

INFANTRY 2.0: MINI DRONES AND THE FUTURE OF TACTICAL WARFARE

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Abstract: *The accelerating integration of unmanned aerial systems (UAS), particularly mini drones, into modern warfare represents a major shift in the tactical employment of infantry forces. As military operations become increasingly digitized, networked, and data-driven, traditional infantry structures must adapt operationally, doctrinally, and educationally. This study explores the doctrinal, organizational, and instructional implications of integrating mini drones into infantry subunits. Based on doctrinal analysis, empirical observations from field exercises, and lessons from the Russo-Ukrainian war, the article proposes structural models for deploying mini UAV teams at platoon and company levels. Findings indicate that mini drones enhance situational awareness, reduce human exposure, increase targeting precision, and expand tactical flexibility. However, these benefits are conditional on doctrinal adaptation, revised training pipelines, updated field manuals, and coherent tactical airspace management. The research highlights the need for a cultural shift: the modern infantry soldier evolves into a digitally assisted operator, integrated into a distributed, sensor-enabled combat network. Beyond being a fighter, the soldier becomes a data integrator and system coordinator. These insights offer concrete guidance for transforming infantry into adaptive, drone-integrated tactical formations suited for future operating environments.*

Keywords: Mini drones, Infantry tactics, Unmanned aerial systems, Tactical innovation, Doctrinal adaptation

1. Introduction

Contemporary armed conflicts are increasingly unfolding in operational environments characterized by digital connectivity, real-time action, and the massive integration of information technologies. Their hybrid nature - defined by the combination of conventional means with cyber, informational, and psychological operations - has profoundly transformed the way land forces, especially infantry, carry out their missions.

The widespread adoption of emerging and disruptive technologies is reshaping the foundations of modern warfare, requiring both NATO and EU states to reassess how

they maintain military superiority and ensure decision-making dominance in a volatile security environment [1].

In this new paradigm, battlefield superiority is no longer determined solely by troop mobility or firepower, but by the ability to access, process, and exploit relevant information within a short time frame. Infantry, as the element that engages in direct contact with the enemy, remains essential but is now required to operate as part of a distributed system supported by sensors, autonomous platforms, and digitized command-and-control networks. In this context, mini-drones are becoming essential force multipliers, capable of

providing informational advantage, fire support, limited tactical delivery, and increased safety for infantry by reducing direct exposure.

Technological transformations have deeply influenced the evolution of infantry tactics: from the advent of automatic weapons and motorization to mechanization and digitalization. Throughout the 20th century, infantry integrated increasingly diversified means—from radio communications and night vision systems to digital command and control networks. Today, with the proliferation of autonomous systems, the modern infantry soldier is simultaneously an operator, an informational node, and a fighter. Mission success increasingly depends on the ability to integrate new technological capabilities into the structure and operational culture of subunits.

The choice of this topic is motivated by the urgent need for doctrinal and educational adaptation, given that the use of drones has become a decisive factor in the success of tactical missions, but is still insufficiently analyzed and systemically integrated into Romanian military literature.

This paper aims to identify the role of mini-drones in modern infantry tactics, with a focus on doctrinal, organizational, and educational implications.

2. Methodology

This paper combines theoretical analysis with an applied observational approach, aiming to identify the role and effectiveness of mini-drones in modern infantry tactics. From a methodological standpoint, the research uses a combination of:

- Documentary analysis of specialized literature and doctrinal studies on recent transformations in infantry tactics;
- A brief historical overview of the evolution of this military branch, from the emergence of automatic weapons to the integration of autonomous systems;
- Semi-structured direct observation conducted during a tactical field exercise (FTX) organized at the “Nicolae Bălcescu”

Land Forces Academy in Sibiu. During this exercise, scenarios involving the integration of commercial mini-drones into infantry platoon-level actions were tested.

The observations aimed to identify relevant aspects such as: the types of missions carried out with drones (intelligence, surveillance, reconnaissance, targeting), the collaboration between drone operators and field leaders, the specific training needs of operators, and the doctrinal and decision-making integration challenges.

