10.12753/2284-9378-19-13

# APPLICATIONS OF UNMANNED SYSTEMS IN MILITARY LOGISTICS

*Lieutenant-colonel Eduard Grigore JELER, PhD Student**
*Colonel (ret). Gelu ALEXANDRESCU, PhD***

In the changing conditions of the operational environment and facing the new security environment which is the most complex and the most ambiguous ever, the nature and the size of threats at the address of security changed a lot. Because of that, the modern army started looking for alternative or better options to exceed this challenge. In the current conflicts, the emergence of autonomous systems represented an opportunity but also a challenge for the armed forces, offering on the battlefield a number of advantages such as increasing the force, speed, response of reaction, precise coordination but also disadvantages such as lack of motivation and flexibility of human intelligence. Combining the best elements of the human-machine team can increase the capacity of future armed forces. The challenge is determining the proper balance between man and machine. Currently autonomous systems are already capable of eliminating the human presence in solving many tasks performed by the military and have the ability to improve over time. The purpose of this article is to analyze both existing and potential uses of autonomous systems in military logistics, focusing on the advantages and risks for military organizations and operations.

**Keywords:** Unmanned Systems; military logistics; AS/RS; UGV (Unmanned Ground Vehicle); UAV (Unmanned Aerial Vehicle); AVS/R.

## Introduction

Throughout history technological developments have influenced the way of waging a war (the weapons used by the military have evolved from swords and spears to firearms), military commanders have come to understand that victory is closely linked to having enough units, soldiers, weapons and assets at the right time and place. In other words, logistics became an essential part of military operations and the superior logistics capabilities gave the military a competitive advantage. Yet, the human resource as well as the others is not infinite. For this reason, the modern army tried to replace this resource with autonomous systems[1].

The development and use of autonomous systems appeared from the need to transport essential logistics goods to a war zone. Together with the remote control (teleauto) invented by Nicola Tesla, in the battlefield of World War I, new, interesting technologies were also introduced which a few years earlier were SF – autonomous systems and unmanned weapons. These appeared like a possible solution when the war entered a deadlock. So the "electric dog" appeared, a three-wheeled trolley designed to follow a light spot emitted by a flashlight, an armored tractor which was designed to move alone and detonate 450 kilos of explosives in enemy trenches, and as the air drone appeared Kettering Bug, a small plane flying on the basis of a gyroscope and then crashing over a target[2,3]

## Current applications and future possibilities of using autonomous systems in military logistics

To face the challenges of current conflicts, the organization of logistic processes requires methods to optimize physical processes in order to offer end users faster, better and more profitable services by applying innovative technologies. More and more autonomous systems have the potential to play a key role in military operations. The main missions of the autonomous systems, without closing the list, in the military logistics are presented in Figure 1.

**Ministry of National Defence*
e-mail: eduard_ jeler@yahoo.com
***"Carol I" National Defence University*
e-mail: *alexandrescugelu@yahoo.com*

