Journal of Military and Strategic Studies

VOLUME 22, ISSUE 4

APPLICATION OF THE TARGETING PROCESS IN SIMULATIONS OF THE ANTI-SURFACE OPERATION CONDUCTED BY MIL MI-24 HELICOPTER

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*1. Introduction

Anti-surface air operations are defined as air power operations against adversary ground force capabilities to produce effects that achieve the joint force commander's (JFC) objectives to dominate the ground environment by employing air power to assist ground maneuvers conducted by Blue units while reducing the adversary's capability and capacity to resist.

Although most often associated with supporting Blue ground forces, anti-surface air operations can also be conducted independently of Blue ground force targets or in areas where Blue ground forces are not present. An independent attack on Red ground forces by Blue air forces often leads to success in taking control, especially early in combat operations.[3]

Air Power Contribution to Counter-Land Operations (APCLO) represents a form of maneuver warfare that seeks to destroy the enemy's combat capability by attacks intentionally directed against key enemy targets.

Air Power Contribution to Counter-Land Operations can be accomplished in two forms: Air Interdiction (AI) and Close Air Support (CAS). The use of CAS should produce effects that support the basic ground maneuver scheme. [4]AI and CAS may be employed as part of the overall offensive or defensive position and are normally integrated and coordinated with the ground component commander's target nomination list and ground maneuver scheme to maximize the effect on the enemy.[5]

The effects of anti-surface operations are aimed at tactical and operational targets of enemy ground forces and their supporting infrastructure.

ISSN : 1488-559X

The targets of anti-surface operations are those objects and structures that are critical to achieving decisive points of an adversary's operation and are conducted against ground forces, command and control (C2) sites and nodes, vital logistics, or supporting infrastructure.[6]

AI and CAS missions may be tailored, with the approval of the appropriate commander, to the evolving battlefield situation to provide the capability to strike time-sensitive targets through a dynamic execution process.

TABLE 1 TARGET DESCRIPTION AND DESIRED EFFECT

PRIORITY	CATEGORY	HPTS	WHEN	EFFECT
AIR DEFENSE PLATOON	MEDIUM	9P516 IGLA	IMMEDIATE	NEUTRALIZE
TANK PLATOON	HEAVY	T-72	PLANNED	SUPPRESS
GRENADE LAUNCHER PLATOON	MEDIUM	AGS-17	PLANNED	DESTROY

The paper presents an experiment of tactical support of ground units at the brigade task force level in an offensive operation.[7]

In this approach, statistical techniques were applied to estimate operation results from data generated by a simulation model.[8]

The validity of the simulation model is assessed by comparing the properties of the estimated simulation to actual Counter-Land Operation (CLO) procedures.

The experiment was conducted with the support of the MasaSWORD simulation technology with the close air support scenario2. Close Air Support Planning Procedure

Close Air Support (CAS) involves the use of munitions within close proximity of ground units and therefore requires detailed integration with movement and fire on the battlefield.

Due to the fact that CAS is implemented in close proximity, which does not represent a specific distance, detailed integration of fire and use of Terminal Attack Control (TAC) is required.[9]

CAS is not defined by a specific location of an operation; it can be conducted at any place and time when Blue ground forces are in close proximity to Red forces.

Successful CAS execution requires detailed integration of all types of fires, proximity, or movement of Blue forces. Detailed integration includes coordination of surface fires and air-delivered fires. Procedures should be flexible enough so that CAS, surface fires, and the ground scheme of maneuver are not overly restricted.

In our case, CAS provides firepower in an offensive operation to destroy, suppress, neutralize, disrupt, fix, or delay Red forces in close proximity to Blue ground forces. To be used effectively, CAS should be prioritized against targets that pose the greatest threat to the supported friendly ground forces.

