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CURRENT CHALLENGES FOR UTILIZATION OF COMBAT UNMANNED GROUND VEHICLES

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ARTICLE HISTORY

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ABSTRACT

The article deals with the topic of unmanned ground vehicles, esp. their combat versions. Nowadays, the Ukrainian conflict is still in an active phase, and the warfighting of both sides has developed, including new tools and entities on the battlefield. The intention of the article is wide description and summarisation of current state and close future challenges for combat units and their new elements—unmanned ground vehicles. From scientific tools, open-source analysis, extrapolation of results, and expert assessment based on experiences, results of experiments and terrain tests, and factual logic has been chosen. For completing the information, the the MOOSEMUSS acronym was utilized. The inputs are based on practical and scientific results, combining a holistic approach. The point of view represents the community of users—commanders of manoeuvring units, prospectively equipped by unmanned ground vehicles. As a result, is offered synthetised and generalised overview according to principles of war on tactical utilisation of unmanned ground vehicles. The aim of article is not to analyse isolated experience from experimental polygons or battlefield.

KEYWORDS

Maneuver, Mass, Offensive, Objective, Security, Simplicity, Surprise, Unity of Command, Unmanned Ground Vehicle.

INTRODUCTION

The modern battlefield and the character of warfighting are linked with the necessity of utilizing new technologies and procedures (PIERCE 2004; ZAHRADNICEK & BOTIK 2024; Hybrid Warfare Reference Curriculum Volume I, 2024), which are leading to gaining tactical, operational, and strategic advantages and defeating the enemy (HRDINKA, 2024). One of the tools representing this approach is the utilization of unmanned vehicles. These vehicles, in various modifications, play a more or less supportive role in the current conflict. The reason why and how to reverse this situation is covered by this article.

The article is focused on tactical utilization of combat unmanned ground vehicles (UGVs) as a core element of research. The increasing trend of deployment of UGVs is visible from various sources (HRDINKA et al. 2025, p. 122-123; KOMPAN, 2024; HRNČIAR 2025)

Despite this, the role of UGV on the battlefield is still supportive. The logical prediction is when these systems will play a decisive role.

The article is supported by statements and "open sources" dealing with the Ukrainian conflict. Also, previous studies and experiments are incorporated.

Mostly filled-in methods for researching the composition of the article were open-source analysis, extrapolation of results, and expert assessment based on experiences, results of experiments and terrain tests, and factual logic.

For better structuring the article, the acronym MOOSEMUSS has been used. This acronym represents "Nine principles of warfighting" (Marine Corps Institute (U.S.) 1989) and represents Mass, Objective, Offensive, Security, Economy of Force, Maneuver, Unity of Command, Surprise, and Simplicity. The nine principles of war are aids to a leader as they consider how to accomplish a mission. As opposed to being prescriptive steps or actions that must be accomplished, they are guidelines for conducting operations through all the levels of war: strategic, operational, and tactical (United States Marine Corps 2018, 28-32). Sightless adherence to these principles will not guarantee success, but each deviation increases risk. This principles do not change in time, they were valid in past, are valid now and will be valid in future. What is changeable, are devices, tools, methods and tactical variables, specifically Mission, Enemy, Terrain and Weather, Troops and Support Available, Time Available, Civil Considerations. Therefore, the MOOSEMUSS, as a tool, seems to be a good opportunity to describe current problems of utilization of UGVs. Other descriptors were considered (for. ex. DOTMLPFI, SWOT analysis, PICO analysis, FMEA analysis, DMAIC analysis), but they do not follow viewpoint from perspective or military art at tactical level.

1 MASS

The concept of "concentrating the effects of combat power at the decisive place and time to achieve decisive results." Vital to the concept of mass is having the insight to identify the decisive place and time in which to attack the enemy's critical vulnerability. Concentrated fire power is irrelevant if applied to an objective of no significance. We seek mass to overwhelm the enemy in an attempt to deliver the decisive blow. It applies not only to fires but also to supporting elements as well. It is closely related to economy of force, as force available is limited and we must decide when and where it is appropriate to mass or economize our force.

The UGVs enable support for the mass. The lack of manned teams can be supported by UGVs as fire support elements equipped with grenade launchers, machine guns, or cannons. Second, it can be used for supporting operations and enable manned teams to be

deployed in decisive operations. The barriers are lack of autonomy, electronic warfare, and speed of actions and reactions (HRDINKA et al. 2025, p. 131-132). According to current conflict experiences, the combat UGV´s are deployed and in stabilised positions, they fill in gaps between combat outpost of infantry. They support the mass.

