantage by investing in quantum computing technologies, developing a tactical IoT and leveraging machine-to-machine learning.
- This proliferation of technology to a wider range of potential adversaries, spurred on in part by competition among international corporations and industry, and in new fields, such as cyber and computing, will rapidly degrade U.S. technological advantages. This trend will increase the likelihood that the United States will be surprised during future conflict.
- Combining multiple technologies in innovative ways to develop new systems and systems-of-systems (such as IoT) can provide significant advantages, but every new capability creates a new vulnerability.

In addition, a future Mad Scientist conference will focus specifically on the rise of megacities and dense urban areas as future environments of warfare. Mad Scientist has already provided insights into the future trends related to megacities:

- By 2050, 66 percent of the world's population will live in urban areas.<sup>6</sup>



- Densely-populated areas are safe havens and support bases for terrorists, insurgents and criminal organizations. Adversaries operate among the people in these areas to avoid U.S. military advantages and to exploit popular disaffection and weak governance.
- Densely-populated areas are also susceptible to mass atrocities.
- The difficulties posed by urban environments will only increase the level of innovation, adaptability and cohesion needed from our Soldiers to win in a complex world.<sup>7</sup>

This conference will feature discussions on the technological capabilities needed to win in megacities, consistent with the Army Warfighting Challenges (AWFCs):

- **Topic: Situational understanding (AWFC #1):** What emerging capabilities will enable Intelligence Preparation of the Battlefield (IPB); Intelligence Surveillance and Reconnaissance (ISR); Mission Command Systems; electronic warfare (EW); and a human, demographic and cultural understanding within megacities?
- **Topic: Future training challenges (AWFC #8):** What emerging technologies and capabilities must the Army employ to realistically simulate megacities to a training audience (home station and combat training centers)?
- **Topic: Expeditionary operations (AWFC #12):** What emerging concepts and capabilities will enable expeditionary maneuver; enhance the management of large population centers; and offer solutions for achieving partner interests and strategic objectives throughout a range of military operations (during peace and combat operations)?
- **Topic: Freedom of movement and protection (AWFC #16):** What emerging capabilities will enable access and freedom of movement in, above, below and around megacities? What new capabilities can improve logistics and sustainment in urban areas? What will protect vehicles and Soldiers from advanced and tech-



nological and environmental threats (e.g., water, sanitation and air pollution)?

### Building a Competitive Advantage

The unprecedented pace of the diffusion of technology, fueled in part by cyber intrusion, poses a major challenge for the Third Offset. Potential adversaries will continue attempting to copy U.S. military technology.<sup>8</sup> The Army, therefore, is seeking a competitive advantage by combining innovation in both the human and technological dimensions. While technology can be copied, it is far more difficult to copy the skills of Soldiers who are integrated with unmanned platforms. Through the integration of manned and unmanned platforms, the Army will leverage its best asset—Soldiers—to maintain its dominance over all potential adversaries.

### The Way Ahead

The Army faces unparalleled complexities in the future operating environment. Myriad potential adversaries are developing a wider array of capabilities more rapidly than ever before. The faster pace of informational and technological diffusion and the current fiscal environment compound these challenges. These trends require the Army to develop new ways of implementing doctrines, acquiring and fielding materials and cultivating agile leaders. In short, the



Army must promote innovation to maintain its superiority in light of these trends. Through initiatives like the Mad Scientist, the Army is doing just that. Mad Scientist provides the Army with expertise across the academic, industrial and governmental communities to harness the power of innovation. This innovation is ensuring that the Army fields a modern force that can maintain overmatch into the future. This modernization, ultimately, will ensure that the Army has the readiness necessary to win in a complex world. Initiatives such as Mad Scientist require timely and predictable funding throughout their duration to ensure not only the future readiness of the Army but the future readiness of the joint force.

- <sup>1</sup> Nassim Nicholas Taleb, “The Black Swan: The Impact of the Highly Improbable,” *The New York Times*, 22 April 2007, <http://www.nytimes.com/2007/04/22/books/chapters/0422-1st-tale.html>.
- <sup>2</sup> Richard Lim, “Innovation and Invention: Equipping the Army for Current and Future Conflicts,” Association of the United States Army National Security Watch 15-3, 16 September 2015, p. 1, <http://www.ausea.org/publications/ilw/DigitalPublications/Documents/nsw15-3/index.html>.
- <sup>3</sup> Department of the Army, *The U.S. Army Operating Concept: Win in a Complex World*, TRADOC Pamphlet 525-3-1, 31 October 2014, p. 15.
- <sup>4</sup> Richard Lim, “These Are the Drones You Are Looking For: Manned–Unmanned Teaming and the U.S. Army,” AUSA National Security Watch 15-4, 21 December 2015, p. 4, <http://www.ausea.org/publications/ilw/DigitalPublications/Documents/nsw15-4/index.html>.
- <sup>5</sup> Lim, “Innovation and Invention,” pp. 5–6.
- <sup>6</sup> United Nations, Department of Economic and Social Affairs, Population Division (2014), *World Urbanization Prospects: The 2014 Revision, Highlights* (ST/ESA/SER.A/352), p. 2, <http://esa.un.org/unpd/wup/highlights/wup2014-highlights.pdf>.
- <sup>7</sup> Russell W. Glenn, “Megacities: The Good, the Bad, and the Ugly,” *Small Wars Journal*, 17 February 2016, <http://smallwarsjournal.com/jrnl/art/megacities-the-good-the-bad-and-the-ugly>.
- <sup>8</sup> Sydney J. Freedberg, Jr., “Adversaries Will Copy ‘Offset Strategy’ Quickly: Bob Work,” *Breaking Defense*, 19 November 2014, <http://breakingdefense.com/2014/11/adversaries-will-copy-offset-strategy-quickly-bob-work>.