UNMANNED AERIAL SYSTEM (UAS) IN THE CONTEXT OF MODERN WARFARE

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Abstract: *With the cybernetic implementation the modern battlefield will impact weapons systems which expands the uses of robotic systems and minimizes the use of human factors, keeping a rational integration between man and machine. Modern technologies offered by unmanned vehicles can provide a viable alternative to atypical confrontations. The article proposes an overview of the characteristics of UAS under modern conflicts.*

Keywords: *UAS, modern conflict, Signus, Airstrato*

Acronims

CDL	*Common Data Link*	*GCS*	*Ground Control Station*
UAS	*Unmanned Aerial System*	*IMINT*	*IMagery INTelligence*
ATO	*Air Tasking Order*	*KFOR*	*Kosovo FORce*
OSCE	*Organization for Security and Cooperation in Europe*	*CAOC*	*Combined Air Operations Centre*
STANAG	*Standardization NATO Agreement*		

1. INTRODUCTION

Modern conflicts have a number of issues with accuracy, efficiency and speed in which it carries out military action primarily for the protection of their military, here are some basic characteristics of military conflicts, characteristics that relate directly to systems of combat used (see Figure 1): the introduction of modern technologies and remote management of technical systems; reducing their costs and losses both own and collateral; interoperability between manned and unmanned systems; modern tactics and strategies based on smart sensors, mobility and targeted actions; informational war, protection and management of data flow [1, 2, 5].

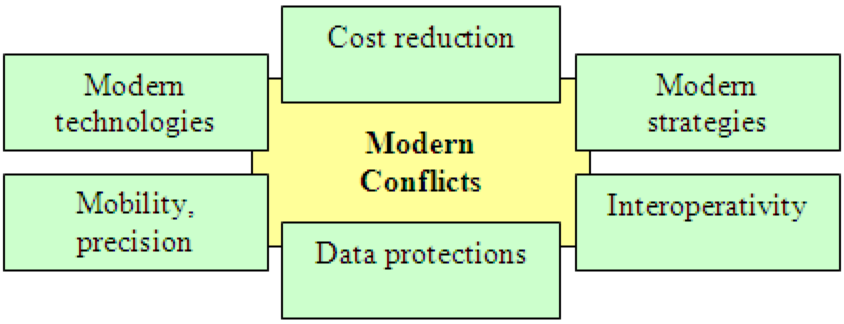

FIG. 1 The characteristics of modern confrontations

The needs of modern battles involves issues regarding the provision of humanitarian logistics to civilian population affected and protecting the civil economy, effectiveness of economic structures, the continuity in the provision of basic utilities to the population since the war is not against the people themselves, the civilian population is not directly involved .

Modern fights are dominated by many atypical features: unequal war, asymmetric confrontation, enemy present but undetectable which means increasing security for own troops in asymmetrical warfare, anti-terrorism and reducing military involvement in dangerous missions through the transition from human controlled systems to unmanned.

Modern technologies offered by unmanned vehicles can provide a viable alternative to atypical confrontation, asymmetric battlefield, the guerrilla terrorist acts, all these issues require tailored strategies nonspecific, classical concept of the battlefield. An unmanned airborne system in modern conflicts remodels the concept of utilization in the modern airspace of sensor systems and information resultant [26, 29 and 30].

According to specialized references [1, 3-7] acquisition and use of UAS sites cannot be done without some risks and challenges, see Figure 2. To minimize these risks we should considered some benchmarks, such as the concept for use in operations; payloads; intercommunication with earth station (GCS), human factors involved in direct operations; lethal and non-lethal airborne weapons systems, existing UAS fleet. Such an evaluation aims to identify existing solutions necessary armed forces.