Successful employment of CAS requires flexible real-time guidance and targeting while minimizing collateral damage. Successful accomplishment of an air-to-ground operation requires the utilization of a Joint Terminal Attack Controller (JTAC) or a Forward Air Controller (Airborne) (FAC[A]) which provide Terminal Attack Control (TAC).[10]

Mission data for a pre-planned CAS request is disseminated through ground maneuver unit channels. Data may be included in an Air Tasking Order (ATO), mission order, or fire support plan.[11]

Mission data shall include at least:

- Mission number
- Call sign
- Number and type of aircraft
- Estimate time on target/time on station
- Contact point
- Initial contact (who the aircrew contacts first)
- Call sign and frequency of the Final Control Agency.

The maneuver force commander generally assigns available CAS to the unit he has designated as his primary mission. Commanders use CAS to support an attack against an enemy force whether it is launched with minimal preparation in an expeditious attack or is a fully synchronized operation in a deliberate attack. here are 3 types of CAS, which differ in how JTAC or FAC(A) visually controls the target and the attacking aircraft. In our case, we used Type 1 CAS, where the JTAC or FAC(A) is able to visually control the attacking aircraft and target for each attack.[12]

At the same time, we used Immediate Requests for CAS in cases where requirements had not been implemented in ATO missions. Immediate Requests for CAS result from unexpected or unplanned needs on the battlefield and may require diverting, rescheduling, or dynamic re-tasking aircraft from other missions.

A significant safety factor is the increased risk from the Blue Unit's fires or excessive collateral damage. At the same time, it must be emphasized that target marking allows for clear identification of specific

targets in the field and increased situational awareness. Marking may be overt or covert and may allow the identification of friendly or hostile positions.[13]

Target development incorporates four distinct functions: target analysis, target validation, target nomination, and collection and use requirements.

The Joint Targeting Cycle is a six-phase process:

- Commander's objectives and intent
- Target development and prioritization
- Commander's decision and force assignment
- Capability analysis
- Mission planning and force execution
- Combat assessment[14]

Furthermore, as the modern battlefield situation becomes more complex, a massive number of factors need to be considered in the evaluation process, which makes the empirical determination of the threat values impractical and hard to reproduce.[15]

3. Experiment Design

The experiment focused on the brigade's tactical activities against a Red battalion tactical group (BTG), where earmarked air forces supported ground forces by attacking ground targets (attack operation).

TABLE 2. WEAPON SYSTEMS AND AMMUNITION USED IN THE MIL MI-24

MIL MI-24		
AMMUNITION TYPE	DESIGNATION	WEIGHT
BOMB	/	250 KG
BOMB	/	500 KG
ANTI-TANK GUIDED MISSILE	9K114 SHTURM	35 KG
UNGUIDED ROCKET	S-8	11.3 KG
UNGUIDED ROCKET	S-5	5 KG
FOUR-BARREL ROTARY CANNON 12.7 MM	9A624	/
MACHINE CANNON 7.62X54 MM	PK	/
MACHINE CANNON 30X165 MM	GSH-2-30	/

In order to verify the model of close air support in the brigade's offensive operation, the following experimental conditions were set[16]:

- Location: Libavá Military Training Area;
- Weather: very sunny day, no rainfall;
- Date and time: 18 October from 16:00 hrs;
- The organizational structure of the Blue Brigade is shown in Table 3;
- The organizational structure of the Red enemy units is shown in Table 4;
- The initial deployment of units before the start of the simulations is shown in Figure 1;
- Aircraft used: Mil Mi-24;
- The simulation was run 300 times with advancing Red units as they began to consolidate on the line reached and in a situation where Red units took up a pre-established defence;
- The simulation was conducted with the support of a flight or squadron of helicopters**Table 3**. Blue Brigade combat equipment numbers

Blue Mechanized Brigade	Armoured infantry fighting vehicle BVP-2	Tank T-72	Vehicle-towed 120 mm mortar Pram L	Self-propelled 120 mm mortar Pram S	Pram carrier Tatra 815-7 Pram	Shoulder-launched anti-tank grenade launcher RPG
1st Mechanized Battalion	39	0	12	0	12	27
2nd Mechanized Battalion	39	0	4	8	4	27
3rd Tank Battalion	X	20	X	X	X	X
7th Mechanized Battalion	39	X	X	X	X	27
Total	117	20	16	8	16	81