Also, current armored vehicles (armored personnel carriers and infantry fighting vehicles) are not equipped with platforms for transporting small UGVs inside the vehicle as part of a section or platoon. This approach is philosophically similar to utilizing antitank rocket launchers as an integral part of the BMP crew (weaponsystems.net). UGVs need to be transported and operated as an integral part of a squad or platoon, which causes utilization at the right time in the right place. The typical tasks, according to ČERNÝ & DROZD (2014), for these elements can be, for example, support by fire, attack by fire, participating in breaching operations, operations for containing, etc. From tests and experiences from operational deployment, they are not ready for utilization in dynamic as a unit performing the main effort.

2 OBJECTIVE

The concept of “directing every military operation toward a clearly defined, decisive, and attainable objective.” Related to mass and economy of force, we must know where to mass and where to economize, which is defined by a decisive objective. It is also related to unity of command, as each subordinate must be led by the intent of one commander towards the commonly defined objective. Communication is also critical, ensuring that the elements of the military operation are acting in consonance towards the same end. (Marine Corps Institute (U.S.) 1989).

These demands seem problematic from the perspective of controlling the UGV. The vehicles must be precisely operated. The specific objective, fulfilled task in the right place against the right enemy, can be disrupted by electronic warfare. Therefore, operating via cables or optic cables as an alternative can be a solution. Using lethal firepower has to be adjusted by man; the target must be verified. Combat identification as a fully autonomous process is still not correctly developed.

3 OFFENSIVE

The concept that we, as a fighting force, are continuously focused on “seizing, retaining, and exploiting the initiative." Maintaining an offensive mindset does not imply that we seek to avoid defence. Rather it implies the use of the defence as a temporary expedient to prepare to resume the offense. Offense being the decisive form of combat, it is the method by which we exploit the enemy weakness, impose our will, and determine the course of war (Marine Corps Institute (U.S.) 1989).

The combat UGV´s have abilities to support the “offensive approach”. Their ability to support by fire manoeuvring elements enable concentrate the power in specific direction or axis, enable movement of manoeuvring elements and keeps enemy pinned down. The firepower is limited by type of weapon, because only heavy weapon with amount of ammunition can be mounted on appropriate chassis. Also, real trafficability of chassis can limit the offence. The small UGV´s can be well equipped by grenade-launchers (JANES 2025) or rocket- launchers (MILLER 2025), what from viewpoint of stability is acceptable solution. The machineguns and rifles, mounted at platform, do not have satisfying ration between lethal effect and consumption of ammunition, when they are not equipped with stabilisation, based on terrain experiments (HRDINKA 2025, p.129-130).

The course of action, based on current conflict is presented on picture bellow, where the UGVs conduct the support by fire, during the units manoeuvre.