The working method was qualitative, with the authors assuming the role of researcher-observers during the exercise, without intervening in its conduct. Although the results cannot be generalized statistically, they provide valuable insights into possible directions for doctrinal and organizational adaptation in the context of accelerated digitalization of the tactical environment.

3. Evolution of Infantry Tactics: From Repeating Rifles to Automatic Weapons

The emergence of repeating rifles in the second half of the 19th century marked a significant transformation in infantry tactics. These weapons, such as bolt-action carbines, allowed multiple shots to be fired rapidly without full reloading, significantly increasing fire density and reducing the time needed to engage successive targets.

This increase in combat efficiency required several fundamental tactical adaptations:

- dispersion of combat formations, which until then had been compact;
- use of natural terrain cover;
- increased mobility and responsiveness of subunits.

This innovation was further reinforced by the introduction of the machine gun—the first automatic weapon with overwhelming firepower for its time. The integration of such weapons into tactical structures led to major changes in subunit organization, troop deployment on the battlefield, and types of tactical maneuvers.

A notable example is the German military doctrine of World War I, which redesigned

the infantry platoon around the machine gun, based on a decentralized “fire and maneuver” concept. As Timothy Lupfer notes in *The Dynamics of Doctrine*, “The German infantry platoon was redesigned around the machine gun as its core. Fire and maneuver tactics emphasized decentralization, initiative at lower levels, and dispersion on the battlefield” [2].

This approach paved the way for a modern infantry doctrine, where local initiative, decision-making autonomy, and distributed firepower became essential conditions for survival and effectiveness in tactical combat.

4. Mechanization and Motorization of Infantry

Technological progress in the first half of the 20th century enabled the development and integration of motorized transport in military structures, profoundly transforming the mobility and organization of infantry forces.

Motorization refers to the process by which infantry subunits were equipped with motor vehicles (trucks, light carriers, military automobiles), replacing foot and horse-drawn movement. Although initially applied mainly in logistics and artillery, motorization was gradually extended to the tactical level. An illustrative episode was the use of around 600 Parisian taxis to transport French troops to the Battle of the Marne (1914) a symbolic moment marking the adaptation of civilian means for operational mobility support: “*Parisian taxicabs were mobilized in an unprecedented military effort, carrying thousands of troops to the front during the First Battle of the Marne – a symbolic moment marking the use of civilian motor transport in modern warfare*” [3].

Following World War I, the growth of the automotive industry accelerated the motorization process. During the interwar period, and especially in World War II, mobility became a critical factor in operational success, and motorized infantry

was integrated into concepts of mobile warfare.

Mechanization, unlike motorization, implies not only transport but also the ability to fight directly from armored vehicles, providing ballistic protection and integrated firepower. The first armored vehicles, such as the British Mark I tank (1916), were designed to support infantry advances through difficult terrain and under enemy fire. Equipped with mixed crews and mounted weaponry, these platforms represented the beginning of integrated protection and firepower within a mobile system meant to accompany infantry units.

In the 1930s, Germany began reorganizing its infantry into specialized mechanized units (*Schützenregimenter*) designed to support tanks in combined arms warfare. These later evolved into *Panzergrenadier* regiments, equipped with Sd.Kfz. 251 half-tracks, automatic weapons, and radio communications, ready to fight both from vehicles and dismounted, depending on the tactical scenario. A prime example is the 1st Panzer Division (1935), which included a mechanized infantry regiment that accompanied tanks during operational advances and consolidated territorial gains. The Soviet Army followed a similar trajectory, developing armored infantry formations integrated with tank units. Structured around the fighting vehicle, these subunits had their own mobility, protection, and firepower, with the infantryman becoming an extension of the mechanized platform. These soldiers were trained for rapid, deep operations, in close coordination with tanks and self-propelled artillery, capable of acting in difficult terrain and exploiting breaches in enemy defenses.

These transformations led to a tactical paradigm shift: from static defense to mobile offense, characterized by speed, synchronization, and the combined action of all components (infantry, tanks, self-propelled artillery, engineers).

