（第一页）

2016年4月

新型科技趋势：2016-2045

综合领先预报

陆军副助理部长办公室（研究与技术）

（第二页）

DISCLAIMER

This report was prepared for the Deputy Assistant Secretary of the Army (Research & Technology) by FutureScout, LLC, a strategy and analytics firm specializing in helping organizations understand emerging trends and how to prepare strategically to thrive in the face of an uncertain future. Questions regarding the preparation of this report may be directed to:

Dr. Jason Augustyn President, FutureScout LLC (571) 730-0992 jason@futurescoutllc.com

This report was prepared as an account of work sponsored by the United States Army. Neither the United States Army nor any component thereof, nor any of its contractors or subcontractors makes any warranty for the accuracy, completeness, or any third party’s use of the information contained herein. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Army or any component thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect official views or policies of the United States Army.

免责声明

本报告是由FutureScout有限责任公司副总裁助理部长（研究与技术）准备的，该公司是一家战略和分析公司，专门帮助组织了解新兴趋势，以及如何在未来面临不确定的因素，战略性地做好准备。有关编写本报告的问题可能针对：

Dr. Jason Augustyn President, FutureScout LLC (571) 730-0992

jason@futurescoutllc.com

本报告是作为美国军队赞助的工作报告编写的。美国陆军及其任何部件，其任何承包商或分包商都不对其准确性，完整性或任何第三方对本文所含信息的使用做出任何保证。本文中以商业名称，商标，制造商或其他方式提及的任何特定商业产品，过程或服务不一定构成或暗示其美国陆军或其任何组成部分或其承包商或分包商的认可，推荐或赞成。这里作者表达的观点和意见不一定说明或反映美国陆军的官方观点或政策。

（第三页）

TABLE OF CONTENTS

EXECUTIVE SUMMARY .....................................................................1

BACKGROUND ..................................................................................2

EMERGING S&T TRENDS .................................................................3

CROSS-CUTTING THEMES...............................................................9

CONCLUSION ...................................................................................12

APPENDIX A: BIBLIOGRAPHY ......................................................14

APPENDIX B: ANALYSIS METHODS .............................................16

TREND CARDS ...................................................................................18

目录

执行摘要 ................................................ ..... ................ 1

背景 ................................................. ................................. 2

新型科技趋势............................................... .................. 3

交叉主题................................................ ........ ......... 9

结论................................................. ................................... 12

附录A：自我介绍.............................................. ........... 14

附录B：分析方法............................... .............. 16

趋势卡................................................ ................................ 18

（第四页）

EXECUTIVE SUMMARY

This is the third annual report on emerging trends in science and technology (S&T) published by the Deputy Assistant Secretary of the Army for Research and Technology (DASA R&T). As in prior years, the report has two primary objectives. First, it is intended to inform leaders across the U.S. Army and stakeholders in the joint, interagency, and international community about S&T trends that are likely to influence the future operating environment and shape warfighting capabilities over the next 30 years. Second, it is intended to spark strategic dialogue around the kind of S&T investments the Army should make to ensure that our Soldiers maintain overmatch in future operations.

This 2016 version of the S&T Strategic Trends report synthesizes 32 S&T forecasts that have been published over the past five years by government agencies in the U.S. and abroad, industry leaders, international institutions, and think tanks. The objective was to identify trends that are most likely to generate revolutionary or disruptive change of interest to the Army over the next 30 years. By consolidating multiple trend analyses into a single reference document, this report aims to provide a ready reference for Army leadership as it considers the important role S&T will play in shaping the future of our Army.

Analysis of the source documents produced 690 individual trends related to science and technology, as well as trends related to broader contextual factors that will shape the evolution of S&T over the coming decades. From this data set, 24 emerging science and technology trends were identified:

执行摘要

这是由科技部副助理部长（DASA R＆T）出版的科技新兴趋势（S＆T）第三次年度报告。与往年一样，该报告有两个主要目标。首先，它旨在通知美国陆军的领导者和联合的机构和国际社会的利益相关者关于科技的趋势，这些趋势可能会影响未来经营环境并在未来30年形成战斗能力。第二，它旨在围绕军队应该做的科技投资方面引发战略对话，以确保我们的士兵在未来的行动中保持过度匹配。

