

Nanotechnologies in Autonomous Warfare: Redefining Power, Precision and Strategy

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Bottom-line-up-front: Nanotechnologies will redefine autonomous warfare by enhancing capabilities, lowering costs, and reshaping global competition, demanding immediate attention to emerging risks.

Problem statement: Advances in nanotechnology present both opportunities and challenges in autonomous systems. This article explores their strategic, operational, and geopolitical implications, with a focus on the risks of arms races and ethical concerns.

So what?: Policymakers, defense leaders, and global organizations must act to develop regulatory frameworks, ensure responsible innovation, and address the transformative impact of nanotechnologies on global security.

Advances in nanotechnology present a still unknown impact on the future of autonomous warfare as it might redefine the interplay between military strategy, geopolitics, and global power dynamics. The proposed paper explores the strategic, operational, and tactical implications of nanotechnologies in autonomous systems. From nano-enabled sensors enhancing situational awareness to nanoscale materials improving durability and efficiency of autonomous platforms, nanotechnologies show great potential in the industrialization of future warfare. [1]

One critical factor is the scalability of these breakthroughs. As nanotechnologies transition to industrial-scale production, the mass production of nanoscale sensors, composite materials, and embedded systems can significantly reduce costs, accelerate deployment, and widen accessibility. [2] This development has an impact on global competition for technological superiority.

All this could affect Western military education and operational doctrines, which often rely on legacy technologies and hierarchical structures. The risks and opportunities associated with integrating nanotechnologies into military environment are considered.

On the geopolitical stage, the incorporation of nanotechnologies into autonomous warfare might spark new arms races, as the US-China chip war has already demonstrated.[3] Ultimately, the proposed paper argues that a comprehensive understanding of the capabilities and limitations of nanotechnology is critical for developing robust strategies in the ever-changing realm of autonomous warfare.

References

¹ Narendra Kumar, Ambesh Dixit, *Nanotechnology for Defence Applications* (Springer International, 2019).

² Malik, Shiza, Khalid Muhammad, and Yasir Waheed. 2023. "Nanotechnology: A Revolution in Modern Industry" *Molecules* 28, no. 2: 661. <https://doi.org/10.3390/molecules28020661>

³ Zeyi Yang, "The US-China chip war is still escalating," July 12, 2023, <https://www.technologyreview.com/2023/07/12/1076156/us-china-tech-war-escalating/>