TABLE 4. RED BTG STRUCTURE AND EQUIPMENT

BTG	ARMORED PERSONNEL CARRIER BTR-80	TANK T-72	AUTOMATIC GRENADE LAUNCHER AGS-17	120 MM HEAVY MORTAR SYSTEM 2S12 SANI	MAN-PORTABLE SURFACE-TO-AIR MISSILE 9P516 IGLA
MOTORIZED RIFLE COMPANY	10	x	x	x	X
MOTORIZED RIFLE COMPANY	10	X	x	x	x
MOTORIZED RIFLE COMPANY	10	x	x	x	X
MOTORIZED RIFLE COMPANY	10	x	x	x	X
TANK COMPANY	x	10	x	x	X
GRENADE LAUNCHER PLATOON	x	x	6	x	X
MORTAR BATTERY	X	x	X	9	x
AIR DEFENSE PLATOON	x	x	x	x	9
TOTAL	40	10	6	9	9

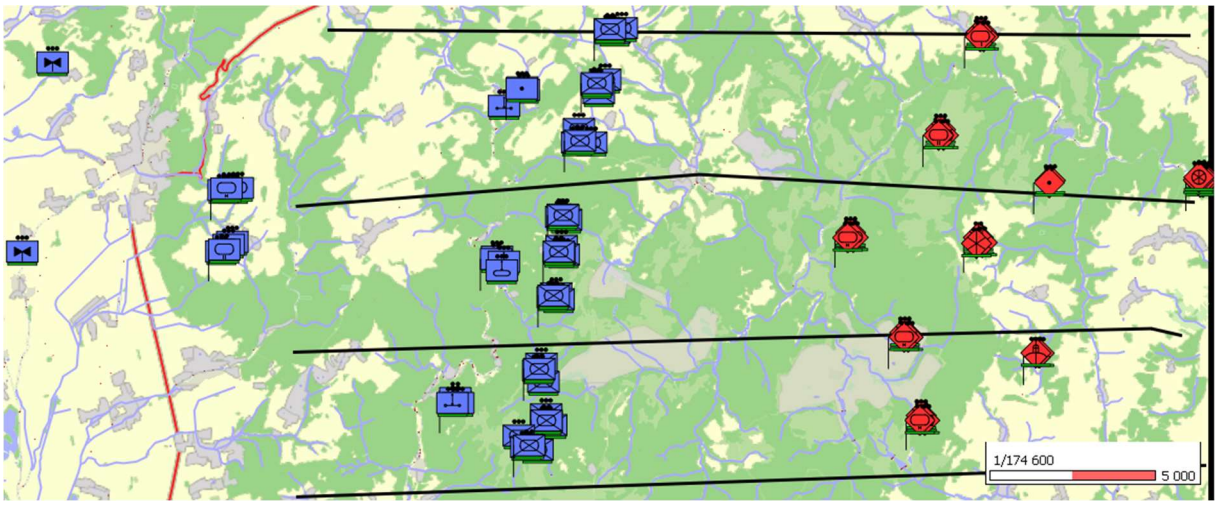

FIGURE 1. INITIAL DEPLOYMENT OF UNITS BEFORE THE START OF SIMULATIONS.

The aim of the experiment was to test the following hypothesis:

The employment of a flight and a squadron of helicopters reduces the time required to tactically destroy enemy units and significantly reduces casualties compared to the employment of a flight of helicopters only.

The following parameters were defined to confirm or refute the hypothesis:

- operational capabilities of Blue units;
- operational capabilities of Red units;
- casualties (Blue forces);
- casualties (Red forces);
- mission duration until Red forces are destroyed to 30 % of their initial strength;
- number of Red assets destroyed by Blue air support.