A doctrinal shift summarized by Harold D. Harris in *Proceedings* stated: *“With this tenfold increase in mobility, mechanized and motorized units have changed tactics by greatly increasing striking power as well as speed of striking”* [4].

This observation reflects the essence of the emerging mobile warfare doctrine: combining speed, striking power, and coordinated action between tanks and infantry supported by motorized or mechanized elements.

The British Mark I tank, introduced in 1916, was the first armored fighting vehicle used on a large scale, originally designed to assist infantry in crossing rough terrain and neutralizing fortified enemy positions. By combining ballistic protection, mobility, and firepower in a single platform, tanks fundamentally changed how infantry operated on the battlefield, allowing troops to advance behind armored support against enemy fire [5].

The newly created mechanized infantry had critical tactical roles: clearing terrain captured by tanks, securing the flanks of armored formations, exploiting breaches in enemy defenses, and consolidating achieved lines. These subunits could fight either mounted or dismounted, depending on the mission, and were trained for fast, deep actions in close coordination with tanks and self-propelled artillery. As General Heinz Guderian emphasized in his doctrinal writings, tanks cannot operate effectively without mechanized infantry support to secure ground and flanks in depth [6].

The combined arms cooperation model was refined during the German campaigns in France (1940) and the USSR (1941), and after the war it profoundly influenced military thinking and practice. It was adopted and adapted by the major military blocs both the Warsaw Pact and NATO in the form of the mobile combined force concept, where all components operate as an integrated, high-speed, efficient system.

In conclusion, **motorization** provided infantry with strategic and operational mobility, while **mechanization** gave it the ability to act integrally, with protection and firepower, transforming it into a key player in modern warfare. These stages prepared the transition to the digitized infantry of the 21st century, supported by autonomous systems and intelligent platforms.

5. Digitalization and the Emergence of Autonomous Systems

The 21st century has brought a profound transformation to the military operational environment, in which infantry, as a fundamental component of land forces, has been compelled to adapt to new technological conditions. While motorization and mechanization redefined mobility and protection, digitalization and the emergence of autonomous systems mark the transition to an era of permanent connectivity, algorithm-assisted decision-making, and operational integration within a network of data, sensors, and autonomous platforms delivering direct battlefield effects.

Digitalization entails the integration of information and communication technologies into the combat structure of land forces. C4ISR systems (Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance) have become the backbone of modern military operations.

In this operational ecosystem, the infantry soldier is no longer an isolated actor but an active node in the tactical network, equipped with personal sensors, digital interfaces, positioning devices, and encrypted real-time communications.

New technologies available to infantrymen include GPS navigation, helmet-mounted digital displays, assisted exoskeletons, personal tracking systems, encrypted communications, and multi-sensor digital interfaces, all enabling constant connectivity to tactical networks. This evolution fundamentally alters how infantry

perceives, maneuvers, and acts within the tactical space, implying a man-machine symbiosis where the human operator cooperates with autonomous systems and decision-support algorithms. The disruptive potential of artificial intelligence in military operations is already evident in areas such as C4ISR, logistics, and autonomous weapon systems. As Mănescu and Stan highlight [7], integrating AI into UAV systems can transform not only the capabilities of these platforms but also the doctrinal logic of modern warfare itself.

Aerial drones (UAVs), reconnaissance robots, AI-enabled strike platforms, and automated logistic systems constitute a new class of force multipliers for infantry.

These technologies provide extended access to information, beyond-line-of-sight capabilities, and the potential to engage targets under reduced risk to personnel. In this context, the mini drone becomes an extension of the modern infantryman - a mobile sensor or tactical effector capable of operating in inaccessible areas, detecting threats, and supporting real-time decision-making.

A recent report by NATO's Allied Command Transformation emphasizes that modern land forces must be connected, informed, and assisted, and that the integration of autonomous systems is essential to reducing human risk and enhancing tactical effectiveness [8].

