

CONCEPT OF IED/EOD OPERATIONS (CONOPs) FOR ENGINEER MISSION SUPPORT ROBOT TEAM

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Abstract

Concept of Operations is the first tool being used in capabilities approach to define military needs being very important task in the beginning of the Life Cycle Management process. The inputs to this process are defined based on the scenarios resulting from the Lessons Learned experience. It creates the technology needs for the new military systems and simultaneously the links between militaries, scientists, designers and producers. The success of missions at the very dynamic contemporary battlefield will heavily dependent on functionality engineering forces taking part in them after all at the very low level of command. The main task of engineering forces that are realized within the convoy protection mission aims at greater soldiers' safety. The efficiency of convoy protection demands a systemic approach and the need to build the system of remote controlled Unmanned Ground Vehicles (UGV). The design of Improvised Explosive Devices (IED), after all their initiating systems, makes Explosive Ordnance Disposal (EOD) missions practically impossible to be realized by humans. The concept of systemic approach to use the remote controlled Unmanned Ground Vehicles for convoys' protection based on Lessons Learned experiences is presented in this paper.

Keywords: *Concept of Operations, Unmanned Ground Vehicles, robot team*

1. Introduction

Some issues presented in this paper were also discussed and some materials were presented during the 35th Applied Vehicle Technology (AVT) NATO Science and Technology Organization Panel Meeting Week within Specialists' Meeting AVT-241/RSM-022 on: Technological and Operational Problems Connected with UGV Application for Future Military Operations that was held from 20-22nd April 2015 in Rzeszow, Poland.

The specific nature of the tasks carried out on the modern battlefield and during the rescue operations carries risks to the health and life of soldiers or lifeguards. Moreover, modern combat operations are characterized by high manoeuvrability. For this reason, troops must have the ability to move quickly into new areas. At these times, equipment and soldiers are moved by means of vehicles formed in marching columns. The experiences of the last few years have shown, these become the object of frequent attacks. To prevent them, adequately insured convoys are formed. The main threats are various types of explosive charges. These may be classic mines, but increasingly we are seeing the use of improvised explosive devices (IEDs) and booby traps [4]. To ensure an adequate level of security, forces must have the ability to detect, identify and neutralize these threats.

It is estimated that approximately 50% percent of the casualties among soldiers involved in missions in Iraq and Afghanistan were victims who suffered as a result of the IED explosions [1, 4]. The increasing distribution of IEDs is related to their low cost. At the same time, these devices have proved to be quite an effective method of restricting or retarding the rate of enemy action. In addition, we must not forget the psychological consequences that arise from this type of threat.

For these reasons, adequate security of convoys is essential for their safety and the pace of their progress over terrain. It should be kept in mind that troops should not only have the ability to detect such explosive charges, but also stimulate these devices.

Improved effectiveness of operations in risk zones can be achieved through the introduction of remote-controlled Unmanned Ground Vehicles (UGVs) equipped with appropriate attachments controlled by a tele-operator system [5]. In this way, the operator is removed from the zone of immediate danger to life and health, and the robot's operating capabilities will enable long-term operation in extreme conditions.

2. Organization of convoys

Initially, during the mission in the Middle East, troops moved around on paved roads. Which is why the adversary mainly placed charges on the roadside. Due to insufficient knowledge concerning the construction of IEDs and the methods for their detonation, no specialized sensors were then employed [3]. Detection of charges consisted only of observation of the terrain by soldiers.

Troops frequently moved around using light off-road vehicles (HUMVEE). On discovery of a potential threat, one of the crewmembers would be sent to determine the nature of the suspicious item. If necessary, he was also meant to neutralize the hazardous charge. He could do this by disarming the device or applying an explosive charge to it. Fig. 1 shows the organization of such a convoy.