这份2016年版“科技战略趋势”报告综合了美国和国外政府机构，行业领导者，国际机构和智库在过去五年中发表的32项科学技术预测。目标是确定在未来30年内最有可能产生革命性或破坏性的陆军利益变化的趋势。通过将多个趋势分析整合到单个参考文件中，本报告旨在为陆军领导层提供一个现成的参考，因为它考虑了科技在塑造我们军队未来方面将发挥的重要作用。

源文件分析产生了690个与科学和技术相关的个人趋势，以及与更广泛的背景因素相关的趋势，这些趋势将决定未来几十年科技发展的形成。从这一数据集中，确定了24个新兴科学和技术趋势：

Robotics and autonomous systems

Additive manufacturing

Analytics

Human augmentation

Mobile and cloud computing

Medical advances

Cyber

Energy

Smart cities

Internet of things

Food and water technology

Quantum computing

Social empowerment

Advanced digital

Blended reality

Technology for climate change

Advanced materials

Novel weaponry

Space

Synthetic biology

Changing nature of work

Privacy

Education

Transportation and logistics

机器人和自主系统

添加剂制造

分析

人类增强

移动和云计算

医疗进步

网络

能源

智慧城市

物联网

食品和水技术

量子计算

社会赋权

高级数字

混合现实

气候变化技术

高级材料

新型武器

空间

合成生物学

改变工作性质

隐私

教育

运输和物流

In addition to these emerging S&T trends, this report discusses six broad contextual forces that are likely to shape the evolution of science and technology over the next 30 years: urbanization, climate change, resource constraints, shifting demographics, the globalization of innovation, and the rise of a global middle class.

As with previous editions of the S&T Strategic Trends report, a set of “trend cards” are included in this report. These cards provide additional detail on the S&T trends, including a synopsis of each trend, along with summaries of enabling S&T domains, recent developments that signal how each trend might evolve, and a high-level consideration of the impacts each trend might have on society, politics, economics, the environment, and defense. These trend cards provide a convenient reference for trends that have the most potential for influencing Army capabilities and the future operating environment.

Science and technology are part of a system of driving forces that will change many aspects of the world over the next 30 years. While it is impossible to accurately predict the future in detail, the trends discussed in this report will influence the course of global change with ramifications for the U.S. Army. The intent behind the analysis presented here is to inform Army leadership about where the future might be headed, and by doing so, support strategic thinking about how best to prepare the force for the road ahead.

除了这些新兴的科技趋势外，本报告讨论了在未来30年内可能影响科学和技术发展的六大广义背景力量：城市化，气候变化，资源约束，人口结构转变，创新全球化，全球中产阶级的兴起。

与以前版本的“科技战略趋势”报告一样，本报告中包含一组“趋势卡”。这些卡片提供了有关科技趋势的更多细节，包括每个趋势的概要，以及有利的科技领域的总结，最近的发展，表明每个趋势可能演变，以及高水平考虑每个趋势可能对社会，政治，经济，环境和国防的影响。这些趋势卡为最有可能影响陆军能力和未来运行环境的趋势提供了一个方便的参考。

科学技术是驱动力系统的一部分，将在未来30年改变世界的许多方面。尽管不可能详细准确地预测未来，但本报告中讨论的趋势将影响美国陆军全球变化的过程和后果。这里提出的分析背后的意图是告知军队领导人未来可能朝向什么，并通过这样做，支持战略思考如何最好地准备前进道路的力量。

Point of Contact

Questions regarding this report should be directed to:

Aaron Chan (Acting) Director, Technology Wargaming and Manufacturing Office of the Deputy Assistant Secretary of the Army (Research & Technology) ASA(ALT) SAAL-ZT 703-697-0427 [aaron.m.chan2.civ@mail.mil](mailto:aaron.m.chan2.civ@mail.mil)

接触点

与本报告有关的问题应针对：

Aaron Chan（代理）陆军（研究与技术）ASA（ALT）副助理部长技术战术和制造办公室主任SAAL-ZT 703-697-0427 [aaron.m.chan2.civ@mail.mil](mailto:aaron.m.chan2.civ@mail.mil)

