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Trends in the Development of Combat Control of Artillery Units

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Abstract
The article explores the trends in the development of combat control of artillery units, considering technological progress, automation, digitalization, and the integration of modern information systems. The study identifies challenges and opportunities in adapting artillery command and control systems to the requirements of modern warfare. The conclusions highlight the importance of network-centric operations, rapid information exchange, and artificial intelligence integration to ensure the effectiveness of artillery units in future combat scenarios.
Keywords: Combat control, artillery units, digitalization, automation, artificial intelligence, network-centric warfare

Introduction. Artillery has historically played a decisive role on the battlefield. Its effectiveness largely depends on the quality of command and control systems, which ensure timely decision-making, accurate targeting, and coordination with other branches of the armed forces. In the 21st century, the rapid pace of technological development has significantly transformed the principles of artillery combat control.

1. Historical Development of Artillery Combat Control

Historically, artillery combat control was limited to visual observation, signal flags, and manual calculation of trajectories. During the 19th and early 20th centuries, artillery relied heavily on human operators and primitive tools to estimate ranges and firing angles. The introduction of telegraphs and telephones improved coordination but remained vulnerable to disruption. The World Wars accelerated the modernization of artillery command and control. In World War I, forward observers were used to direct fire through telephone lines, while in World War II, the integration of radio communication revolutionized artillery command. Radar and early computing machines enabled faster target acquisition and more accurate fire missions. By the late 20th century, satellite navigation systems and digital mapping allowed for precision-guided artillery fire, marking a decisive shift toward technological dominance in combat control.

2. Modern Challenges in Artillery Command and Control

Contemporary warfare is shaped by high mobility, urban operations, and the integration of multiple domains—land, air, cyber, and space. Artillery command faces challenges such as electronic warfare, cyberattacks, and the widespread use of unmanned aerial vehicles (UAVs) for both reconnaissance and attack purposes. A major difficulty is maintaining secure and uninterrupted communication. Adversaries use electronic jamming to disrupt artillery fire control systems, while cyberattacks target command networks. Another challenge lies in the need for rapid, real-time decision-making in environments where delays of even seconds can affect mission outcomes. Additionally, the human factor remains critical—ensuring that personnel are adequately trained to operate advanced automated systems is a constant challenge for modern armed forces.

3. The Role of Digitalization and Automation

Digitalization has transformed artillery combat control into a highly automated and data-driven process. Modern fire control

systems incorporate GPS technology, real-time meteorological data, and digital topographic maps to calculate firing solutions instantly. Automated systems reduce the decision-making cycle from minutes to seconds, enhancing battlefield agility. Artificial intelligence further supports decision-making by analyzing vast datasets gathered from reconnaissance drones, satellites, and radar. AI can predict enemy movements, identify optimal firing positions, and allocate resources efficiently. These technologies enable commanders to execute fire missions with unprecedented precision and minimal human error. Automation also plays a vital role in logistics and ammunition management. Automated resupply vehicles and robotic loaders reduce the burden on soldiers and ensure sustained combat effectiveness.

4. Network-Centric Warfare and Artillery Units

The shift toward network-centric warfare highlights the need for integrated, real-time communication between all combat elements. Artillery units connected to a joint command network can share targeting data with infantry, armor, aviation, and naval forces. This integration ensures that artillery strikes are coordinated, precise, and responsive to rapidly changing battlefield conditions. Network-centric systems provide situational awareness by combining data from sensors, drones, satellites, and command posts. This information flow allows artillery units to execute synchronized strikes, suppress enemy defenses, and support maneuver operations with greater efficiency. Moreover, network-centric warfare enhances survivability, as decentralized command structures allow units to continue functioning even if higher headquarters are disrupted or destroyed.

5. Prospects for Future Development

Looking ahead, the future of artillery combat control will be shaped by emerging technologies and doctrinal innovations. Artificial intelligence will not only assist in decision-making but may also enable semi-autonomous or fully autonomous fire control systems. This raises both opportunities for increased efficiency and ethical questions about machine autonomy in lethal operations.

The implementation of 5G and 6G networks will ensure faster and more reliable communication, enabling real-time coordination on a global scale. Space-based assets, such as satellite constellations, will provide constant surveillance and targeting support. The use of drone swarms for reconnaissance and target designation is expected to become a standard feature of artillery operations. These drones will enhance situational awareness, reduce the risk to human observers, and provide persistent surveillance in contested environments. Finally, cybersecurity will remain a critical concern. As systems become more interconnected, protecting them from cyberattacks will be as important as defending them from physical destruction.

Conclusion: The development of artillery combat control has followed a trajectory from manual methods to highly digitalized, automated, and network-centric systems. Each stage of evolution has been driven by technological innovation and the demands of modern warfare. While challenges such as electronic warfare, cyber threats, and training requirements persist, the future promises unprecedented levels of efficiency, accuracy, and adaptability. Artillery will continue to play a decisive role on the battlefield, provided that command and control systems evolve to meet the requirements of 21st-century conflicts. The integration of artificial intelligence, digitalization, and advanced communication technologies will ensure that artillery

remains a powerful and indispensable force multiplier.

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