4. MasaSWORD Calculations

During a CAS mission simulation, helicopter units decide which targets to attack. A Ph Limit factor, is defined by the unit's current mission and represents the minimum probability of hit that the unit must have to consider an enemy unit attackable, and the level of detection is considered. Only recognized or identified enemy units can normally be attacked.[17]

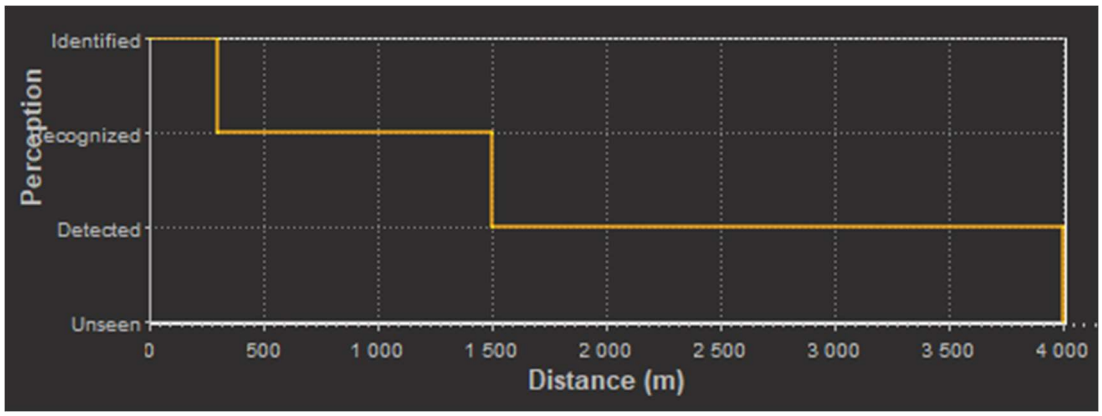

Figure 2. Recognition of a heavy target by sensor Pilot eyes to the ground

The modalities of fire are also evaluated during the simulations. The modalities of fire are usually defined by the unit's current mission and vary depending on the firing mode, fired type, firing type, percentage of eligible equipment that will actually be used, and the armament and material available to the unit. Selecting a firing mode means that the helicopter will use only its best weapon system or all of its weapon systems. The fired type means that all equipment contained in the enemy unit can be attacked or only major equipment can be targeted.[17]

Depending on the fired type, a list of potential targets (equipment contained in the enemy unit) is defined and randomized. Then, target by target, the best firer in terms of dangerousness is defined:

$$\text{Lethality} = Ph * (Pk[\text{destroyed}] + Pk[\text{maintenance support needed}]/2 + Pk[\text{on site fixable}]/4) \quad (1)$$

where:

- Ph is the probability of being hit by the coupled equipment/weapon system, and
- Pk[x] is the probability of killing if hit by the weapon system.

With distance, the probability of a hit can be calculated using the "Distance/Probability to hit" matrix for the weapon system and target category.[17]

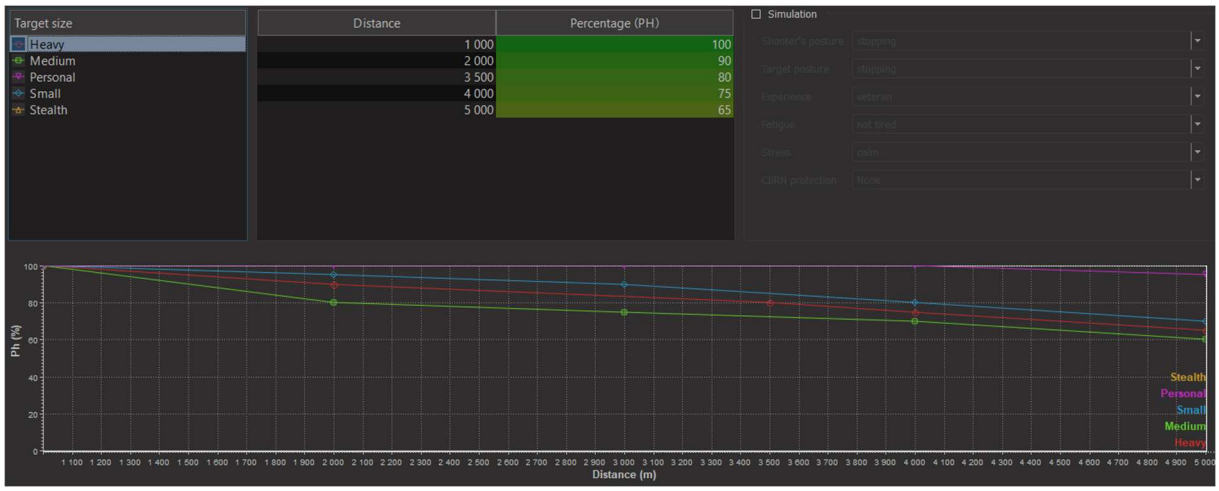

Figure 3. Probability of target hit by distance for S-8 unguided missiles

In addition, the human factor applies. Thus:

