ASPECTS REGARDING THE USE OF UAV IN INTELLIGENCE OPERATIONS RECONNAISSANCE AND SURVEILLANCE

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Abstract: *This article presents the evolution of the instruments and means used in reconnaissance and surveillance, with the purpose of delivering the information needed for planning the military operations. Acquirement of the information was and still is the most decisive element of the war.*
Demonstrating the differences and the similarities between the units (human and UAV) involved in reconnaissance and surveillance, will be done by filtering them through the functional model of Gerbner. In that purpose, we underline the differences between the information acquired due to this model of the communication theory.
In this paper a connection will be created between the information provided by both subjects using content and a unique form that is easy to use by leader/commander.

Key words: information, research, surveillance, time, operation, decision, UAV, selection, Network centric warfare, commander.

Acronyms

HUMINT	*Human Intelligence*	*RMA*	*Revolution in Military Affairs*
IMNT	*Imagery Intelligence*	*SIGINT*	*Signal Intelligence*
ACTIN	*Signal Intelligence*	*MASINT*	*Measurement and Signature Intelligence*
AOC	*Air Operational Center*	*ASC*	*Air Surveillance Center*
C2	*Command and Control*	*AOC*	*Air Operational Center*

1. INTRODUCTION

Specialty studies define the term "information" as the amount of knowledge that is owned about the enemy, the ally forces and the operation theater. Information is the gas that fuels the decision-making machinery of the commander. As in the fuel with a low octane value, uncertain or wrong information may destroy this machine of war. In the doctrine of the reconnaissance and

surveillance [1] information plays a very important role in planning and unfolding the operations, protecting the force, dealing with the threat and commanding the operational environment. The matter of Informational operations existed since ancestry from the time that Sun Tzu walked on this planet. Sun Tzu offered a great importance to preliminary knowledge [2]. His opinion was that if a commander is winning constantly this is because of a proper preliminary knowledge, acquired by the spies in collecting / corruption of information and securing / destroying of the communication means. There is no place, domain, plan that has a chance of succeeding without proper information. Information is the "bridge" that links planning and execution of the tasks / missions on a tactical, operational and strategic level. This very bridge that doesn't allow us to fall in "the impression of senses" [3] described by Clausewitz.

The impression of the senses affects by planting or amplifying the uncertainty in the commander's conscience. The remedies for this neurotic illness known as "Impression of senses" is reconnaissance and surveillance. We can observe the evolution of the information flow in Figure. 1.

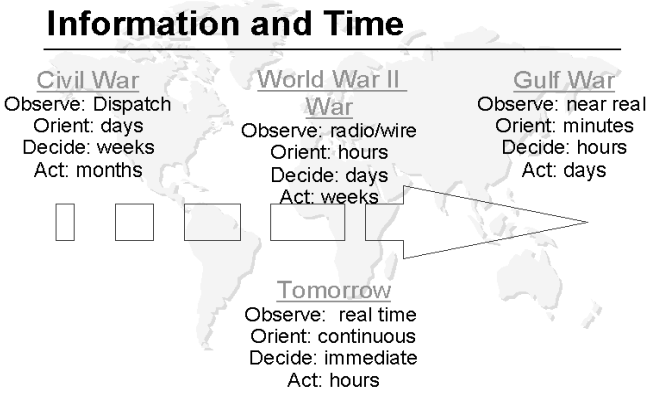

Figure 1. Information and Time [4]

According to the glossary of terms NATO [5] we have the following surveillance and reconnaissance terms:

"Reconnaissance - A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an

enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area".

"Surveillance - The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means.

Informing systems in the time of the two military paradigms of Sun Tzu and Clausewitz were based on the means and ways of reconnaissance and surveillance included in the HUMINT category. Due to RMA (Revolution in Military Affairs), research and surveillance means have evolved. New methods of collecting information appeared: Imagery Intelligence – IMNT; signal Intelligence – SIGINT; Acoustic Intelligence – ACTIN; Measurement and Signature Intelligence – MASINT.

Even considering the new methods, a long period of time, man has remained the basic tool for collecting intelligence.

At the moment, the development direction of the informational operations tends towards the usage of UAV's, that may create a false opinion that the removal of man is wanted from the informational cycle. The usage of UAV's is more a completion instead of a replacement in the Network centric warfare. For a better explanation, the Gerbner model in the Figure. 2 will be analyzed, with a few changes made for a better understanding of the article.

