THE ROLE OF CONSTRUCTIVE SIMULATION IN THE AVIATION SECURITY MANAGEMENT

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Abstract: *The Airspace Security Management is a challenge at both operational and educational level. The "Henri Coanda" Air Force Academy has the mission to train future military specialists in a manner adapted to changing demands. Constructive simulation is one of the tools that, once integrated in the training curriculum, provides for students the skills needed to successfully operate in a complex, diversified and ever changing field. The JCATS software platform covers the full range of operational requirements specific to the air forces.*

Keywords: *constructive simulation, aviation security management, Air Tasking Order, Airspace Control Order, Integrated Air Defense System*

1. INTRODUCTION

The Airspace Management is a complex issue in terms of increasing demands for use, both for civilian and military purposes. NATO concerns (through the Air Traffic Management Committee - NATMC) and the EU (through the European Commission) focus on flexible use, cost efficiency, safety and security [1].

The competition for areas and operating time in peace conditions leads to an adaptation and continuous improvement of specific airspace control processes. For crisis and war situations, the existence of clear procedures for achieving the transfer of authority over the air space to the military factor is an incontestable necessity.

Through the implementation of the Single European Sky (SES) and the Flexible Use of Airspace (FUA), the EU aims to "accommodate operational requirements" [2] by applying the principle of equality (between civil and military aviation) within the Functional Airspace Blocks (FABs).

The Airspace Security Management is not a new concept, but it is very important to ensure that future specialists are the result of a training process focused on integrating into the operational work of the three components: live, virtual and constructive (LVC). NATO differentiates these components according to two criteria: the type of people operating systems (real, virtual or simulated) and the type of operating systems (real or simulated) [3].

Current defense investments create new capacities that, in order to meet the desired capabilities, need to be doubled by investment in education and training. The Romanian Air Force has understood these imperatives and initiated a process of curriculum reform in order to ensure that the future pilots, air traffic controllers and anti-aircraft racers are ready to become adaptive and agile thinkers.

2. PLANNING IN THE MILITARY DECISION MAKING PROCESS

In any civil or military organization, the decision-making process is known as the process in which it is decided *whether, when* and *what*. Also, the whole process involves the understanding of the consequences of taking decisions on each considered course of action. The decision is the instrument by which a commander transposes his vision into action.

The decision means both science and art. Some aspects of military operations (eg. the effect on the target) are quantifiable and, moreover, part of the science of war. Other aspects of military operations (eg. impact of leadership, enemy intent) belong to the art of war [4].

The decision process is a complex and complete process and has a number of advantages, such as:

- analyzes and compares multiple COAs - war gaming and the result is to identify the best, most effective and optimal course of action;
- produces integration, coordination, and synchronization in order to support operations and to reduce the risks of critical issues.

The major disadvantage of the decision-making process is the great time consumer, especially since the decision taken largely influences the military operations.

Commanders - regardless of the hierarchical level - are responsible for the decision-making process, and they decide on the procedures to be used on a case-by-case basis. In the literature, the stages of the decision-making process are well known, analyzed and detailed:

1. receiving the mission
2. mission analysis
3. developing the courses of action (COAs)
4. analysis of the COAs (war game)
5. comparing of the COAs
6. approval of the course of action
7. approval and issuance of the action order

The simulation of the decision-making process aims to prepare the commanders to identify the best course of action in complex and uncommon situations. Thus, by overlapping the process of constructive simulation with the stages of the decision-making process, the efficacy indicators needed for the analysis of the COAs and decision can be obtained [3]. Joint Conflict and Tactical Simulation (JCATS) is not a dedicated command-control platform, but can implement NATO reporting formats.

For the purpose of this paper, highlighting the role of constructive simulation in the decision-making process specific to airspace security management, we have built the matrix of concordances: operational requirements, missions and simulation platform capabilities (Fig. 1).

The main purpose of the WARGAMING execution is to validate the course of action, in which air force missions are established based on the Air Task Order (ATO) and Airspace Control Order (ACO). Thus, according to the operational requirements formulated by the air forces, the development, implementation and dissemination of these documents is the key element of constructive simulation training.