（第五页）

BACKGROUND

This is the third annual report on emerging trends in science and technology (S&T) published by the Deputy Assistant Secretary of the Army for Research and Technology (DASA R&T). As in prior years, the report has two primary objectives. First, it is intended to inform leaders across the U.S. Army and stakeholders in the joint, interagency, and international community about S&T trends that are likely to influence the future operating environment and shape Army capabilities over the next 30 years. Second, it is intended to spark strategic dialogue around the kind of S&T investments the Army should make to ensure that our Soldiers maintain overmatch in future operations. This report is part of the DASA R&T’s broader Technology Wargaming program, which seeks to provide strategic foresight research and analysis in support of both S&T investment planning and Unified Quest, the Army’s annual future study program sponsored by the Chief of Staff and conducted by the Army Capabilities Integration Center (ARCIC).

We stand on the cusp of technological revolutions on multiple fronts, in fields as diverse as robotics and synthetic biology. Technology has been central to the American way of war throughout the nation’s history,1 and it is safe to assume that scientific and technological advancements will remain an important foundation for U.S. Army capabilities over the next 30 years and beyond. At the same time, the global economic and political landscape is undergoing the most profound realignment since the fall of the Soviet Union. The United States military has long relied on an overwhelming advantage in research, development, and innovation that is unlikely to persist much longer. As China, Russia, and other nations modernize their militaries through investments in science and technology, it will become essential for the U.S. Army to make the most effective use of S&T investments to stay ahead of emerging threats.

Effective investment strategies start with an understanding of emerging trends. Therefore, the aim of this edition of the S&T Strategic Trends report is to identify the major trends in science and technology that are likely to influence Army capabilities and the future operating environment over the next 30 years. The approach toward identifying these trends involved a comprehensive review and synthesis of open source forecasts published by government agencies in the U.S. and abroad, industry analysts, think tanks, and academic organizations. These institutions are also grappling with the influence of S&T on social, political, economic, environmental, and defense-related issues, and an analysis of the documents they produce reveals a number of common themes. Rather than duplicating the numerous S&T-related forecasts conducted by the U.S. National Intelligence Council, U.K. Ministry of Defense, the McKinsey Global Institute, and other major organizations, this report seeks to leverage their collective insights to identify trends that will impact the U.S. Army.

背景

这是由科技部副助理部长（DASA R＆T）出版的科技新兴趋势（S＆T）第三次年度报告。与往年一样，该报告有两个主要目标。首先，它旨在通知美国陆军的领导者和联合的机构和国际社会的利益相关者关于科技的趋势，这些趋势可能会影响未来经营环境并在未来30年形成战斗能力。第二，它旨在围绕军队应该做的科技投资方面引发战略对话，以确保我们的士兵在未来的行动中保持过度匹配。

本报告是DASA R＆T更广泛的技术战略计划的一部分，旨在提供战略前瞻性研究和分析，以支持科技投资规划和统一任务，陆军的年度未来研究计划由参谋长赞助，由陆军能力集成中心（ARCIC）执行。

我们站在多个领域技术革命的尖端，包括在机器人和合成生物学等各种领域。技术在美国历史上一直是美国战争的核心，1可以安全地假设科技进步将继续是美国陆军在未来30年及以后的能力的重要基础。与此同时，自苏联垮台以来，全球经济和政治格局正在经历最深刻的调整。美国军队长期以来一直依赖于在研究，开发和创新方面的压倒一切的优势，这种优势不可能持续得更长。随着中国，俄罗斯和其他国家通过科技投资使其军队现代化，美国陆军必须最有效地利用科技投资，以保持领先于新出现的威胁。

有效的投资策略从理解新兴趋势开始。因此，本版“科技战略趋势”报告的目的是确定科学和技术的主要趋势，这些趋势可能在未来30年会影响陆军能力和未来经营环境。确定这些趋势的方法涉及对美国和国外政府机构，行业分析师，智囊团和学术组织发布的开源预测的全面审查和综合。这些机构也在努力解决科技对社会，政治，经济，环境和国防问题的影响，对它们所产生的文件的分析揭示了一些共同的主题。本报告不是重复美国国家情报委员会，英国国防部，麦肯锡全球研究所和其他主要组织进行的众多与科技有关的预测，而是试图利用他们的集体见解来确定将影响美国陆军的趋势。