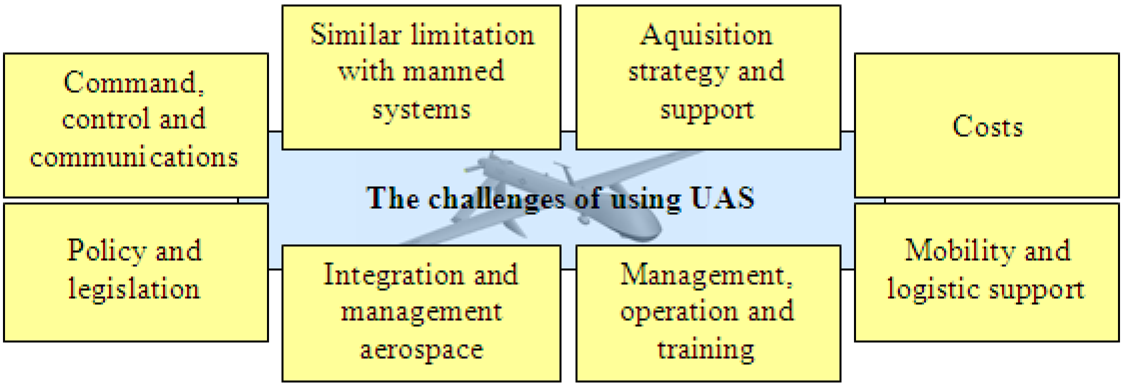

FIG. 2 The challenges of using UAS

Using a UAS in a hostile environment reduces risk and allows launching of guided munitions accurately from outside the range of enemy forces and means. The availability of a UAS is determined by the capacity and quality of the payload in most existing vehicles being represented by different types of sensors. The sensors carry differ in type and performance in accordance with UAS's role and mission requirements.

All payloads specialized in the field of IMINT (Imagery Intelligence) are characterized by sensitivity that they have in building and finally expressed the image quality that is given by resolution, [6, 7].

2. THE USE OF UAV SYSTEMS IN NATO STRUCTURES

A number of basic requirements have been accepted to a common level by policy makers, it is desired that UAS can operate in all categories of airspace to be available on all weather conditions, with a range of sensors, to be multirole with greater autonomy and stealth abilities, interoperable and low cost.

UAS integration in NATO's current operations immediately raised a range of questions from various military fields. One of the main questions was how to be responsible for UAS flight in formation bombardment manned platforms and provide commanders the confidence that no matter what, with or without man, the mission will be fulfilled.

NATO experience operations highlight the need to resolve fundamental problems to give the alliance necessary capability to solve an increasing number of operations and also to execute geographical areas outside of the territories of the member countries. In the new strategic environment, how forces are subject to hazards of a higher complexity require a new perspective on collective defense and how NATO operates.

NATO members have begun to look at the issue from a perspective based on capabilities instead of a traditional one, with an approach based on threat. The new "formula" must equip NATO with a well-developed and interoperable set of capabilities that allow commanders to work in this new era of globalization and asymmetric conflicts. In this process of transformation, unmanned aircraft systems already play a remarkable role enabling commanders to be better prepared to meet the demands of emerging modern battlefield and to design forces in any way they see fit. Reducing threats to allied forces is one of the main factors that are taken into account. In addition, increasing demand for UAS NATO is promoted by a wide variety of tasks that UAS can perform.

The presence of unmanned aircraft in theaters in the Balkans dates back to 1994. In 1995 RQ-1 Predator flew for the US for the first time operational mission over Bosnia [8, 9, 10], See Figure 3. In October and November 1998 RQ-1 Predator flying from Hungary to the US helped European Organization for Security and Cooperation (OSCE - Organization for Security and Cooperation in Europe) through verification missions over Kosovo [11], See Figure 3. German armed forces have used CL-289 Luna based in Macedonia. Immediately after these and other NATO members have carried out their own missions with UAVs, [12].

FIG. 3 RQ-1 Predator [8]

FIG. 4 CL-289 Luna [12]

The activity of NATO and USA throughout the air campaign was coordinated by the Combined Air Operations Center (CAOC - Combined Air Operations Centre) in Vicenza Italy. Each UAS mission over the Balkans had to be included in each day Air Load Order (ATO Air Tasking Order) with consequent difficulties in coordination. Another obstacle was important to combat conflict mitigation. The situation became more complicated after the deployment of KFOR and because of the increasing activities of transport helicopters.