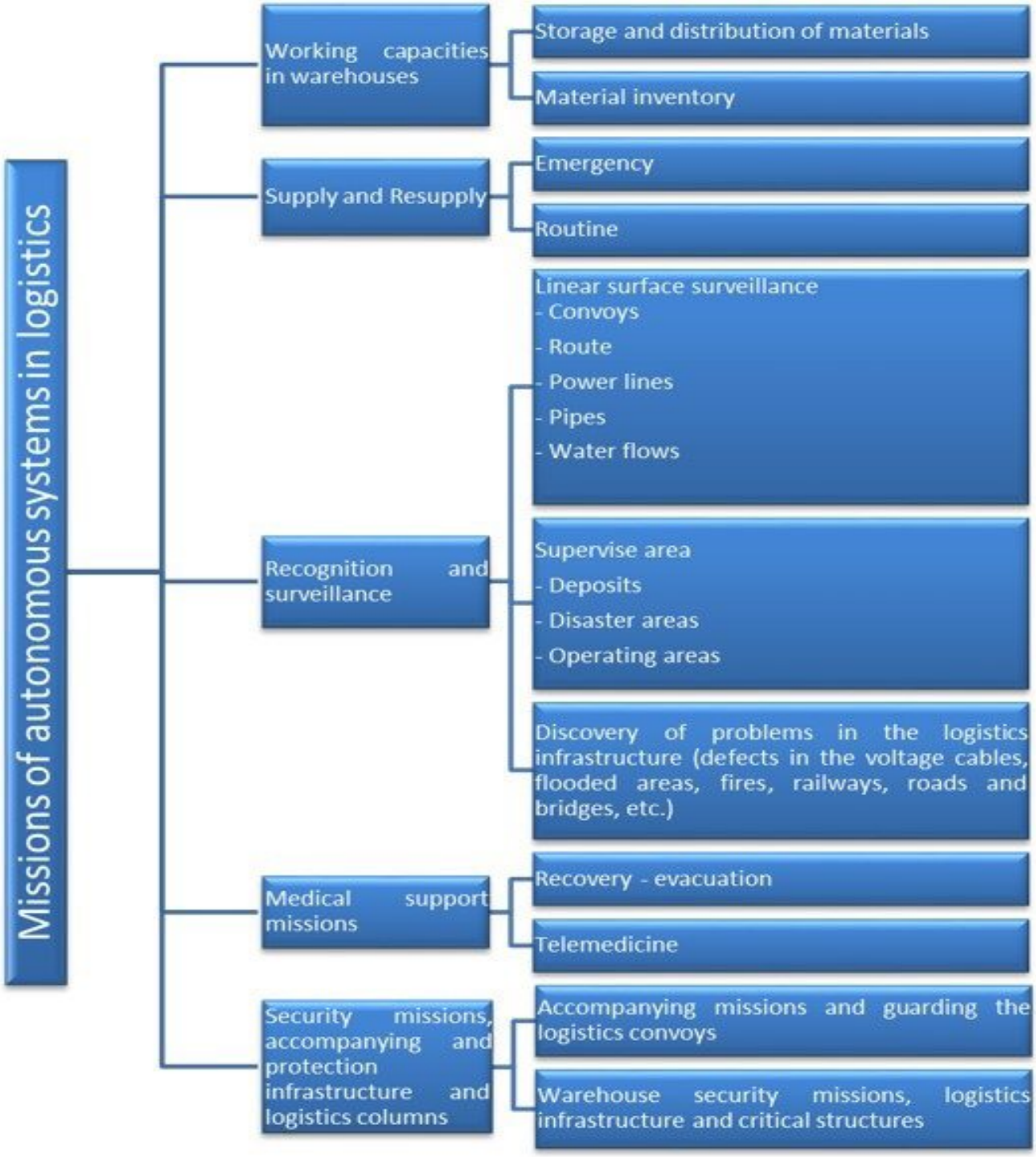


**Figure 1** *Possibilities of using autonomous systems in military logistics*

**Use of autonomous systems in warehouses**

Within the military structures there are a lot of warehouses where you have to work permanently and without interruptions. Inside the warehouse they carry out logistic tasks such as material handling, packing – unpacking, storage maintenance, inventory etc. Warehouse operations tend to be laborious and require large space for facilities. Large buildings are needed for storing materials on shelves, moving stocks, unloading and loading. These tasks require a large number of personnel performing routine, boring and sometimes even dangerous operations (handling ammunition and explosive materials). All warehouses are inventoried by people and sometimes this causes problems due to human factors. In this context, the concept of deposit automation emerged[4,5]. Although the concept seems new, the first automated

warehouses appeared in 1960 in Germany using the concept of AS / RS (Automated Storage and Retrieval System)[6,7]. Figure 2 shows a classic AS / RS system.