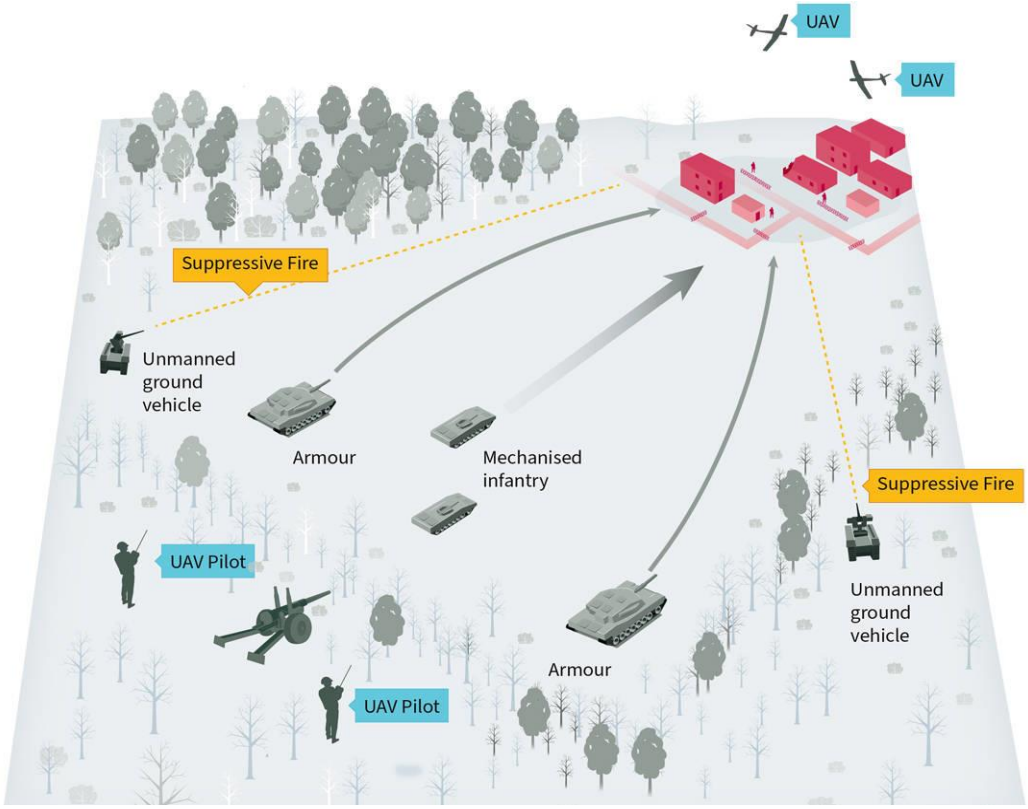

Figure 1 Closing with the Enemy: the role of UGV

Source: Watling, 23 October 2025

4 SECURITY

The concept that we, as a fighting force, are continuously focused on “seizing, retaining, and exploiting the initiative." Maintaining an offensive mindset does not imply that we seek to avoid defense. Rather, it implies the use of the defense as a temporary expedient to prepare to resume the offense. Offense being the decisive form of combat, it is the method by which we exploit the enemy weakness, impose our will, and determine the course of war (Marine Corps Institute (U.S.) 1989).

The combat UGVs have abilities to support the “offensive approach.” Their ability to support by fire maneuvering elements enables concentrating the power in a specific direction or axis, enables movement of maneuvering elements, and keeps the enemy pinned down. The firepower is limited by the type of weapon, because only heavy weapons with an amount of ammunition can be mounted on appropriate chassis. Also, real trafficability of the chassis can limit the offense. The small UGVs can be well equipped with grenade launchers (JANES 2025) or rocket launchers (Miller 2025), which, from the viewpoint of stability, is an acceptable solution. The machine guns and rifles, mounted on the platform, do not have a satisfying ratio between lethal effect and consumption of ammunition when they are not equipped with stabilization, based on terrain experiments (HRDINKA 2025, p.129-130).

5 ECONOMY OF FORCE

The concept of "allocating minimum essential combat power to secondary efforts." This goes hand-in-hand with the concept of mass. ln order for us to concentrate decisive combat power at the decisive point, we must know where to economize forces at our secondary efforts. This also implies an acceptance of calculated risk at these secondary efforts. Limited attacks, defense, deceptions, or delaying actions can help us economize forces allowing us to weight the main effort with mass (Marine Corps Institute (U.S.) 1989).

This principle is extremely valid for utilising not only for UAV´s, but also for UGV´s and in fact it is the reason, why to develop unmanned vehicles. Advanced robotic systems, working autonomously or semi-autonomously enable the commanders safe the manpower for deceisive operations or for activities, where is presence of manned teams essential. Good example can be stabilising operations or counter-insurgency operations (HRNČIAR 2018).

6 MANEUVER

The concept of "allocating minimum essential combat power to secondary efforts." This goes hand-in-hand with the concept of mass. In order for us to concentrate decisive combat power at the decisive point, we must know where to economize forces at our secondary efforts. This also implies an acceptance of calculated risk at these secondary efforts. Limited attacks, defense, deceptions, or delaying actions can help us economize forces, allowing us to weight the main effort with mass (Marine Corps Institute (U.S.) 1989).

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The maneuver is limited. The significant limit is terrain in combination with level of autonomy (KOMPAN 2025). Many scientific studiea are extremely focused on technical solution, but practical impact and results in battlefield are „for discussion“. The remote controlled UGV´s are deployed in current praxis. The idea of combined arms manned-ummanned system is cultivated, and almost every month developed.