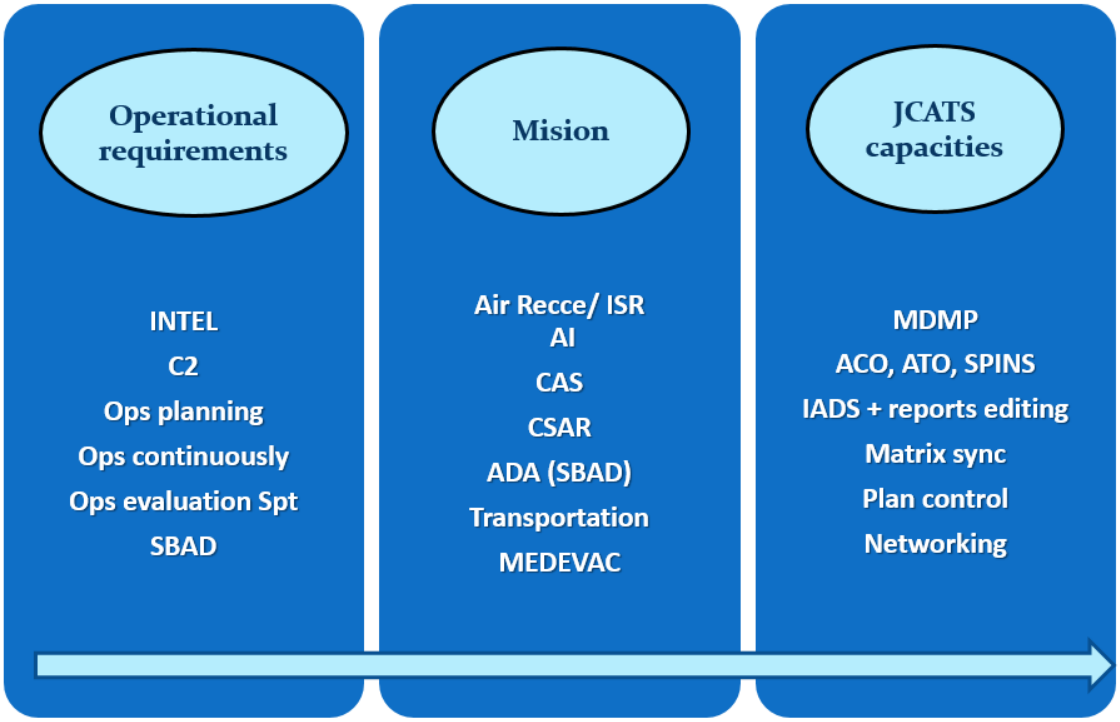

FIG. 1 The matrix of concordances

3. ATO, ACO AND IADS TOOLS

According to the air force doctrine, Air Tasking Order (**ATO**) and Airspace Control Order (**ACO**), combined with special instructions (**SPINS**), represents the main tool in planning, analyzing and conducted an air mission, provides tactical and operational direction for air operations.

An air operation is a complex and an integrated military activity, is conducted by air force and all structures which are link-up with air space security are implied: aviation (rotary and fixed wing), air defense artillery (ADA), unmanned aerial systems (UAS), surveillance and reconnaissance [5].

ATO and ACO are guidance to provide sufficient details to allow air components to plan conduct and execute a mission. They are a set of character-oriented message text formats used in support of C4 systems.

An ATO standard format contains some blank Intel witch have to be updated and we will show some of the [6], but a basic one:

- The mission **ID** represents an assigned number, a standard one, is unique and is used for reports and for publishing into the federation;

- The **Start Time** is the time when the systems will start to execute of any activity orders for the fixed or rotary wing;

This **Start Time** is one of the most important values because it must be and can be adjusted, using two standard controls: **Use start date of** and **Offset Time**.

- The **Mission Type** represents any kind of air mission, in according with air force doctrine; in that case all systems will have a different behavior, in according with the specifics of the mission;

In JCATS there are some standard missions like attack (ATK), capture (CAP), recon (RECCE) etc. and any type of mission can be selected from the standard or can be edited (changes type).