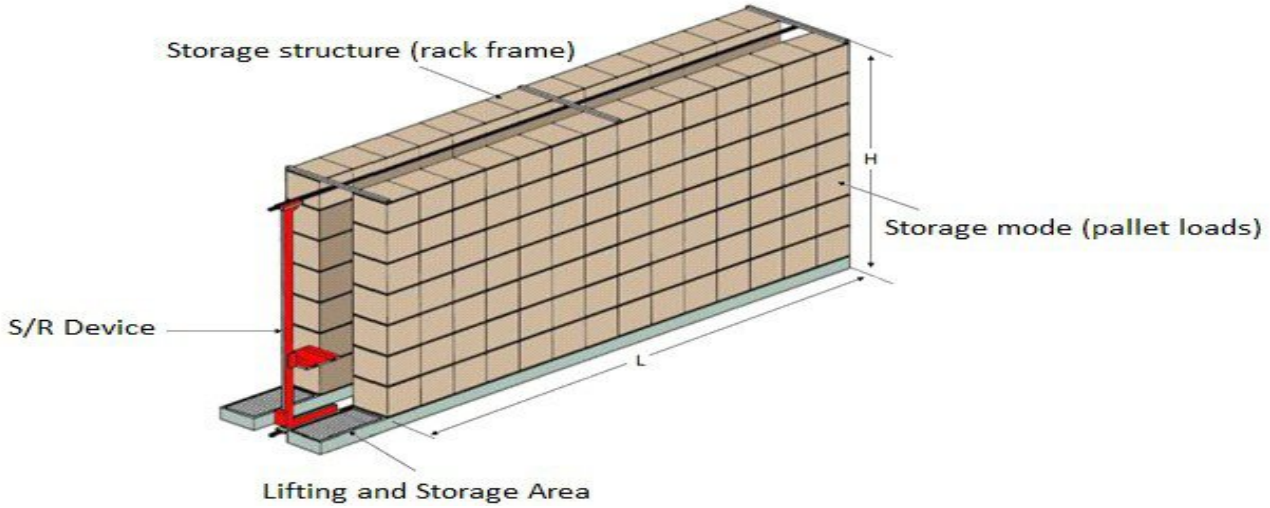


**Figure 2** *Graphical presentation of the AS / R system*[8]

It is an automated system for entering - storing - removing materials and consists of a variety of computer-controlled systems for automatically inserting and removing loads from defined storage locations. They have a number of advantages such as the possibility of moving into and from the warehouse of a very large volume of loads, the increase of the storage density; the fact that it does not require additional costs related to the training and salary of a person handling the materials[9].

In the last period, regarding the automation of deposits, the emphasis has been placed on AVS/R (Autonomous Vehicle Storage and Retrieval System) systems. Figure 3 shows the basic elements of an AVS / R system.

These systems use pallet racks, with each other being passage corridors and using automated guided vehicle systems that operate at every level in each aisle. Vertical transport is carried out with the help of elevators[11]. Figure 4 schematically shows the flow in a warehouse with AVS/R and AS/RS systems.

Another possibility of using autonomous systems is the inventory of the materials in a warehouse, necessary having as a condition of accomplishment the standardization and the use of bar code labels. Figure 5 presents a fully automated inventory of logistics materials. An Unmanned Ground Vehicle (UGV) moving near each rack is used as a ground reference for UAV

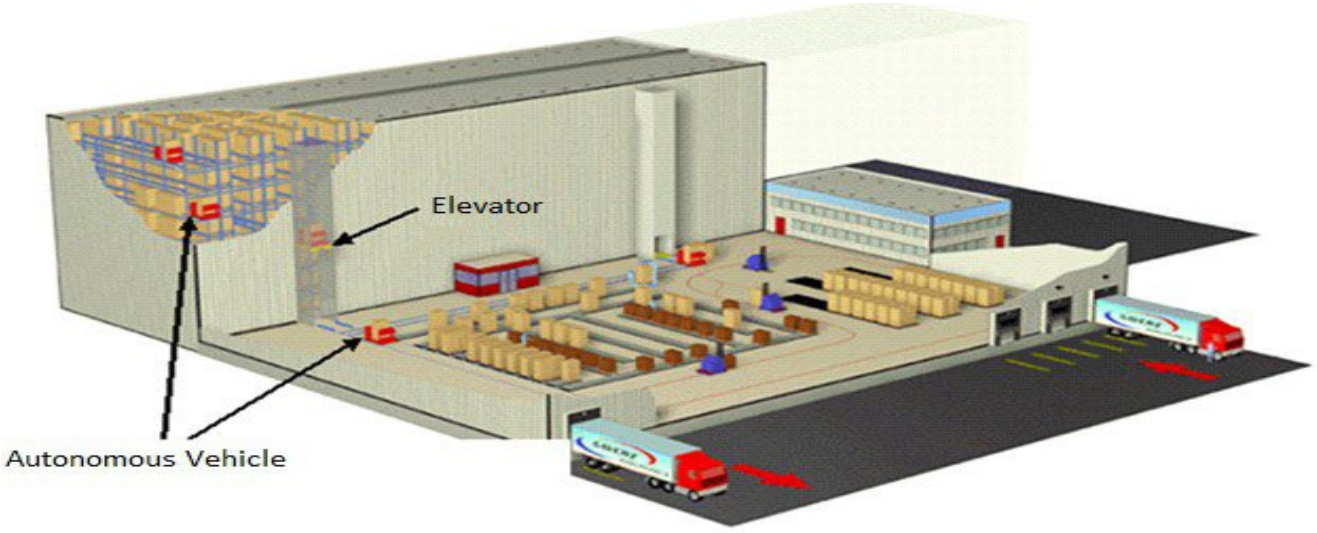


**Figure 3** *Storage system AVS/R*[10]

(Unmanned Aerial Vehicle) flight which is used as a mobile scanner that flies vertically to scan bar codes[13].