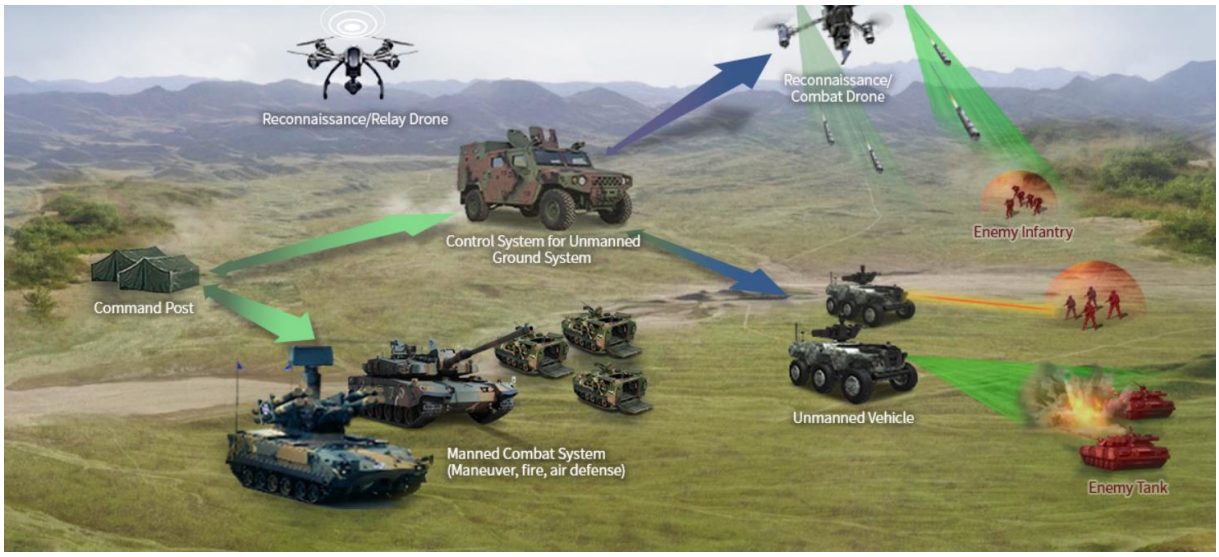

Figure 2 Combined arms: Dronebot combat system

Source: Dronebot Combat System

The proportions of current battlefield are changed according known doctrines. From this perspective, the aerial and ground unmanned systems are extremly valid, because they support mass, concentration and are able to fill-in gaps and empty corridors. Maneuvring is more probable and the operation dynamics is from perspective of movement is to solve. This prevents the situation, where the forces are generaly „positioning“.

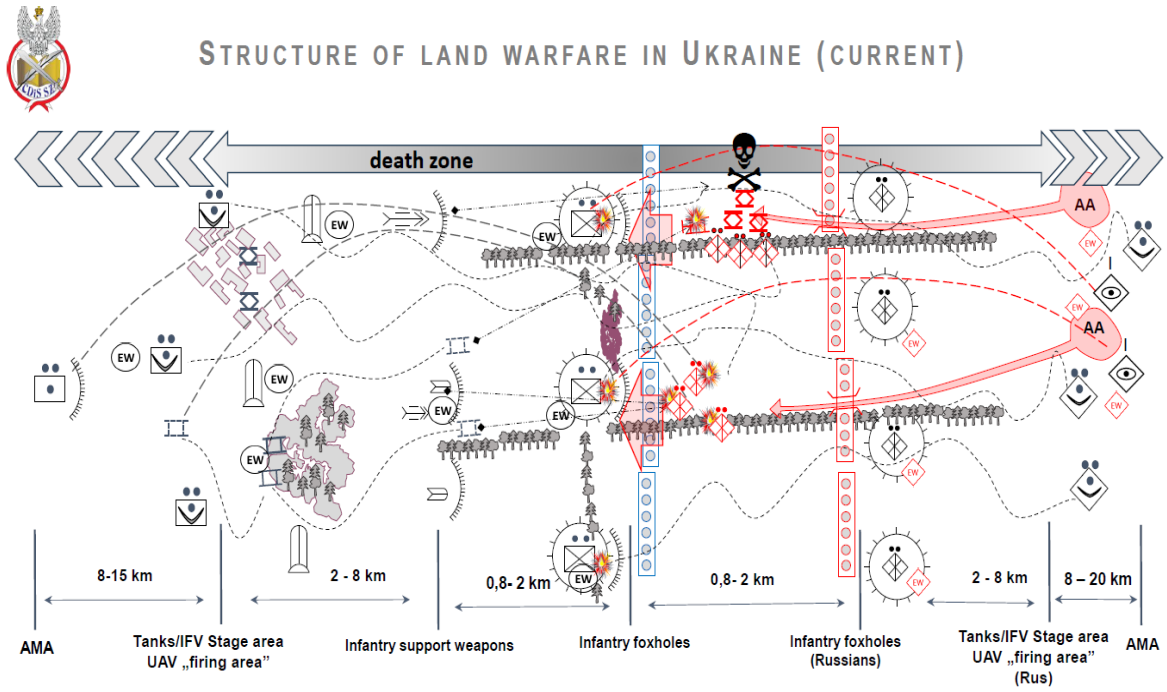

Figure 3 Structure of land warfare Ukraine (current)

Source: Niedźwiecki, 2025

As above mentioned author Niedźwiecki explains,the battlefield leads the commanders to solve, how to boost the movement, dynamics and unblock current general state. Based on discussions, the authors can uderline results from discussion of Future Land Forces conference and recommned: deploy ammount of small hi-tech object on battlefield, duouble or shift some capabilities on drones, fires (combination of massive and precise) will be essential, counter drone capabilities unblock the positioning, electronic warfare needs to be the ability of small unit, not the ability of achelons and formations.