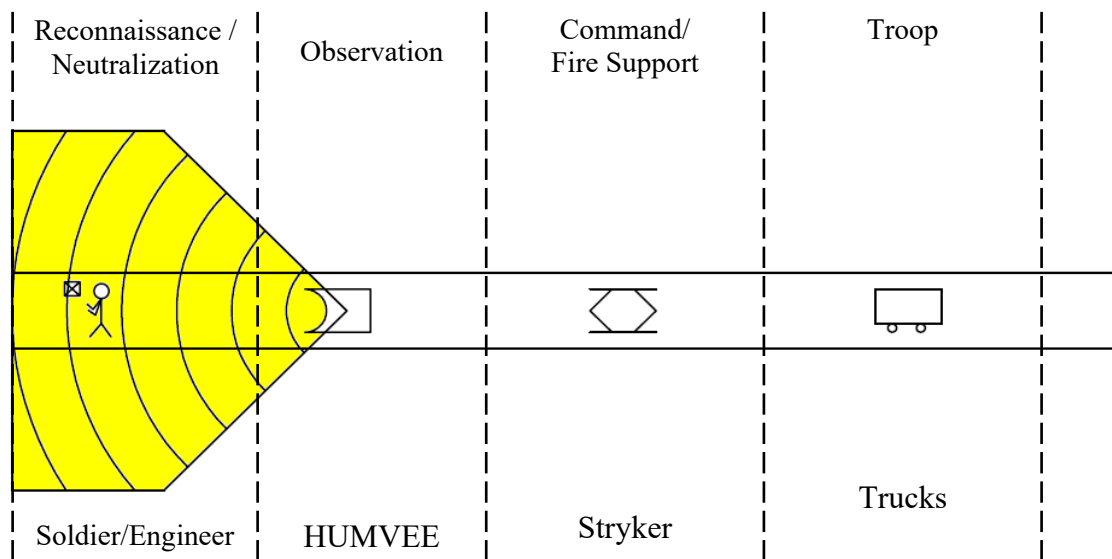


Fig. 1. A convoy's initial formation

This approach proved to be very ineffective. Because the adversary started to appropriately, secure charges, which meant a growing threat to the life and health of engineers. In order to eliminate the need for soldiers to come into direct contact with the explosive charge, they began to use small, remote-controlled robots and MRAP type vehicles (Mine Resistant Ambush Protected) (Fig. 2) instead of HUMVEE. Thanks to their better armour and the use of a V shaped chassis, these have a much higher resistance to explosive charges. They could be equipped with a manipulator with a double-toothed grabbing device and a single spike on the opposite side. This allowed a cursory inspection of any element. Due to the low mobility of these vehicles to identify and neutralize IEDs in difficult conditions, remotely controlled robots continued to be used. In addition, forces also began to use special booms. These made it possible to initiate detonation of explosive charges by means of a photocell, before a vehicle was in the danger zone.