forces are recorded when supplying the fighting forces in direct contact with the enemy. For this reason, autonomous systems can be used for the

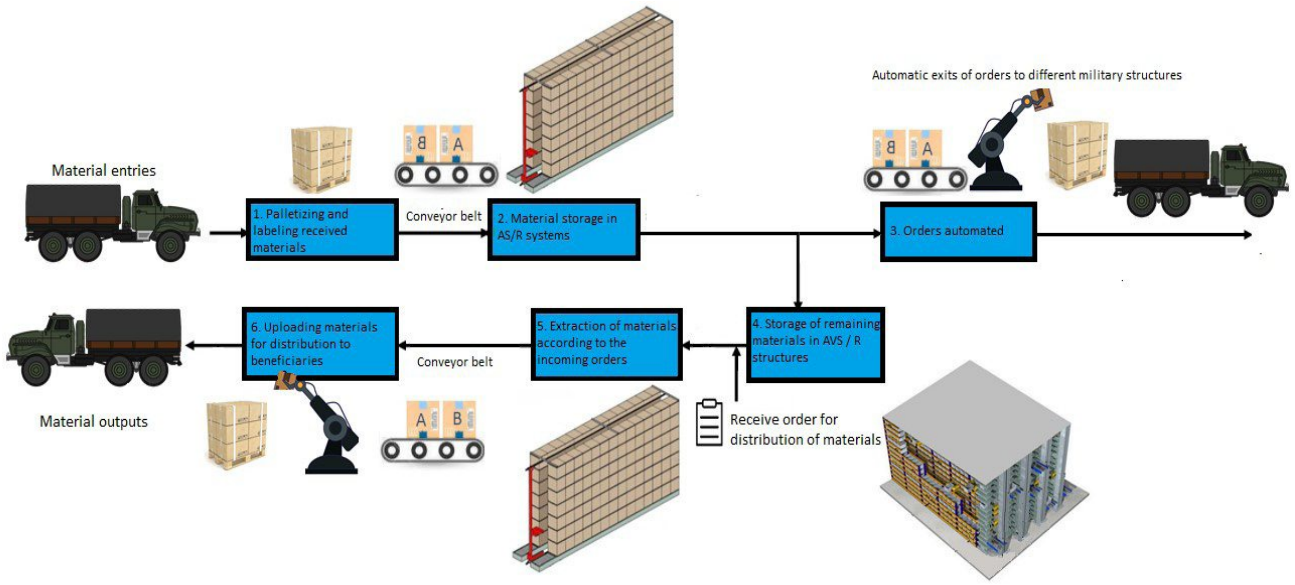


**Figure 4** *Flow in a warehouse with AVS/R and AS/RS systems*[12]

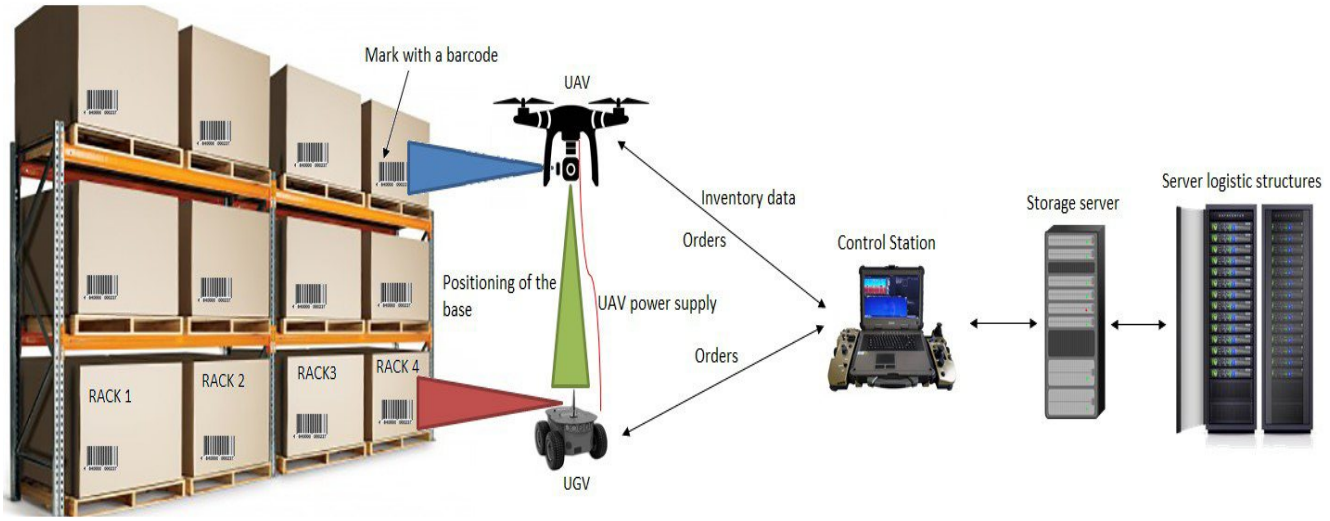


**Figure 5** *Inventory diagram of an automated warehouse*[14]

**Use of autonomous systems in surveillance missions, guarding and accompanying logistic facilities and convoys**

Autonomous systems can be used for reconnaissance and surveillance activities to provide logistics convoys; identifying and if possible, neutralizing the potential dangers for logistics convoys or offering solutions to avoid ambushes, surveillance of pipes, power lines, rivers, supply depots, contaminated areas, etc. The largest number of human losses within the logistics

supply of units in combat to avoid personnel losses. In Figure 6 cases of supply of combat forces[15] are possible.

In studying the conflicts, it was found that most victims of medical personnel during battles occur after the treatment of soldiers under fire and among the fighters there are many victims when they provide assistance to injured comrades. At the same time, human medical personnel have difficulty performing interventions in dangerous areas (e.g. mined) or NBC contaminated. Autonomous