This technological transformation also demands a profound adaptation of the infantryman as the human factor. Concepts such as situational awareness, cognitive load, and decision speed become essential components of modern training. Infantry soldiers must be able to rapidly interpret large volumes of data, prioritize threats, and act in coordination with autonomous platforms within an accelerated decision cycle.

At the same time, this evolution introduces a range of vulnerabilities: dependence on stable energy sources, susceptibility to electromagnetic jamming, information

overload, and the need for complex training to operate advanced equipment. Moreover, doctrinal frameworks and legal regulations often evolve more slowly than technological innovation, creating a gap between technical capabilities and institutional integration.

In conclusion, digitalization does not replace infantry; it transforms it into an interconnected, assisted, and technologically extended component. The modern infantryman becomes a high-tech operator and integrator, functioning as a conscious node within an intelligent combat network. His or her effectiveness is closely tied to the ability to interpret complex information flows, collaborate with autonomous systems, and make rapid decisions in an operational environment characterized by high information density and temporal pressure.

6. The Role and Use of Mini Drones in Infantry Support

As part of the adaptation process to the conditions of the digitized battlefield, the use of mini drones by infantry units has become a fundamental element in achieving information superiority, expanding tactical mobility, and reducing direct exposure of personnel. Following their massive and documented use in the Russo-Ukrainian war, mini drones are no longer considered marginal or experimental tools but are doctrinally integrated into the operational structure of an increasing number of modern armies.

Mini drones have rapidly become an essential tool in supporting infantry actions, contributing to increased tactical efficiency, reduced human risk, and expanded observation, strike, and maneuver capabilities. Without imposing a rigid classification, we can identify several functional directions and operational characteristics of mini drones used in infantry subunits:

- **Support for reconnaissance and surveillance (ISR):** Mini drones are used for direct observation of the tactical field, terrain mapping, detection of enemy

movement, and real-time data transmission to tactical decision-makers.

- **Precision engagement and direct strikes:** Certain types of FPV drones can be used in a loitering munition or “kamikaze” role, enabling engagement of opportunity targets deep within enemy formations at low cost and minimal risk to friendly forces.

- **Electronic support:** Drones can carry jamming systems or be used to locally disrupt enemy communications and sensors, affecting their command-and-control capabilities.

- **Light logistical support:** In difficult or fragmented terrain, mini drones can be used for emergency delivery of limited amounts of ammunition, sensors, medical supplies, or communication equipment.

- **Connectivity and tactical network extension:** Some models can function as temporary communication relays or distributed sensors, supporting the continuity of information flow in isolated or electronically contested areas.

In terms of operating mode, mini drones range from fully remote-controlled models operated via radio link, to semi-autonomous systems capable of altitude maintenance, target tracking, or perimeter patrolling, and

even to autonomous drones capable of navigating and executing preprogrammed missions using AI-based algorithms.

Most mini drones used in infantry support have limited endurance (10–30 minutes), making them suitable for tactical missions at squad, platoon, or company level. The choice of model and mode of use depends on the operational objective, terrain configuration, and the electronic density of the battlefield environment.

7. Advantages and Disadvantages of Using Mini Drones in Tactical Military Operations

The integration of mini drones into infantry structures represents a significant transformation in contemporary military art, marking a paradigm shift in the planning, execution, and command of tactical operations. While the benefits of these platforms are evident and continuously expanding, their use also involves a range of technological, operational, and doctrinal limitations that must be understood and properly managed. Table 1 summarizes the main advantages and disadvantages of employing mini drones in support of infantry tactical actions.

Table 1: Advantages and Disadvantages of Mini Drones in Tactical-Level Military Operations

Advantages	Disadvantages
Information superiority – Real-time data on the enemy; reduces uncertainty.	Vulnerability to electronic warfare – Susceptible to jamming, interference, or interception.
Reduced human losses – Minimizes exposure in reconnaissance/strike missions.	Limited energy autonomy – Short flight duration; requires frequent recharging.
Increased precision – Optimizes ammunition usage and strike effectiveness.	Need for specialized operators – Requires trained personnel with analytical capabilities.
Tactical flexibility – Rapid response to changes on the battlefield.	Information saturation – Risk of cognitive overload and decision-making bottlenecks.
Logistical and communication support – Limited resource delivery; relay function.	Doctrinal and legal limitations – Issues related to international humanitarian law and regulation.