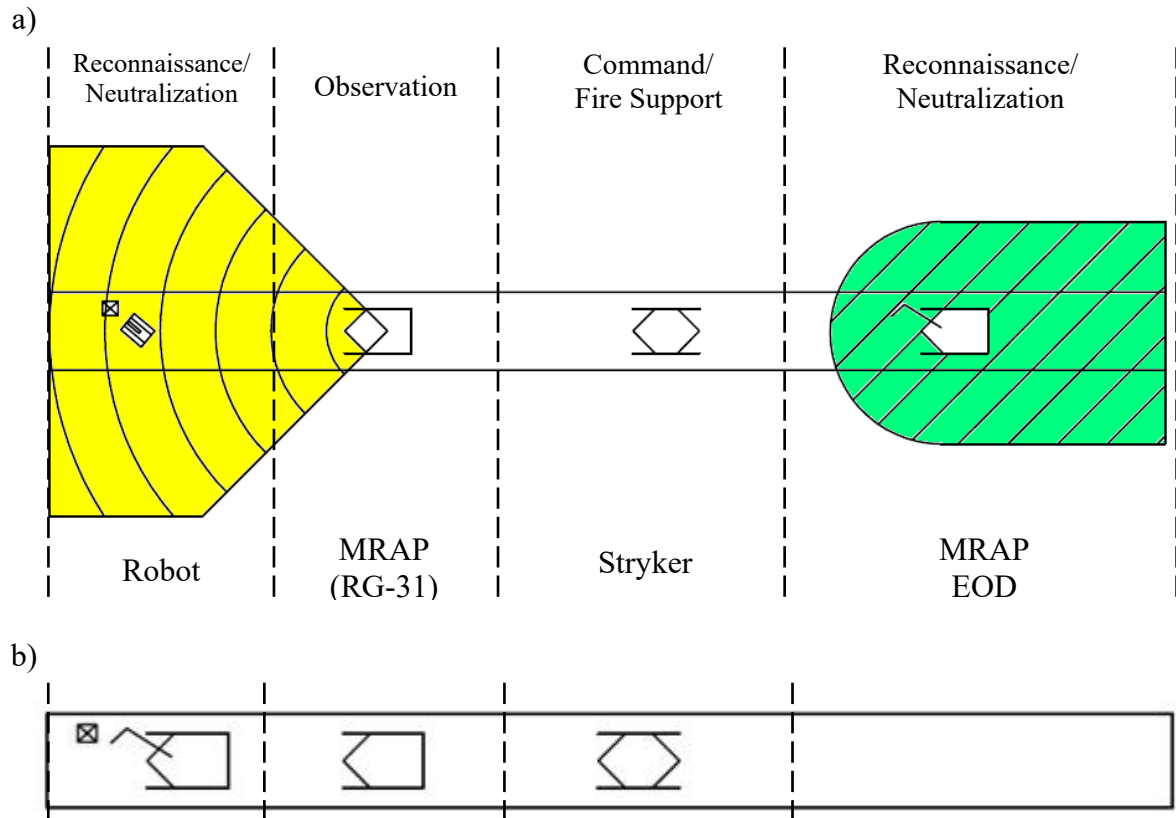


Fig. 2. Formation of a convoy with MRAP vehicles, recognition of charges using: a) a remote-controlled robot, b) a vehicle with a manipulator

During the mission in Afghanistan, columns mainly moved around on unpaved roads. Explosive charges were placed not only on the roadside, but also in the traffic lane. This meant with the need to conduct reconnaissance along the entire crown of the road [2]. The security tactics developed because of operations in Iraq proved not very effective.

Due to charges being placed in traffic lanes, work began on a new vehicle. This was to move in front of the column to detect and neutralize all dangers in the way of the march. In the initial stage, these vehicles, purchased in South Africa, were Meerkat MDVs (Mine Detection Vehicles). This vehicle's characteristic feature is a short, armoured hull with a one-man cabin and a "V"- shaped floor pan. However, the most important feature was two modular sets of wheels protruding beyond the outline of the cabin. Their design allows for quick repair of the drive chain following the explosion of a charge.

Thanks to its low weight and reduced pressure in its tires, the Meerkat is characterized by a reduced risk of detonation of classic anti-tank mines with pressure detonators. In order to detect these, mounted beneath the engine compartment is a 3-meter wide induction metal detector. Its effectiveness was thus restricted to explosive structures with a metal casing. This shortcoming was somewhat offset by the vehicle's resistance to explosions from anti-tank mines, as well as a 7-kilogram charge of TNT.

The Meerkat's limited reconnaissance capabilities led to work being started on a new design. The result was the Husky vehicle. Its construction was very similar to its predecessor. However, it was characterized by greater length and weight (nearly 7,000 kg), and was driven by both axles. Apart from an inductive detector, the front of the vehicle featured a special boom on which GPRs (ground-penetrating radars) could be mounted. This gives the possibility of also detecting charges that do not contain metal parts.

Another modification of the convoy formation was to replace the MRAP EOD vehicle (due to the manipulator's limited operating capabilities) with the Buffalo vehicle. This vehicle has a high

resistance to detonation of explosive charges. It can withstand an explosion of approximately 20 kg of TNT under a wheel, and 14 kg beneath the floor pan of the hull. On the front bumper is mounted a rotary arm of considerable length (10 meters) thanks to which it has a broad operating range. In addition, there is a camera mounted on it, thanks to which one can check such places as the hard shoulder, culverts and road barriers. The manipulator is equipped with a nine-toothed grabbing device with a single spike on the opposite side. The arm's strength allows it for instance puncture an asphalt road surface.

Bringing up the rest of the column were several MRAP vehicles, mainly RG-31A2s, which are used to command the team and transport soldiers and equipment. In this vehicle are also carried (one or two) small remotely controlled robots, which are used to identify and neutralize IEDs. Initially, these were carried inside the vehicle. To take any action, the operator had to leave the vehicle. This exposed him to enemy action. Therefore, as a modification, special lifts were later used, allowing the use of the robot without soldiers needing to exit the vehicle.