$$\text{Probability to hit} = \text{Ph (Distance)} * \text{Experience effect} * \text{Fatigue effect} * \text{Stress effect} \quad (2)$$

A target is hit if the random factor is greater than the probability of to hit.

When a target is hit (by direct or indirect fire), the effect is called attrition. Attrition falls into one of four categories:

- Killed/Destroyed
- Damaged with maintenance support needed
- Damaged but repairable on-site
- Not damaged

Each type of ammunition has its own attrition matrix. The attrition is calculated by comparing a random factor (between 1 and 100) to this matrix.[17]

Armor	% repairable on site	maintenance support need	% destroyed
HeavyTank	5	20	40
MediumTank	10	30	50
LightTank	10	30	60
ArmouredCarrier	10	30	60

Figure 8. Attrition to target by S-8 unguided missiles

4.1 Probability of hit for direct fire

The probability of hitting a target depends mainly on the representation of the distance between the shooter and its target. Here:

$$\text{Distance} = \text{Actual distance} / \text{Ph Modifier} \quad (3)$$

The actual distance is calculated as a straight line between the two units. The Ph Modifier represents the influence of the stance of the shooter and its target. Stance has a completion percentage because a unit needs time to transition from one stance to another, for example, if a unit changes its stance from "movement" to "short stopping".[17]

Using the launcher's Ph Modifier matrix, the Ph Modifier is calculated as:

$$\text{Ph Modifier} = \text{Target stance completion} \times \{(\text{Shooter stance completion} \times \text{Ph Modifier (Shooter stance \& Target posture)} + (1 - \text{Shooter stance completion}) \times \text{Ph Modifier (Shooter last stance \& Target stance)}\} + (1 - \text{Target stance completion}) \times \{(\text{Shooter stance completion} \times \text{Ph Modifier (Shooter stance \& Target last posture)} + (1 - \text{Shooter stance completion}) \times \text{Ph Modifier (Shooter last stance \& Target last stance)}\} \quad (5)$$

		Target's posture						
		moving	safety	stopping	short stopping	parked	parked on self-prepared area	parked on engineer-prepared area
Shooter's posture	moving	80	60	90	80	70	70	70
	safety	80	60	90	80	70	70	70
	stopping	80	60	90	80	70	70	70
	short stopping	80	60	90	80	70	70	70
	parked	80	60	90	80	70	70	70
	parked on self-prepared area	80	60	100	80	70	70	70
	parked on engineer-prepared area	80	60	100	80	70	70	70

Figure 4. Modifier matrix of shooters and targets posture for S-8 unguided missiles

In this example, where the shooter is at 70% from "stopping" to "moving" and the target is at 60% from "parked" to "moving", we have:

$$\text{Ph Modifier} = 0.6 \times (0.7 \times 0.8 + 0.3 \times 0.8) + 0.4 \times (0.7 \times 0.7 + 0.3 \times 0.7) = 0.76 \quad (4)$$