8. Integration of Mini Drones into Infantry Tactical Structures

The integration of mini drones into infantry tactical structures represents a critical step in the adaptation of land forces to the modern operational environment, characterized by informational speed, interconnectedness, and real-time action.

Whereas drones were initially used in isolated contexts, primarily for observation, the current trend is their organic integration into combat units - ranging from platoon level to larger tactical formations.

Based on lessons learned from the Russo-Ukrainian conflict and the results of the CADET exercise conducted at the “Nicolae Bălcescu” Land Forces Academy [9], we propose the formal inclusion of a drone team within the infantry platoon’s organic structure. This team could consist of 2–3 soldiers equipped with one or two modular mini or micro drones capable of:

- Conducting reconnaissance and surveillance within the platoon's area of responsibility;
- Engaging identified targets, either through integrated weapon payloads or by using kamikaze-style drones;
- Jamming enemy reconnaissance and strike systems (including hostile drones);
- Providing emergency logistical transport (e.g., medical supplies, ammunition, radios).

At the infantry company level, we recommend the creation of a drone group composed of two to three teams equipped with compatible drones—ideally of the same type—to facilitate data transfer and enable swarm-like connectivity. The missions of these teams would broadly mirror the tactical roles of lower-level teams, while acting as a force multiplier through centralized coordination and focused support based on operational needs. Effective integration of these systems requires the development of a command-and-control framework capable of coherently managing information generated by aerial platforms and allocating missions,

targets, or flight paths in real time. In an evolutionary perspective, this system could be supported by advanced AI-based software, capable of optimizing the data flow between drones and command centers, prioritizing objectives, synchronizing actions, and - under electronic warfare or jamming conditions allowing drones to autonomously continue their strike trajectory or reroute to previously assigned targets.

9. Doctrinal and Training Adaptations for Infantry Subunits in the Context of Tactical Mini Drone Use

Integrating mini drones into infantry tactical structures is not just a matter of acquiring equipment or establishing new organizational components—it calls for a deep doctrinal and educational reform. Technology becomes effective only when supported by institutional processes of adaptation, revision, and operationalization of new capabilities.

Based on the findings from this research, including direct observations from applied exercises, several key directions emerge for the doctrinal and educational transformation of infantry subunits:

- **Incorporating a dedicated module** into the curricula of military education institutions focused on the tactical use of mini drone systems, emphasizing planning, coordination, and integration within operational networks;
- **Revising combat manuals and doctrinal documents** in accordance with the new capabilities, equipment, and organizational structures of land forces;
- **Integrating mini drones into mission planning** as an active part of the operational cycle, rather than a marginal or auxiliary resource;
- **Synchronizing aerial observation, fire engagement, and ground maneuver** through the development of standardized operating procedures (SOPs) to streamline data transfer between aerial platforms and human decision-makers;

- **Establishing a new concept of tactical airspace management** applicable to small units, aimed at preventing interference, collisions, or electromagnetic conflicts in the vicinity of the battlefield;

- **Training UAV operators as an integral part of the modern infantryman's profile**, with an emphasis on developing technical (mechanics, aerodynamics), geospatial (mapping, orientation), electromagnetic (jamming, EM spectrum), and cognitive (anticipation, systems thinking, adaptability) competencies.

In conclusion, the effective integration of mini UAV systems into infantry subunits requires an institutional transformation that goes beyond mere technological acquisition. It calls for a paradigm shift in organizational culture, in which the infantryman becomes an active node in a distributed system of real-time information collection, analysis, and exploitation in support of combined operations

10. Conclusion

The rapid acceleration of technological progress in the early decades of the 21st century is driving a profound reassessment of how infantry operates within the modern tactical environment. The integration of mini drones into tactical structures—particularly within infantry subunits—is no longer an experimental option, but an operational imperative with direct implications for doctrine, force organization, and personnel training.