The researcher named George Gerbner [6], claims that the message plays a very important part as element of the communication process, because it is the informational content. The message is the link between emitter and receiver. In this article I strive to analyse the need and the advantages of using a reconaissance and surveillance system based on UAV merged with human personnel.

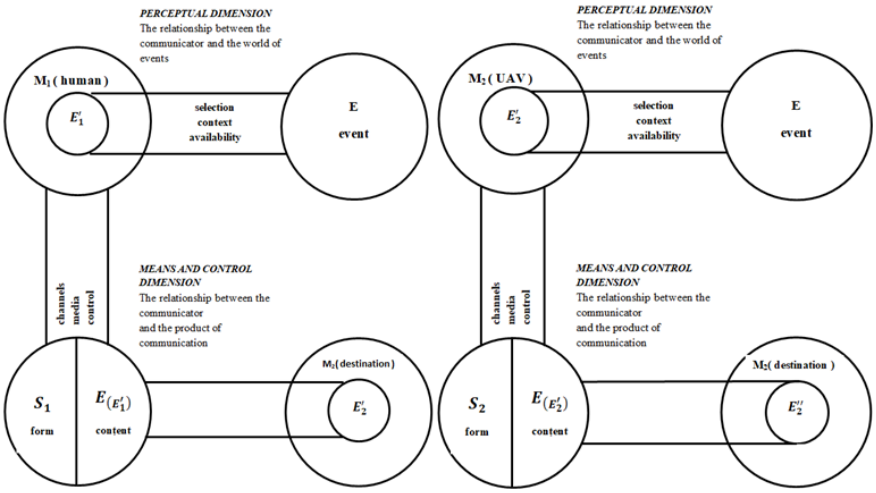

Figure 2. Adapted multifunctional model of Gerbner.

2. PERCEPTUAL DIMENSION

Perception is a tiny piece of the superior mental / mechanical process named human thinking or artificial intelligence. Thinking is the mental activity that involves understanding, processing and transmitting the information.

The M_1 and M_2 subjects (human and UAV, see Figure.2) subordinated to *ASC (Air Surveillance Center)* engaged in surveillance and reconnaissance operations, observe an event E, for example, the enemy troops moving. The events perceived and reported farther to *AOC (Air Operational Center),* will be (E'_1) and (E'_2). Information (E'_1) and (E'_2) are different due to the selection, context and access level. As stated above, intelligence is like a bridge whose surface has to be safe. Unfortunately, man or UAV, both derived the event E, in which case we have an information loss. The question that remains is: which of the subjects manage to report the information closest to the truth? For this purpose, the components of the axis of perception will be split:

2.1 Selection

It represents collecting the information considered relevant to be reported in a determined amount of time. The need of the selection is a consequence of the

matters caused by the velocity and keeping the message upright.
Selection is characterizing by the properties of the memory as:
- *Saving or storage velocity* – process of recording the information in the memory or on storage devices (v_m / v_s)
- *Storage capacity* – the space in which the information is saved

The V_s of the human is probably infinite so we could wrongfully think that humans have an advantage but keeping in mind that V_m is smaller than V_s by tens of times this advantage is not relevant anymore. We could say that in a reconnaissance and surveillance mission, the quality of the selection is represented by the *quantity of the perceived content*: (*Cp*), so *Cp=Vm x t* or *Cp=Vs x t*

M2 has the advantage of higher recording velocity. Plus, there have appeared drones with a system of real-time delivery of the information that diminishes the need of high storage capacity.

2.2. Context

Represents the physical, mental, and even social dimensions. M_2 works on artificial intelligence so it is not bothered by mental and social factors. The context is affected by the background which M_1 and M_2 possess. The context of the ordered mission/task can be characterized by *the environment and the problem space* [7], a concept developed by the Nobel Prize winners, Newel and Simon. The environment of the problem is the situation in which the problem is displayed, as it is the situation in its objective state. The space of the problem is the way of perceiving it by the one who solves it or the one who gets the surveillance mission done. The way he understands it, in his opinion, the perception is subjective and that results in subjective information created by the brain of the solver.