7 UNITY OF COMMAND

Best exemplified by commander's intent, "Unity of Command" is the concept that "for every objective, we ensure unity of effort under one responsible commander." Mass, economy of force, and maneuver would be impossible without the vision of a single leader. To ensure that vision is carried to the lowest levels while still allowing for flexibility and initiative, we use commander's intent. It allows for and leverages mass, objective, and economy of force at the decisive point.

The autonomy of vehicles and "un-crewing" makes pressure to keep them under control, using the principal of unity of command. The task must be clearly understood, and the vehicle's behavior has to follow the orders. In case of adding the vehicles as a part of platoons, every battalion will be reinforced by minimally 9 new UGVs, which can represent the firepower of a large platoon or small company, based on weapon systems. Exponential increasing of UGVs will require a robust command and control system and upgrading related

functions, such as intelligence, surveillance, target acquisition, and reconnaissance. Situational awareness and operational picture will be more dense, and also inputs and analyzing incoming messages will be the next task for small unit leaders. The capacity of communication systems can be a challenge, similarly like in the Ukrainian conflict (SpaceX Starlink internet isn't fast enough for Ukraine's combat robots, 2025).

8 SURPRISE

The concept that we seek to "strike the enemy at a time or place or in a manner for which he is unprepared." It does not require the enemy to be caught unaware, but rather that he becomes aware too late to react effectively. May include the use of speed (maneuver in time), unexpected forces (mass), operating at night (psychological and technological maneuver), deception (psychological maneuver), security, variation in techniques, and use of unfavorable terrain (spatial maneuver) (Marine Corps Institute (U.S.) 1989).

The definition of surprise can be filled by the implementation of UGVs into structures of combat units as well. The "unknown" elements on the battlefield have not only lethal power but also psychological. Based on experimentation by the Department of Tactics, University of Defence, the manned units are attracted by the movement of UGVs. Similarly, like by the presence of drones. This can take away the vigilance of forces and create conditions for tactical surprise. Additionally, the movement to contact, in order to find the enemy or disrupt the enemy, is a logical opportunity for how to implement this characteristic.

9 SIMPLICITY

The concept that the preparation of "clear, uncomplicated plans and clear, concise orders ensures thorough understanding" and therefore ease of execution. Plans and orders should be as simple and direct as the situation and mission dictate. This reduces the chance of misunderstandings that inject internal friction and therefore cause ineffective execution. Ceteris paribus (all variables being equal), the simplest plan is preferred (Marine Corps Institute (U.S.) 1989).

The simplicity of utilization is crucial when using a number of sophisticated systems. Adequate mission tasks, limiting possible failures, are necessary to order. Commanders have to reduce the risks of failures. Again, adequate tasks, right timing, and having contingency plans are the way to reduce possible mistakes. The operators, controlling UGVs from a distance, do not have a 3D view, like the foot soldier. The UGVs are not so quick in reaction or are extremely quick in reactions. It can cause unpredictable situations.

CONCLUSION

The UGVs, similarly to other elements on the battlefield, have to adopt principles of warfighting because they are part of a warfighting organism—a hybrid military system.

Overall output from this study is that UGVs are not developed for autonomous acting from the viewpoint of tactics. They can be able to conduct „isolated" actions, but they are not fully technically prepared to replace soldiers or crews. On the other hand, they demonstrate opportunity, how to support their own capabilities, and how to increase combat effectiveness. The core of development is in experimentation in real or almost real situations and adapting not only machines but also operators and commanders (ZAHRADNÍČEK et al. 2023).

The authors are convinced that the principles described in the acronym MOOSEMUSS are influencing each other according to the matrix. Therefore, the real abilities of UGVs are related also.

Table 1: MOOSEMUSS matrix

	M	**O**	**O**	**S**	**E**	**M**	**U**	**S**	**S**
M	x								
O		x							
O			x						
S				x					
E					x				
M						x			
U							x		
S								x	
S									x

Source: Own

The key message of the article was described in chapter 6. Not only unmanned systems, but whole approach to modern warfare has to be adopted. The combined arms, equipped by family of drones, operated in planned frequence, sequence, tempo in small groups or separately will be essitial. The battlefield will be inflated, according to new abilities of devices (esp. range of fire, precision). This creates significant change comparing valid doctrines from WW2 to 2022.

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