In order to ensure even greater safety when troops are on the move, a SPARK (Self-Protective Adaptive Roller Kit) was introduced. This was pushed by one of the RG-31A2s.

To increase capabilities of system the Husky vehicle was additionally equipped with a GPR (ground-penetrating radar). In the case of navigating two-lane roads, two Husky-type vehicles and SPARKs were used, heading the column. If a threat is suspected, a small robot is used to identify and neutralize potential explosive charges (Fig. 3). This is also sent out to check culverts under the road. This task can also be performed by the Buffalo vehicle.

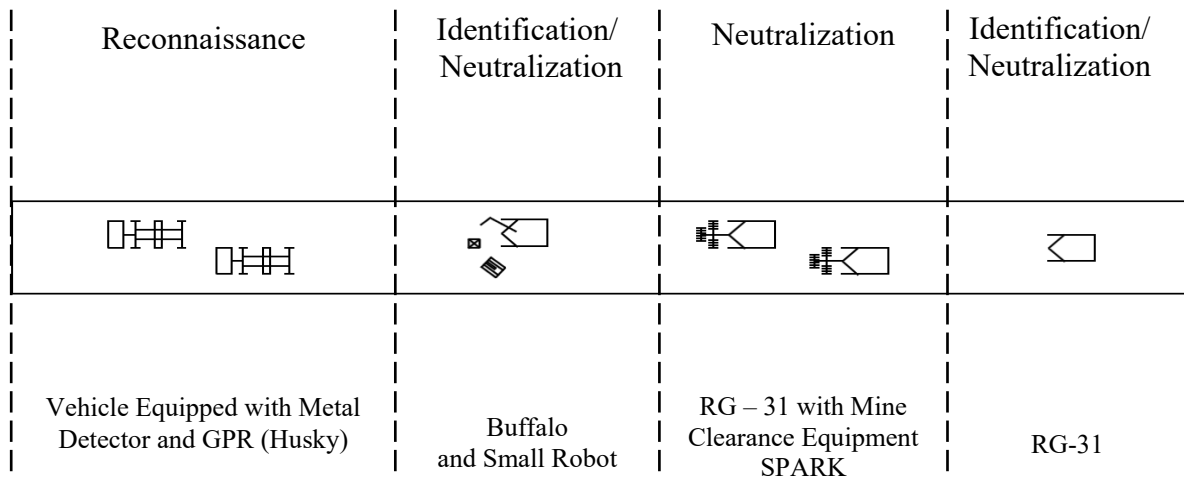


Fig. 3. Formation of a convoy on a two-lane road with Husky vehicles using GPR (Ground-penetrating radar) and Buffalo vehicles with small robot taking detection and neutralization action against a threat and SPARK Self-Protective Adaptive Roller Kit

The positioning of particular vehicles in the column depended on many factors. The following had a decisive influence:

- type of road,
- quality of the surface,
- experience of IEDs having been previously place on a particular road.

The avoidance of rigidly defined tactics also made it difficult for the adversary to take effective sabotage action.

3. Summary

Lessons Learned experience gathered during missions in Iraq and Afghanistan allow to conclude that the use of various types of measures reducing the freedom of manoeuvre of

marching columns may effectively reduce the pace of operations. This is also shown by the military operations that are currently taking place in different places in the world. For soldiers not only the physical threat but also, even after all, psychological impact is important to be considered. Any effort to increase safety measures involves the introduction of measures to detect and neutralize threats. So far, manned vehicles have mainly been used to guard convoys.

Due to the authors, to be able significantly improve the safety of troops executing engineering missions, unmanned solutions should be implemented on a larger scale. The proposed concept for a task force convoy formation is based on robots performing mission to protect moving troops. This would move ahead of the appropriate column, at a distance of at least 200 m. They should monitor not only the crown of the road but also its immediate surroundings. For the time being, there are no solutions that could effectively perform this type of task. That is why it is possible to formulate such a thesis that it is necessary to develop new types of robots that will be able to overcome terrain obstacles, would be adapted to the area of operations – detect, recognize and utilize the threats. Another serious challenge is to adjust their performance to the expected speed of movement of the military column.

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