2.3. Availability

Availability or *accessibility* represents the possibility of perceiving the event. It becomes greater as the experience, knowledge and acquiring information skills of the M_1 and M_2 subjects increase. Acquiring information is helped by a number of technical sensors, divided in two categories: the image (Figure. 3) (optical sensors, infrared visual sensors, radar visual sensors, passive metric radio sensors) and the non-image (sound, meteoro-logical conditions, distance) [8].

At the same time, we can't deny the necessity of man in the

operation theater for maintaining the relationships between civils and military. A consistent source of intelligence is the local people.

For a better unfolding of the operation the study of psychology and understanding of the local culture is mandatory. The political-military interest is to maintain good relations for helping each other.

Figure 3. FLIR Cameras [8]

3. MEANS AND CONTROL DIMENSION

In this chapter we will talk about the relationship between the one who reports and the result of the report. The second axis is bound to show how the message is being created having a form and a clear content. The purpose of any surveillance mission is to convey intelligence using the most discreet method, sending all the intelligence to only one person (the commander). The commander checks them, makes a decision and then informs the subordinates. The subjects of this chapter will be the channel, the means of communication and the control.

3.1. The channel

Taking into consideration that we are in an intelligence age, in the military branch exists a tendency to abandon bureaucracy which was overworking the commanders. The channel used for transmitting the intelligence by M_1 and M_2 during the mission is the air that allows the spread of radio waves.

That spread can be difficult because of the atmospheric composition which differs depending on the attitude and the terrestrial form. Due to this variations different radio frequencies are used for different altitudes.

This channel can be affected by technical barriers such as jamming. The purpose of jamming and deceiving techniques are: interrupting the radar tracking systems, incapacitate intelligence acquiring by the enemy radars, interrupting the tracking systems used by guided missiles, deceiving telemetric systems of the radars.

Jamming has two states: passive or active. Depending on the size of the specter, active jamming could be: narrow frequency; variable frequency, widened frequency.

Depending on the wanted effect jamming could be: Imitation jamming, concealment jamming, neutralization jamming.

To diminish eventual problems that could appear on transmission channel between Rx and Tx in times of peace, crisis and war, interference analysis is being done continuously.

An example regarding alarm and countermeasures systems could be RWR (Figure.4), installed on MiG-21 LanceR fighter planes. It has the purpose of recording the radar signals which discover and trace the aircraft and determine some parameters such as: frequency, time interval and amplitude of signal. The systems detects and displays radar threats that work with impulses between 0.7 to 18 GHz.

The information is used for turning on the active jamming container for E.C.M. protection that is able to detect the radar controlled threats (aircraft, missiles, UAV's, radar systems)

There are some UAV's with flying abilities similar to the fighter MiG-21 LanceR. Those have radio-electronic equipment with similar functions and parameters, but different user interface.

Figure 4. RWR, Threats Warning Display [9]

3.2. Media

Media divide in presentational, representational or mechanics. In the presentational ones M_1 presents itself before M_3 to report the results of the reconnaissance and surveillance and so the possibility of surprise is diminished because information may not be reported in a useful time. The same problem is encountered in the representational means.

Means used by M_1 and M_2 are mechanic. Mechanic means possess undoubtable advantages: modulation, codification, and instant mechanical amplification. Taking into consideration the informational flow between M_1, M_2 and M_3, each of them become emitters and receivers.

For emitter's protection there are the following automatic systems: drop of the emission power, wide frequency specter, wobbling frequencies, blocking the sector's emission.

For receiver's protection there are the following automatic

systems: Automatic adjustment of the amplifier, selection system of mobile targets, the use of more than 1 receiving channel.

M_1 is equipped with PANTHER 2000 V [10] radio station that can transmit data at the following velocities: 300, 600, 1200, 2400, 4800 Bd or 16 kb/s, each of them selectable by the operator. Battery autonomy is about 10-12 hours [11].

The velocity of data transmission of a simple UAV is about 1-56 kb/sec. For video data, velocity is 8 MB/s for a high-quality video link [12]. Autonomy of a reconnaissance and surveillance UAV as AN RQ-4 Global Hawk is 32 hours [13]. At an RQ-1/MQ-1 Predator autonomy is 24 hours or 40 hours if the altitude is 910 m [14].

Figure 5. Panther 2000V.