Lessons identified and analyzed in UAS's deployment in the former Yugoslavia contribute positively to the success of NATO operations and the evidence from different scenarios outside NATO, UAS have become a new priority for many European NATO members, [13].

3. ISSUES OF STANDARDIZATION AND INTEROPERABILITY

To exploit the unique operational capabilities of UAS in civil and military operations, several technical issues must be addressed and resolved. UAS sites should have the same level of compliance as manned aircraft in the air traffic management, communications, navigation and surveillance needs where it intends to operate. According to specialized references, [24 and 25] standardization and interoperability efforts include a series of standards issued, summarized as follows:

STANAG 3680 constitutes a glossary of terms and definitions.

STANAG 4586 includes NATO standards for interfacing control systems of UAS (data transmission, command, control and interface operator-system), it describes five levels of interoperability: from capturing and transmitting data received from the sensors to complete control and monitoring of aircraft including unmanned launch and recovery.

STANAG 4609: the standard of the captured images;

STANAG 4626: refers to the modular avionics architecture

STANAG 4660 it contains recommendations UAS command and control data link

STANAG 4670 it includes recommendations for the training of UAV operators.

STANAG 4671 the needed for UAV systems to meet the requirements of airworthiness. It requires a minimum standard of airworthiness for an UAV fixed wing as exemplified in documents such as 14 CFR Part 23 and EASA CS-23, while we recognize that there are several features for UAV systems that require compromises and additional subparts.

STANAG 7085 contain recommendations on data transmissions CDL.

STANAG 5066 refers to the communication errors.

STANAG 7023 it contains recommendations on primary format for images.

STANAG 7192 SD It contains recommendations on medical references for operators of UAVs.

It is also relevant to mention a series of recommendations that include STANAG cycle for operating picture, [27]:

- STANAG 3377: The report text, picture and annotated maps;
- STANAG 4545: Secondary image format;
- STANAG 4559: Library inteface for image standards;
- STANAG 4575: Advance interface for data storage;
- STANAG 4607: The format for the mobile ground target indicator;
- STANAG 4633: Common format for emiting reports.

4. UAS NATIONWIDE

Global and European trends have defined nationally a series of steps for design and implementation of robotic systems both small UAV categories and at close range [14, 18]. In what follows we present the top national projects in this area funded by commercial entities.

Signus

Signus was designed and built by TEAMNET Bucharest, Romania, see Figure 5 for mission data acquisition of the land and sea borders, with performance similar against other UAV of the same class (eg. RQ-7 Shadow 200). A number of features and performance are shown in Table 1. Signus supports the same ground station used to Hirrus, capable of mission data acquisition in real time used for the management of emergencies, environmental monitoring, agriculture, transport network utilities and communication routes (roads, railways, river, maritime) [15, 19].

Table 1. Characteristics

Span/ lenght (m)	5,2 / 3,8	G_{max} / G_{ut} (kg)	150/ 45
V_{max} / V_{cr} (km/h)	230 / 140	Autonomy (h)	2
Engine (CP)	32 / 61	Range (km)	150

FIG. 5 Signus [15]

FIG. 6 Airstrato Explorer [16]

Airstrato

It's a UAV designed by ARCA Space (USA) having its first test flight in 2014, see Figure 6 and technical characteristics of Table 2. Its performance is comparable to aerial robotic systems operational, with a cost ranging between $ 80-140000. There are two models version Airstrato Explorer and Pioneer. Both are constructed of reinforced composite materials and feature electric motors powered from internal batteries and photovoltaic, they are launched airborne pneumatic catapult and recovered by ballistic parachutes. US air transport avionics systems compatible, includes a pilot PLC internal equipment providing flight status information and computer system ADS-B flight. Connections between vector air and ground station are encrypted with standard AS 256, [28].

Air applications for Strato may include: border protection land / sea, disaster management, reconnaissance, communications relay, sea traffic control and scientific activities [16, 17, 20].

