

Developing resilience against cyber, chemical, biological, and artificial intelligence dual-use technology threats

Ashok VASEASHTA

https://doi.org/10.1007/978-3-032-10947-7_2

Abstract

Modern battlefield theatre is far more complex and kinetic than ever before. The emergence of new technologies, such as biotechnology, artificial intelligence, Unmanned Aerial Vehicles, Information technology, the Internet of Things, and other similar recent technologies, has altered warfare dynamics. Notwithstanding their beneficial uses, these technologies present dual-use challenges, as they can compromise security and present harm, such as physical, financial, social, and even emotional harm. Hence, deploying strategic tools to thwart such threats is of vital importance. This article provides an overview of dual-use research, methods and technologies, the nature of threat vectors, and how approaches such as complexity sciences, red-teaming exercises, and technological advancements, in conjunction with ATT&CK tools, techniques, and procedures, can be used to thwart such threat vectors, to develop a resiliency strategy. The landscape of dual-use technologies is quite large; hence, the scope of this article is focused on a few emerging technologies for both challenges and solutions.

Keywords: *artificial intelligence; dual-use; nanotechnology; resiliency; synthetic biology*

References:

1. Vaseashta, A.: Existential Risks Associated with Dual-Use Technologies (2023). <https://doi.org/10.25740/ZY474YF0050>
2. Harris, E.: Governance of Dual-Use Technologies: Theory and Practice (2016) [Google Scholar](#)
3. Lebedeva, S.: Investigating the Success Criteria for Dual-Use Biosecurity Education (2023). <https://doi.org/10.25740/ZK826VC3386>
4. Vaseashta, A.: Advanced sciences convergence-based methods for surveillance of emerging trends in science, technology, and intelligence. *Foresight* 16, 17–36 (2014). <https://doi.org/10.1108/FS-10-2012-0074>
[Article Google Scholar](#)

**Multidisciplinary International Conference of Research Applied to
Defense and Security, MICRADS 2025**

24-26 July 2025 Orlando USA ISBN 978-3-03210946-0

5. Vaseashta, A.: Roadmapping the Future in Defense and Security: Innovations in Technology Using Multidisciplinary Convergence. In: Petkov, P., Tsiulyanu, D., Popov, C., Kulisch, W. (eds.) *Advanced Nanotechnologies for Detection and Defence against CBRN Agents*, pp. 3–14. Springer, Netherlands, Dordrecht (2018)
[Chapter Google Scholar](#)
6. Vaseashta, A., Susmann, P., Braman, E.: *Cyber Security and Resiliency Policy Framework*. IoS Press, New York, USA
[Google Scholar](#)
7. O'Donnell, J.: AI can now create a replica of your personality (2024)
[Google Scholar](#)
8. Voigt, C.A.: Synthetic biology 2020–2030: six commercially available products that are changing our world. *Nat. Commun.* 11, 6379 (2020). <https://doi.org/10.1038/s41467-020-20122-2>
[Article Google Scholar](#)
9. NAS: *Gain-of-Function Research: Background and Alternatives*. Washington, DC (2015)
[Google Scholar](#)
10. Baldwin, J., Noorali, S., Vaseashta, A.: Biology and behavior of severe acute respiratory syndrome coronavirus contagion with emphasis on treatment strategies, risk assessment, and resilience. *COVID 3*, 1259–1303 (2023). <https://doi.org/10.3390/covid3090089>
[Article Google Scholar](#)
11. Vaseashta, A.: The threat of bioterrorism: the regional and global facets. *Future Trends and New Approaches in Defeating the Terrorism Threat* 111, 47–68 (2013). <https://doi.org/10.3233/978-1-61499-272-1-47>
[Article Google Scholar](#)
12. Chowdhry, R., Lu, S.Z., Lee, S., Godhulayyagari, S., Ebrahimi, S.B., Samanta, D.: Enhancing CRISPR/Cas systems with nanotechnology. *Trends Biotechnol.* 41, 1549–1564 (2023). <https://doi.org/10.1016/j.tibtech.2023.06.005>
[Article Google Scholar](#)
13. Vaseashta, A.: The Potential Utility of Advanced Sciences Convergence: Analytical Methods to Depict, Assess, and Forecast Trends in Neuroscience and Neurotechnological Developments and Uses. In: *Advances in Neurotechnology: Ethical, Legal, and Social Issues*, pp. 15–36. CRC Press (2012)
[Google Scholar](#)
14. Peksa, J., Mamchur, D.: State-of-the-art on brain-computer interface technology. *Sensors* 23, 6001 (2023). <https://doi.org/10.3390/s23136001>
[Article Google Scholar](#)
15. Knotkova, H., et al.: Neuromodulation for chronic pain. *The Lancet.* 397, 2111–2124 (2021). [https://doi.org/10.1016/S0140-6736\(21\)00794-7](https://doi.org/10.1016/S0140-6736(21)00794-7)
[Article Google Scholar](#)
16. Zhang, S., et al.: Molecular basis for selective activation of DREADD-based

**Multidisciplinary International Conference of Research Applied to
Defense and Security, MICRADS 2025**

24-26 July 2025, Orlando, USA, ISBN 978-303210946-0

chemogenetics. Nature 612, 354–362 (2022). <https://doi.org/10.1038/s41586-022-05489-0>

[Article Google Scholar](#)

17. Siegenfeld, A.F., Bar-Yam, Y.: An introduction to complex systems science and its applications. Complexity 2020, 1–16 (2020). <https://doi.org/10.1155/2020/6105872>
[Article Google Scholar](#)
18. Qudrat-Ullah, H.: Introduction: overview of complexity in decision-making. In: Navigating Complexity, pp. 1–9. Springer Nature Switzerland, Cham (2025)
[Google Scholar](#)
19. Pennington, A., et al.: Getting started with MITRE ATT&CK. US (2018)
[Google Scholar](#)
20. MITRE: MITRE ATT&CK. <https://attack.mitre.org/>
21. Vaseashta, A.: Applying resilience to hybrid threats in infrastructure, digital, and social domains using multisectoral, multidisciplinary, and whole-of-government approach. In: Bogdanoski, M. (ed.) NATO Science for Peace and Security Series - D: Information and Communication Security. IOS Press (2022)
[Google Scholar](#)