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._

<table>
<thead>
<tr>
<th>Mad Scientist Event</th>
<th>Theme</th>
<th>Outcome</th>
<th>Partnership</th>
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<tbody>
<tr>
<td>April 2015, “Challenges in the Future World”</td>
<td>Event focused on the unique challenges of disruptive technologies and examined emerging technologies to mitigate potential overmatch areas.</td>
<td>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.</td>
<td>Georgetown University</td>
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<td>October 2015, “Human Dimension in 2025 and Beyond”</td>
<td>Event examined how to optimize individual, team and organizational emerging concepts and capabilities that will disrupt current structures, systems and processes.</td>
<td>Informed Combined Arms Center Human Dimension Strategy.</td>
<td>Army University</td>
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<tr>
<td>April 2016, “Megacities and Dense Urban Areas in 2025 and Beyond”</td>
<td>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.</td>
<td>Informed ARCIC Megacities Information Paper; ARCIC science and technology needs; Maneuver Center of Excellence scenario development and material developer communities.</td>
<td>Arizona State University (ASU) and Army Intelligence Center of Excellence</td>
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必要的要克服盲点和集体思维时考虑的未来操作环境;它具体寻求克服的机制是“黑天鹅”现象。这个概念,由学者和统计学家纳西姆·尼古拉斯·塔莱布 (Nassim Nicholas Taleb) 描述,组织计划已知和重复的事件并忽略极端事件的可能性。这些极端事件往往是未知和不可预测的,但是它们在结果中可能产生不成比例的影响。思考不熟悉的和不可能的结果,在快速适应解决方案的范围广泛。为了未来的各种情况。

**Army Innovation in the Human Dimension**

士兵提供了一个竞争优势,一个不能被替换为技术的先进火炮和平台。没有在人类维度的战争,军队不能建立高效和可携的单位,以实现压倒性的战术和保持和推动的倡议。今天的操作环境具体需要领导者是适应的和,因此,在条件下的头脑风暴和不确定。这些领导者必须具备思维、认知和身体的敏捷性,以适应新的要求变化而不会损失功能。

一个最近的Mad Scientist会议探讨了“人类维度：2025年及以后”并提出了以下见解：

- 个体士兵的优化对维持陆军的认知和物理优势至关重要。
- 通过高级数据计算和算法,军队将招募2025年及以后的士兵作为世界顶级运动员。
- 商业和政府部门的科学和技术 (S&T) 投资将帮助提供工具和培训,使士兵达到其最高认知和物理潜力。
- 这些工具包括定制的饮食、智能药物和更大的态势感知,通过一个战术互联网的物联网 (IoT) 由集成的软传感器、处理器和机器人。
- 通过定制训练,军队可以发展出可以正常运行于广泛环境和场景的联合体,这将依赖于虚拟游戏和游戏化的训练环境和“脑健身房”——个性化训练以提高认知能力——增强专业能力同时使各自的贡献对一个团队至关重要。

**Army Innovation in the Technological Dimension**

通过创新在现有技术的创新,军队正在努力确保未来的优势。这种努力,
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.\(^3\)

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\(^4\) and to develop the High-Energy Laser Mobile Demonstrator, the electromagnetic railgun and third-generation forward-looking infrared systems.\(^5\)

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.\(^6\)

- 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.\(^7\)

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. 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.

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