Table 2 Technical characteristics Airstrato Explorer

Span/ lenght (m)	16 / 7	V (km/h)	170
G_{max}/G_{ut} (kg)	230	Engine	6 x electric
Autonomy (h)	20	Altitude (m)	18000

Argus

Aviation vector realized by INAV S.A. Bucharest is at the stage of data acquisition demonstrator missions in areas of interest. Argus is built in 3 versions XL (Figure 7) XS Argus (Figure 7b) and Argus L, equipped with recovery systems [14, 22]. All versions have ground control stations equipped with telemetry and video transmission; technical characteristics are shown in Table 3.

a b

FIG. 7 Argus XL (a), Argus XS (b), [22]

Table 3. Caracteristici tehnice Argus XL

Span/ lenght (m)	5 / 4,1	V_{max} / V_{cr} (km/h)	300 / 210
G_{max} / G_{ut} (kg)	140 / 40	Range (km)	300
Autonomy (h)	1,5		

CONCLUSION

The cybernetic implementation in the modern battlefield will impact weapons systems that expand the uses of robotic systems and the human factors will be minimized, keeping a rational integration between man and machine. Impact of information technology stems from a series of advances in both hardware and software that innovative concepts and materials on military technical systems.

UAVs can currently carry identification, observation, surveillance, air support of military actions, assessment of actions or strikes, acquisition targets and laser indication, in the military field.

Improving system reliability for UAS is an important goal to ensure efficient use in combat. Current levels of reliability UAS sites have a negative impact on utility operational procurement costs and their acceptance in aerospace regulations. The costs associated with improving reliability must be optimized both in relation to the purchase price, maintenance costs and less quantifiable benefits proposed by specific missions.

UAS technology will be integrated into a well-developed doctrine, tactics, techniques and mature procedures. A good level of integration airspace is essential to getting the full potential that unmanned platforms they provide.

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REFERENCES

[1] Balaceanu I., Râpan F. şi alţii , *Inteactiunea strategiilor in conflictele armate moderne*, Editura Universitătii de Apărare “Carol I”, Bucureşti 2010, ISBN 978-973-663-853-4, 300p.

[2] Prisacariu V., *The UAVs in the theatre of operations and the modern airspace system*, RECENT 3 (39)/2013, ISSN 1582-0246. p 169-180

[3] Isache L., *Avioanele fără pilot uman la bord, tehnică de viiitor pentru forţele armate,* Gândirea militară românească, 6/2006, ISSN 1454-0460, p108-117, www.gmr.mapn.ro,

[4] Ştir M., *Angajarea sistemelor aeriene fără pilot în acţiunile militare*, Gândirea militară românească 6/2010, ISSN 1454-0460 print, ISSN 1842-8231 online, p24-41

[5] Paraschiv C.V., *Proiect de cercetare PNCDI, Platformă aeriană autonomă cu modul de luptă strategic* – PAMLUS, ttp://mail.incas.ro/PNCDI2_ Program4/81 025/index.html, consulted on 04.08.2015

[6] *OSD UAV Roadmap 2002-2027*, Office of the Secretary of Defense Acquisition, Technology, & Logistics, Air Warfare, December 2002.

[7] *Unmanned Aircraft System (UAS) ROADMAP 2005-2030*, US DoD, Washington DC, 2005, 213p.

[8] http://defense-update.com/products/p/predator.htm, consulted on 04.02.2016

[9] Jones C.A., *Unmanned aerial vehicles (UAVS) an assessment of historical operations and future possibilities*, AU/ACSC/0230D/97-03, 76p, available at https://fas.org/irp/program/collect/docs/97-0230D.pdf

[10] Thirtle M.R., Johnson R.V., Bidder I.L., *The Predator ACTD: a case study for transition planning to the formal acquisition process*, 19980220 045, 107p, 2003, available at http://www.dtic.mil/dtic/tr/fulltext/u2/a337401.pdf,

