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Mini Review



# RAND Wargames Explore Potential of Remotely Operated and Autonomous Ground Combat Vehicles

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## Mini Review

The U.S. Department of Defense (DoD) has initiated several efforts to accelerate development and fielding of warfighting capabilities incorporating artificial intelligence and machine learning (AI/ML). As part of those efforts, the U.S. Army—Army Futures Command's Next-Generation Combat Vehicle Cross-Functional Team (CFT)—is developing robotic combat vehicles (RCVs) to determine the feasibility of integrating unmanned vehicles into ground combat operations. The vehicles are potentially to be fielded in the 2020s. [1,2]. The CFT, with the assistance of several Army research and development labs, including the Army Artificial Intelligence Integration Center, is also looking beyond the RCVs to develop autonomous combat capabilities within the Army [3]. The RAND Corporation recently developed and ran a series of tactical tabletop wargames to explore the potential for incorporating realistic AI/ML–enabled capabilities in such games and to take a preliminary look at the utility of certain AI/ML-enabled systems in ground combat [4]. The games involved hypothetical company-sized combat engagements in the Baltic States in the 2030s between Blue (U.S.) and Red (Russian) forces. In the first, baseline, game, the Blue force, a mechanized company task force, was equipped with remotely operated (RO) light- and medium-weight robotic combat vehicles (RCV-Ls and RCV-Ms) operated under the continuous control of soldiers (as envisioned by the Army for relatively near-term fielding). Both types of RCVs were lightly armored vehicles armed with anti-tank guided missiles. The Blue force was also equipped with remotely-operated unmanned aerial systems (UAS or drones) usable for reconnaissance. In the second, AI/ML, game, the RCVs were assumed to operate fully autonomously, executing movement and enemy engagements without human intervention but consistent with orders provided by their company commanders. (Such capability arguably goes beyond what would be permitted by current DoD policy on autonomous weapon systems [5].) The forces in both games were otherwise equipped as they might be in a conflict in the Baltic States circa 2030. The Red force was the same in both games: a motor rifle company task force equipped with manned systems. It possessed neither RO nor autonomous vehicles. The game setting was in a rural area with mixed wooded and open terrain. In both wargames, the Blue force was given the mission of attacking and defeating the Red force. Putting Blue on the offensive stressed the command and control capabilities needed to operate the RCVs and the autonomous vehicles more than the tactical defensive would have. The game players were RAND analysts who were former field-grade Army officers with operational and wargaming experience, technologists with expertise in AI/ML, and an Army general officer with both technological expertise and operational experience.

Developing the games required the research team to devise rules necessary to allow the RO and autonomous vehicles to operate in the games as it was envisioned that they would operate on the battlefield. They primarily concerned the command and control of the vehicles and were based partly on assumptions regarding their future performance. The RO RCVs had to be under positive control by human operators at all times to be effective. Each human controller team could control one RCV at a time. The Blue company possessed two infantry fighting vehicles that carried two controller teams each. The RO RCVs also had to be within line of sight of a controller vehicle, at a maximum distance of 2.5 km. Communications between controller vehicles and RO RCVs could also potentially be jammed (which would cause the RCVs to temporarily hold in place). The RO RCVs' only autonomous capabilities were to follow other Blue

vehicles in line when moving. RO RCVs fired their weapons only under the direct remote control of their human operators.

The autonomous RCVs, by contrast, could act on their own after receiving orders from their human commanders. This reflected the cognitive capabilities of the vehicles that the research team deemed potentially achievable by the 2030s. The autonomous vehicles could follow simple orders (e.g., maneuver in formation, navigate in all but the most complex terrain, and engage targets following simple logic) but could not follow more-complex mission-type orders or operate independently (as human-crewed vehicles could). The autonomous RCVs were able to execute unambiguous fire orders as directed (e.g., "fire on enemy unit X," "fire on enemy in direction Y," "fire on enemy in geographic area Z"). Once such fire orders or permissions were given, further interaction or confirmation with humans was not necessary. Running the games yielded several preliminary observations related to the advantages and disadvantages of RO and autonomous vehicles in combat operations that should be explored further in subsequent wargames and analyses. In the baseline game, the need to maintain line-of-sight communications with the RO vehicles imposed constraints on Blue forces, slowing the pace and complicating the management of Blue's advance. The Red force's effective use of jamming substantially limited Blue's ability to use those vehicles. The potential ability of an enemy to interfere with communications with RO vehicles and its effects should be studied further. Such exploration could involve more tactical gaming, with different assumptions regarding the communication requirements of the RO vehicles. In addition, the physical systems could be field-tested to assess the practical vulnerability of the vehicles to communication interruption, as was assumed in the game.

In the baseline game, the Blue force was also limited in the number of RO RCVs it could commit to action at any time. Controller vehicles were able to command only two RCVs each, preventing Blue from massing RCVs against a Red position. In contrast, there was no such limit on the fully autonomous vehicles. They could be committed as desired, potentially all at once, as long as the commanders did not demand that they execute overly complex orders. That assumption was in line with reasonable extrapolations of the state of technology in the foreseeable future. It was implemented in the game by limiting the bandwidth of the orders Blue could give to the autonomous vehicles. The potential performance of future RCVs, and thus the benefits of AI/ML–enabled combat vehicles, should be explored further to guide the development of these capabilities.

In both games, the players treated the RCVs as being more expendable than crewed vehicles. RCVs were always the first vehicles Blue moved forward and the first to take direct fire. The players said that the RCVs, whether RO or completely autonomous, were used essentially as bait because doing so did not put soldiers at risk. Moreover, loss of the RCVs seemed, at least initially, not to cause the Blue force commanders substantial regret, because the RCVs' offensive capabilities (especially those of the RCV-Ls) were limited compared with those of other vehicles (infantry fighting vehicles and tanks). Whether RCVs would be viewed by real commanders as essentially disposable could and should be examined in future games, including situations in which the players (commanders) are informed that the cost to replace the RCVs is high and their inventory is limited, or situations in which the RCV-equipped force must conduct multiple engagements in sequence without reinforcement.

These wargames could not yield definitive conclusions about the utility of AI/ML systems in combat. Nonetheless, they suggested some preliminary observations about both AI/ML and the utility of wargames employing it that could be useful to further research with games or with AI/ML systems.

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## Conflict of Interest

No Conflict of interest.

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