This paper has demonstrated that mini drones can generate significant advantages in terms of informational superiority, precision targeting, reduced human exposure, and expanded maneuver and

response capabilities for combat subunits. However, these capabilities cannot be fully leveraged without a coherent adaptation of the doctrinal framework, sustained institutional training efforts, and a reorganization of the tactical architecture to include dedicated teams and standardized procedures.

The proposals advanced in this study - from embedding UAV teams within platoon and company structures to defining a new concept for tactical airspace management - illustrate the essential steps required for the effective and real integration of these technologies. The mini drone thus becomes an operational extension of the modern infantryman, who no longer operates in isolation, but as part of a digitally assisted and interconnected system.

In this context, infantry faces a dual challenge: doctrinal adaptation and cultural transformation. The modern infantryman is no longer merely an executor of fire and movement, but an informed operator capable of managing data flows, acting within a networked environment, and collaborating with autonomous systems. Adaptability, specialized training, and systemic thinking are becoming essential conditions for future success in military operations.

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References

- [1] Cîrdei, I.A., & Metea, I.G. The Importance of Emerging and Disruptive Technologies in the Military Field. In: National and International Security 2024: Proceedings of the 15th International Scientific Conference [online]. Liptovský Mikuláš: General Milan Rastislav Štefánik Armed Forces Academy, 2024, pp. 38–46. ISBN 978-80-8040-673-8 (online). <https://doi.org/10.52651/nmb.c.2024.9788080406738.38-46>.

- [2] Lupfer, Timothy T. The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War. Leavenworth Paper No. 4. Fort Leavenworth, KS: Combat Studies Institute, 1981. <https://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/leavenworth-papers-4-the-dynamics-of-doctrine.pdf>.
- [3] Porch, Douglas. The March to the Marne: The French Army 1871–1914. Cambridge: Cambridge University Press, 1981. <https://www.cambridge.org/core/books/abs/march-to-the-marne/antimilitarism-and-indiscipline/397EE349B5E83A84C9A3837B5E9AB11F>.
- [4] Harris, Harold D. Effect of Mechanization and Motorization on Tactics. Proceedings, U.S. Naval Institute, vol. 60, no. 5, May 1934, p. 682. Accessed April 23, 2025. <https://www.usni.org/magazines/proceedings/1934/may/effect-mechanization-and-motorization-tactics>.
- [5] Fletcher, David. The British Mark I Tank 1916. Oxford: Osprey Publishing, 2004. Accessed April 26, 2025. <https://tanks-encyclopedia.com/ww1/uk/tank-mark-i/>.
- [6] Guderian, Heinz. Achtung – Panzer! The Development of Armoured Forces, Their Tactics and Operational Potential. Translated by Christopher Duffy. London: Arms and Armour Press, 1992. (Original edition: 1937), p. 140. Accessed May 2, 2025. https://archive.org/details/achtungpanzerdev0000gude_j4e6/page/226/mode/2up.
- [7] Mănescu, G. & Stan, S.E. The Influence of Disruptive Technologies on the Preparation of the National Economy and of the Territory for Defense. International Conference KNOWLEDGE-BASED ORGANIZATION, vol. 27, no. 1, 2021, pp. 204–209. <https://doi.org/10.2478/kbo-2021-0031>.
- [8] NATO Allied Command Transformation. NATO Decision-Making in the Age of Big Data and Artificial Intelligence. Edited by Sonia Lucarelli, Alessandro Marrone, and Francesco N. Moro. Norfolk, VA: NATO ACT, 2021. Accessed May 6, 2025. https://www.act.nato.int/wp-content/uploads/2024/07/20210301_AC-2020_Final-Report.pdf.
- [9] Bojor, L. & Grigore, L. Implementing Small Commercial Drones in Land Forces Operations: Considerations for Optimizing ISR (Intelligence, Surveillance, and Reconnaissance). International Conference KNOWLEDGE-BASED ORGANIZATION, vol. 30, no. 1, 2024, pp. 25–35. <https://doi.org/10.2478/kbo-2024-0004>.