- **Tasked Unit**, **Depart From** and **Recover To** are a description of the aircrafts (group of aircraft). They represent the information obtained from the mission and the standard textbox can be filled with those values;

The mission can be edited from the standard window; on the left hand side is the Aircraft Groups, which contains the type of aircrafts that are needed (COMAO), aircraft **Callsign** and **IFF** settings (IFF settings can be sated in 6 different modes) (Fig. 2).

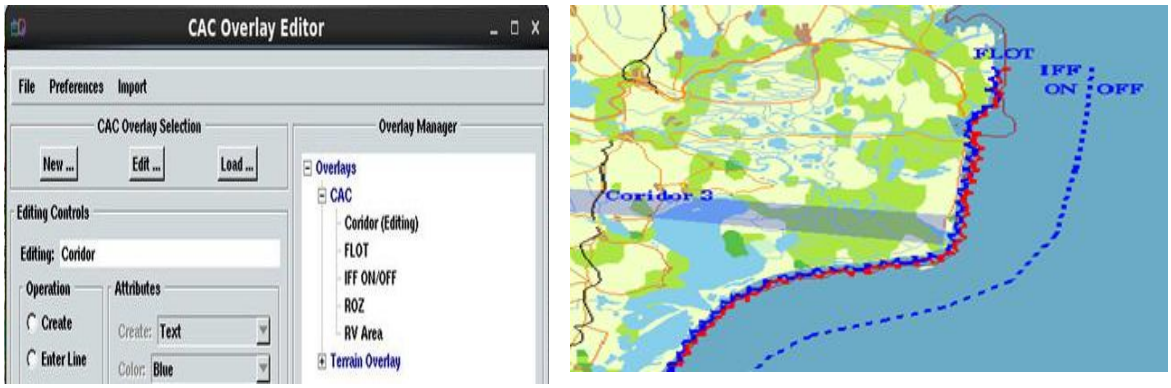

FIG. 2 Highlighting the IFF ON/OFF alignment with the CAC editor

In mission editing the **Description** textbox (location)has to be filled up, as well as the **Duration** of the mission, the **Altitude**, the **Route** (can be an activity like *Air Loop*), the **Specified Point** (the location of the order) and the **State** of the aircraft.

In ATOs we can add one group of aircrafts or more, and in this case the **Add** button has to be pressed to determine which aircraft to assign to the list and in which group. That means all aircrafts will have the same ATO and will follow the same rules.

Integrated Air Defense System (IADS) network consists in two primary tools [7]:

1. An Acquisition Radar, designated to detect incoming threats and hands off those acquisitions to the Fire Control Network;
2. A Fire Control Network which provides target tracking via a Tracking Radar and one or more platforms filling the role of the Shooter (Fig.3).