[11] Haave C.E.,. Haun, P.M, *A-10s over Kosovo the victory of airpower over a fielded army as told by the airmen who fought in operation Allied Force*, Air University Press Maxwell Air Force Base, Alabama, 365p, 2003, available at www.dtic.mil /dtic/tr/fulltext/u2/a421682.pdf

[12] *Germany: A review of uav programmes and initiatives*, 4p, available at http://uvs-info.com/phocadownload/05_3h_2004/21_overview_germany.pdf, consulted on 12.02.2016

[13] Manolache Diana, Chiş C., *NATO bombing in the former republic of Yugoslavia*, AFASES 2015, ISSN 2247-3173, p 61-69.

[14] Prisacariu V., Cîrciu I., Luchian A, *Unmanned aircraft vehicle (UAV) in the Romanian airspace. An overview.* JOURNAL OF DEFENSE RESOURCES MANAGEMENT, vol.4 issue 1(8)/2014, ISSN: 2068-9403, eISSN:2247-6466, ISSN-L: 2247-6466, p123-128.
[15] http://www.rumaniamilitary.ro/uav-uri-romanesti-signus, consulted on 04.03.2016
[16] ARCA, *Airstrato. The most amazing air robot in the world*, 4p, 2014, disponibil la http://www.arcaspace.com/docs/ARCA_AirStrato_Press_Release.pdf, consulted on 05.02.2016
[17] http://www.arcaspace.com/en/airstrato.htm, consulted on 24.02.2016
[18] Magdalena I., *Unmanned air vehicles in Romania. Steps to the future*, AFASES 2015, vol I., ISSN 2247-3173, p55-60.
[19] Clavert J., Geffard J-C., Maloney P., *RQ-7B Shadow Achieved Performance Model Verification Final Report*, 2011, U.S. Department of Transportation, Federal Aviation Administration, DOT/FAA/TC-TN11/8, 31p, available at www.tc.faa.gov/its /worldpac/techrpt/tctn11-8.pdf
[20] http://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=1300, consulted on 11.01.2016
[21] Blyenburg P. *Overview of the European UAS Community*, p120-138, available at http://uvs-info.com/phocadownload/05_3b_2010/P120-138_Overview-of-the-European-UAS-community_PVB.pdf
[22] INAV service offer, disponibil la http://www.inav.ro/eng/downloads/INAV-Services%20offer-extended%20version.pdf
[23] http://www.eurocontrol.int/mil/public/standard_page/atm_mil_uav.html, consulted on 09.01.2016
[24] NSA NATO Standardisation Agency, *STANAG 4586, ediţia a 3-a, Standard interface of UAV system (UCS) for NATO interoperability*, NSA/1235(2012)4586, 2012, 509
[25] Reg Austin, *Unmanned Aircraft Systems UAVs design, development and deployment*, Aerospace Series, ISBN 978-0-470-05819-0, 2010, 365p
[26] Muraru A., *An overview on the concept of uav survivability*, International conference of scientific paper AFASES 2011, ISSN: 2247- 3173, p1231-1236.
[27] *Integration of Motion Imagery into the STANAG 4559 Data Model*, 2014, 12p, available at www.gwg.nga.mil/misb/docs/rp/RP0813.1.pdf
[28] Intel, *Intel® Advanced Encryption Standard (AES) New Instructions Set*, 323641-001, Revision 3.0, 2010, 81p
[29] Boscoianu M, Cioacă, C., Rau C., Circiu I, *Concerted Systems for Increasing the Survivability of the Aircraft against Terrorist Threats*, Applied Mechanics and Materials, Vol. 325-326 (2013), Trans Tech Publications, doi:10.4028/www.scientific.net/AMM.325-326.756, pp. 756-760.
[30] Muraru A., Cioaca C, Boscoianu M.**,** *Modern Sense and Avoid Strategies for UAV***,** la the 9th International Scientific Conference New Trends in Aviation Development, Technical University Kosice – Faculty of Aeronautics, Gerlachov-High Tatras, September 16-17, 2010, Slovak Republic, ISBN 978-80-553-0475-5

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