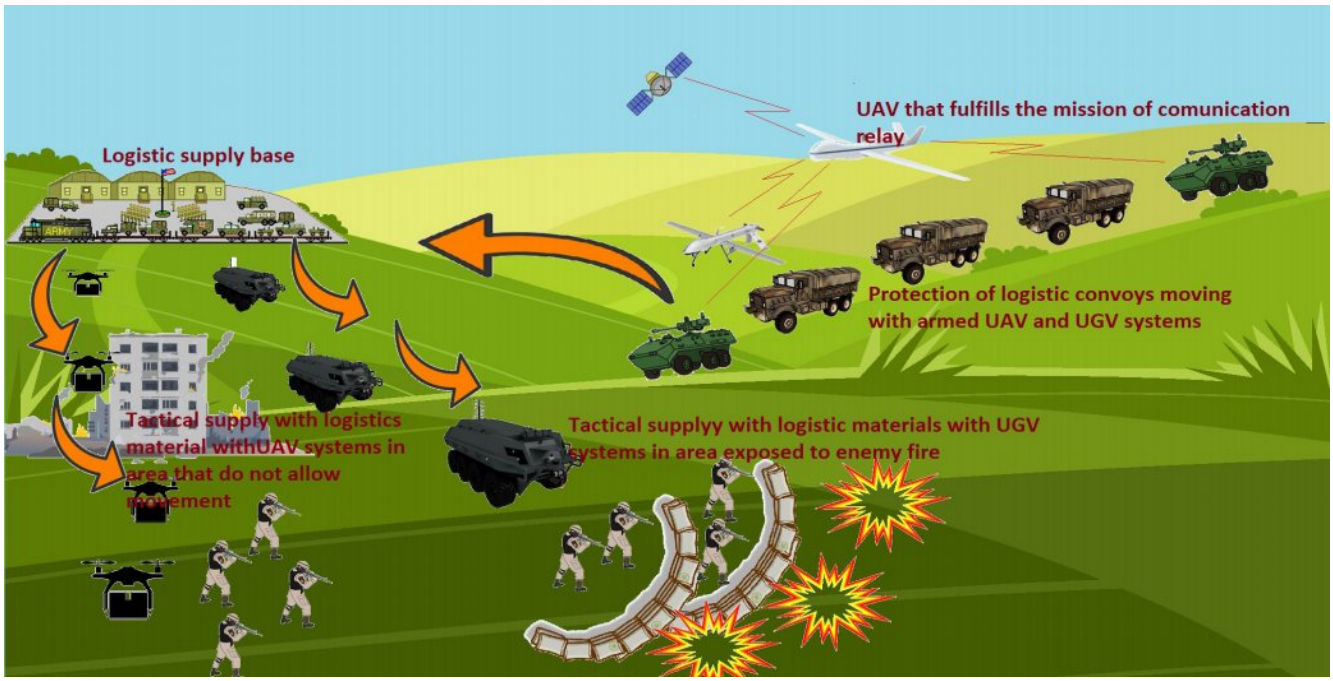


**Figure 6** *Possibilities of supplying with autonomous systems the forces in contact with the enemy*[16]

systems can have a number of applications such as: location, extraction and tactical evacuation of wounds, route care during transport of the wounded military man, delivery of medicines, telemedicine[17,18]. An operational conceptual scheme is presented in Figure 7.

**Conclusions**

Autonomous systems play a key role in military operations, respectively in military logistics. These tendencies for the development of autonomous systems present both an opportunity and a challenge for the military as well as for the political decision makers. Such systems have the potential to provide more effective military force on the