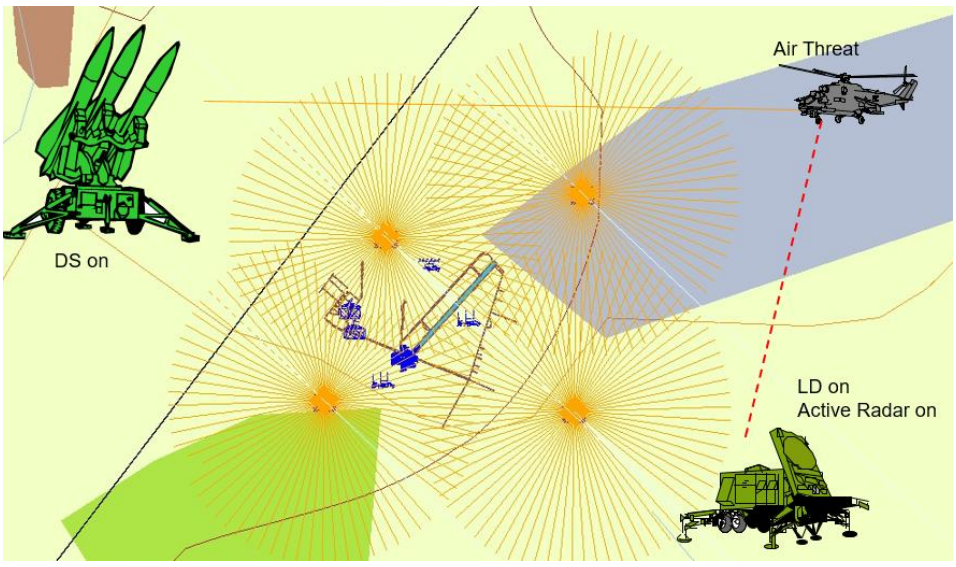

FIG. 3 The architecture of a combat formation

IADS can be built dynamically in the simulation. An example of a functioning IADS Network can consist of the following:

-IADS ACQ RADAR;

-IADS TRACKING RADAR;

-IADS SHOOTER.

In IADS the Acquisition Radar is not marked as ADA Tracking Only, it has at least one Weapon Station with an Active Radar. In a Fire Control Network there can be one or more IADS members filling.

The main role in Acquisition Radar is played by one IADS member, one system which acquires targets with his radar and provides those targets to the IADS Network; that means they can be handed off to the appropriate Fire Control Network for tracking and engagement.

IADS Network will automatically acquire incoming hostile aircraft and missiles and hand those tracks off to one of its Fire Control Networks for tracking and engagements. The IADS network will try to hand off an acquisition to the Fire Control Networks from the closest to the farthest from the target. The position of the Fire Control Network is taken to be the position of its Tracker.

There can be one or more Fire Control Network members filling the Shooter role in a Fire Control Network. The Shooter role is filled by a system that fires on a tracked target when commanded by the Fire Control Network. The Shooter has to be marked as capable of being fired in direct support mode.

The IADS Network manages two types of munitions guidance type:

1. Remote Guided – will always work but munitions may only be used in IADS. Remote guided munitions may be effected if the Tracking Radar is killed causing the munitions to lose guidance and the munitions will most likely miss the intended target.

2. Self-Guided – may be used but shooter and must have LOS (Line of Sight) to target, but acquisition is not required. Self-guided munitions are not affected by the loss of its Tracking Radar. If the Tracking Radar is killed while the munition is in flight, it will continue on to its intended target. Data requirement is that a self-guided munition must have a sensor defined for the fly out package.

Finally, a mission can be assigned to an IADS Network Acquisition Radar and the limits are on how the system engages on different threats based on mission priority. This feature is the same as assigning a mission to a system.

CONCLUSIONS

Training using constructive simulation using dedicated agent based simulation software (e.g. JCATS v.13), which meets the characteristics of air operations, represents a guarantee of the human factor value, both at the decision-making and execution level. The eternal concern for achieving interoperability on the organizational, procedural and technical level can thus be achieved by acquiring new competencies related to the efficiency of force structures, weapon systems in their endowment, or doctrinal regulations.

From the analysis of JCATS capabilities for Air Forces, it can be appreciated that the characteristics of aerial operations according to doctrinal regulations are respected as follows:

✓ *variety of operations* (execution of the air strikes from any direction; simultaneously on multiple targets; the transport of personnel and equipment in inaccessible areas to land or sea means);

✓ *mobility* (to achieve force protection in short and long distance due to the speed of movement);

✓ *continuity and reactivity* (the conduct of air operations throughout the joint operation; engaging and discouraging the Air Forces in a very short time);

✓ *coordination* (using airspace effectively with the possibility of applying airspace control degrees);

✓ *finality* (the Air Force operations aim to achieve strategic, operational and tactical objectives);

✓ *integrated used* (using ammunition of all types of forces);

✓ *combat intensity* (the possibility of calculating the sorties number/ fighter or the number of missions performed in a unit of time);

✓ *psychological effect* (displaying the scale of the air strikes and their effects on the target);

✓ *depth from the Forward Edge of Battle Area* (wide range of combat air systems).

The multilevel training requirements of the future air force officers include the entire package of modeling and simulation of military actions (Live-Virtual-Constructive) at the individual and tactical level.

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