3.3 Control

C2 Rx (air) and Tx (ground) systems represent the instruction and control. The instruction is being made on 420-450 MHz.

In the transmitting phase from M_1 and M_2 the date and destination of the message can be controlled, as long with the filter of the information, depending on the request from the superiors.

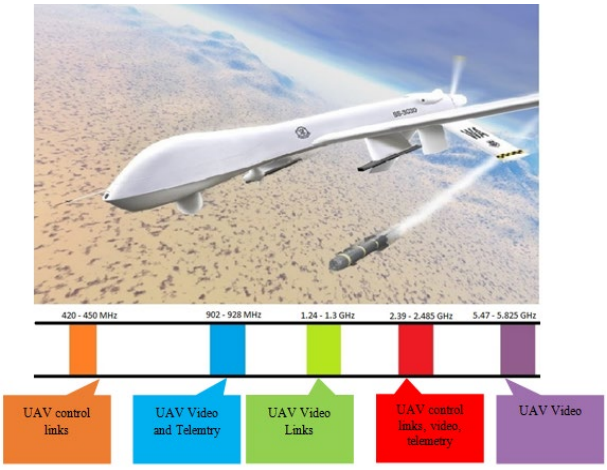

Figure 6. Control.

4. FINAL PRODUCT: FORM AND CONTENT

Form and content of the message are two notions that are interdependent and *adaptable*. The example of the Psychology specialist Iona Negură from The Republic of Moldova will be used to explain these two words [15].

Content ($E_{(\varepsilon_1)}$ or $E_{(\varepsilon_2)}$) is the informative component of the message that has to be organized and displayed in a relevant form for the receiver. If the form doesn't corespond to the type of the information, difficulties can appear in understanding the message.

Form (S_1 *or* S_2) is similar to a ship. If a suitcase has to be taken from spot A to spot B a good ship is needed or else there is the risk of reaching the destination without the content or the content could be affected. For example, if M_1 verbally sends information of imagistic type with a vast amount of details through the PANTHER 2000 V radio station, there will be losses because of the selection, context, access degree, capacity of structuring the information and cognitive capacity of the receiver to imagine the tactical situation.

At the same time, M_1 has a direct link to the event so he could physically interfere in the course of action. This way, modelling the scenery is possible in allies' advantage.

The informational systems based on the UAV's can display the information on a computer's monitor, in a conference hall or even on a cellphone in a corresponding form with the request from the ones who ordered the mission. The product of thought is the organized and structured form that merge into a whole. For the optimization of the man-machine interface one can request help from a designer. In result, merging the information from both M_1 and M_2 results in a clearer situation image of the operation theater. (Figure 7).

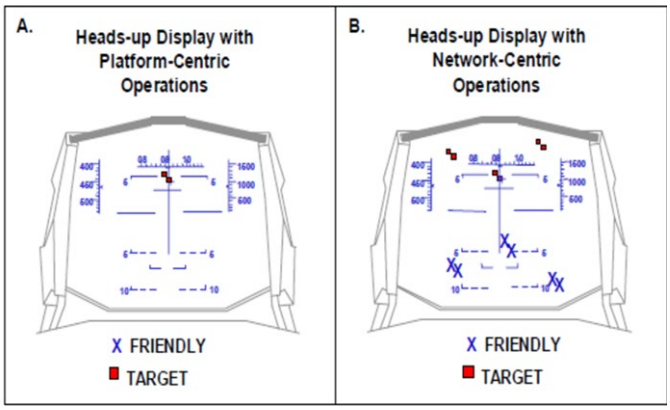

Figure 7. Heads-up Display.

5. CONCLUSION

On the global communication map new concepts and tools appear (UAV's as example) that change the perspective of the intelligence operations, due to the intrinsic abilities of those new systems and their way of using in modern conflicts.

The paper presented demonstrated the undoubtable advantages of utilizing UAV's in combination with human personnel. The final product of this cooperation is the improvement of the message due to the quality of information (quantity and accuracy), by summing up the results of the events derived from each reconnaissance and surveillance unit, a clear example of the Network centric warfare. The axis of perception and the axis of means and control complete each other and describe a more accurate situation. The success of the operation consists of receiving intelligence in real-time, continuously updating the information, immediate decision making and short execution time.

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