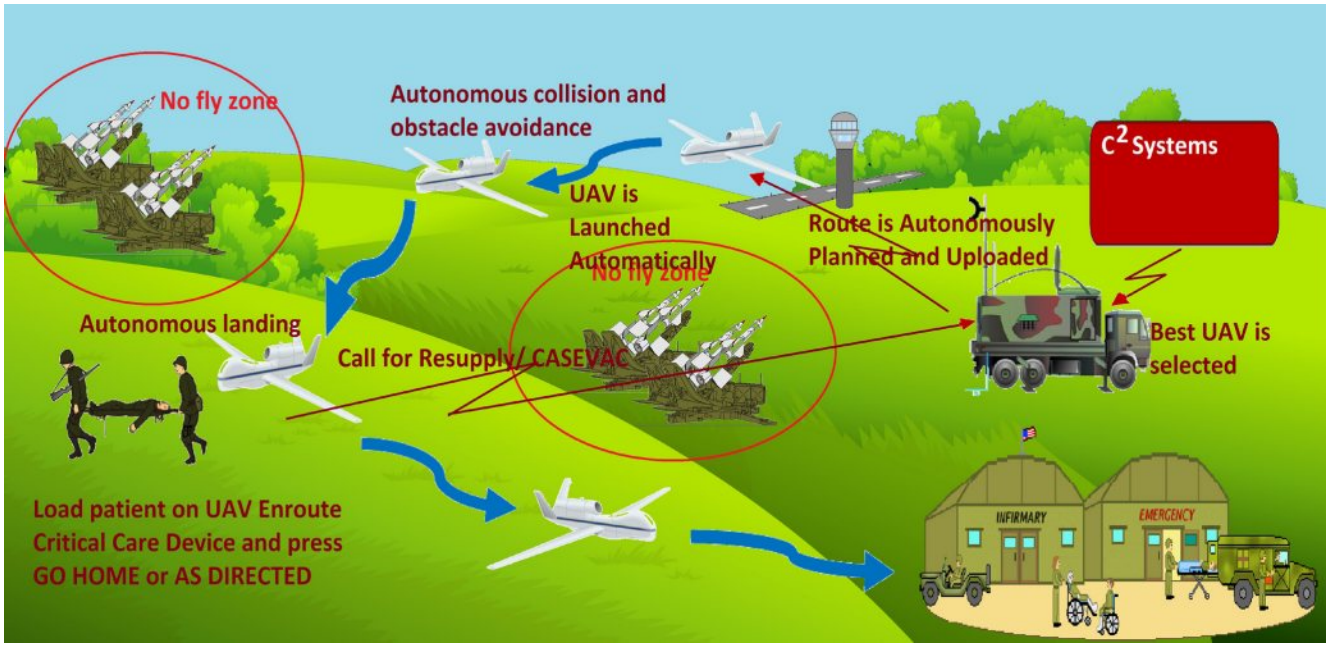


**Figure 7** *Operational conceptual scheme for the use of autonomous systems and medical support missions*[19]

battlefield, allowing them to operate in dangerous environments. Autonomous systems can operate without the human limit. Commanders can also send robotic systems on more dangerous missions, for which they would not be willing to risk a human life, allowing completely new operating concepts. Increased automation will allow military forces to operate with greater coordination, intelligence and speed, by shortening decision cycles or, in some cases, eliminating people from decision making.

Given the potential benefits of autonomous systems in the military, the use of this technology in military logistics would prove valuable in reducing costs, taking more risks with less losses, increasing capacity and speeding up delivery processes.

**NOTES**:

1. Yigit Ergene, *Analysis of unmanned systems in military logistics*, Thesis, Naval Postgraduate School Monterey, California, December 2016, p.5.
2. P.W. Singer, *Wired for War? Robots and Military Doctrine*, JFQ / Issue 52, 1st quarter 2009, p.105.
3. https://www.historynet.com/drones-dont-die-a-history-of-military-robotics.htm, accessed on 08.07.2019.
4. Yigit Ergene, *op.cit*.
5. Azadeh Kaveh and de Koster, M.B.M. René and Roy, Debjit, *Robotized and Automated Warehouse Systems: Review and Recent Developments*, May 30, 2017, pp.1-2.
6. http://www.mhi.org/glossary, accessed on 09.07.2019.
7. Andy Lockhart, Brad Moore, Kenneth Ruehrdanz, *The Benefits of ASRS for Warehouse Automation*, Promat, Chicago, April 8-11, 2019 – available at https://2019.promatshow.com/seminars/assets-2019/1534.pdf.
8. M. Prasanna, *Automated Storage and Retrieval System*, Thiagarajar College of Engineering Madurai, https://www.slideshare.net/Prasanna3804/prasanna-60978203, accessed on 11.07.2019.
9. Vladimir Karandaev, *Development of a mobile robot of hybrid autonomous system aimed at automation of warehouses inventory management*, Skolkovo Institute of Science and Technology, June, 2018, p. 2.
10. Anastasia L. Maukar, *Facility Design – Warehouse Operation*, President University, p.11 https://slideplayer.com/slide/5974398/, accessed on 15.07.2019.
11. Gino Marchet et all: "2013 Development of a framework for the design of autonomous vehicle storage and retrieval systems", International Journal of Production Research, 2013, pp.4365-4366.
12. Azadeh, Kaveh and de Koster, M.B.M. René and Roy, Debjit, *op.cit*.
13. Jasmina Pašagić Škrinjar, Pero Škorput, Martina Furdić, *Application of unmanned aerial vehicles in logistic processes*, 4th International Conference, „NEW TECHNOLOGIES NT-2018" Development and Application, Sarajevo, Bosnia and Herzegovina, June 14-16. 2018, pp.5-6.
14. *Ibidem*.
15. John E. Peters et all, *Unmanned Aircraft Systems for Logistics Applications*. RAND Corporation, December 23, 2011, pp.19 - 30.
16. https://www.janes.com/article/87805/uk-boosts-funding-further-for-robotics-and-autonomous-systems, accessed on 20.07.2019.
17. Michael K. Beebe, David Lam, *Unmanned Aircraft Systems for Casualty Evacuation What Needs to be Done*, U.S. Army Medical Research and Materiel Command Telemedicine and Advanced Technology Research Center, pp 3-5.
18. Gary R. Gilbert et all, *SAMRMC TATRC Combat Casualty Care and Combat Service Support Robotics Research & Technology Programs*, U.S. Army Medical Research and Materiel Command, Telemedicine & Advanced Technology Research Center, Fort Detrick, MD, 21702-5012, August 2006.
19. STO TECHNICAL REPORT TR-HFM-184: Safe Ride Standards for Casualty Evacuation Using Unmanned Aerial Vehicles, North Atlantic Treaty Organization, Science and Technology Organization.

## BIBLIOGRAPHY

Andrew P. Williams, Paul D. Scharre, "Autonomous Systems Issues for Defence Policymakers", NATO Communications and Information Agency ISBN 9789284501939.

Unmanned Systems Integrated Roadmap FY2013-2038, Department of Defense, 2017.

Nato Logistics Handbook, Logistics Capabilities Section, Defence Policy and Planning Division, NATO HQ, Brussels, BELGIUM 2012.