5. Results

5.1 Experiment of an attack on the advancing Red units as they began to consolidate on the line reached

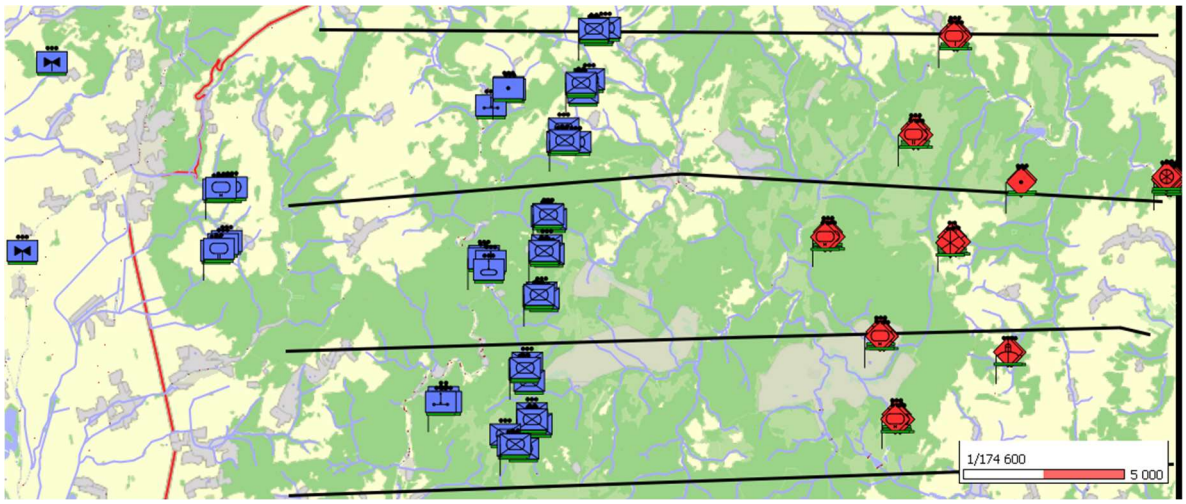

Figure 5. Initial deployment of units before the start of simulations.

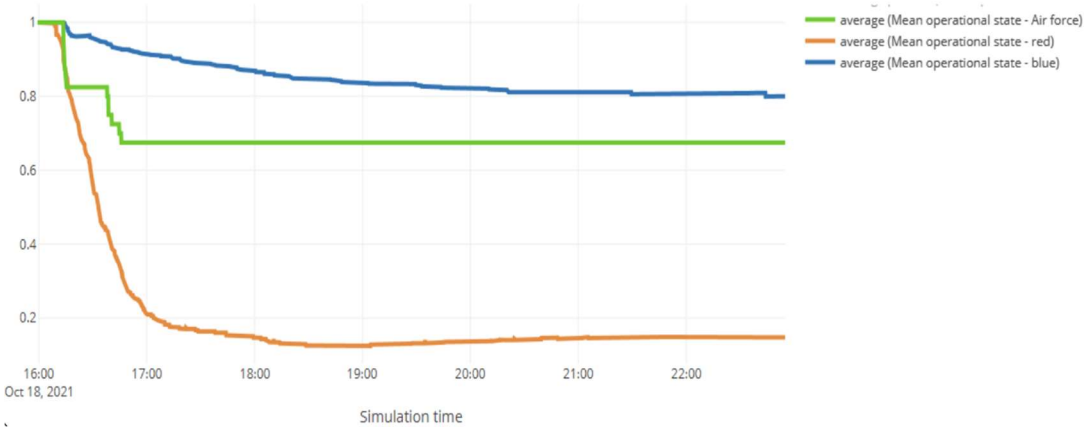

Figure 6. Simulation results of the Blue brigade engagement supported by a flight of helicopters against Red units

The results of the 300 simulations of the engagement of the Blue brigade, supported by four helicopters, against Red units as they began to consolidate on the line they had reached are shown in Figure 6 and Figure 7. Figure 6 shows the decline in operational capability of each unit, with the blue curve showing the Blue units, the green curve showing the helicopters, and the orange curve showing the Red units. At 16:46, Red units had operational capabilities reduced below 30% and were therefore considered destroyed and unable to fight, while at the same time, Blue units had operational capabilities above 90%.

The overall operational state of Blue units dropped below 80% after six hours, meaning that the unit was no longer capable of being effectively deployed in further combat.

The operational state of supporting helicopters was reduced to approximately 70%, meaning that on average one helicopter had been destroyed. In the simulation, helicopters contributed to the destruction of an average of twenty-seven BTR-80 vehicles, the air force was involved in the destruction of approximately 65% of enemy combat equipment.

On average, approximately 130 members of the brigade were killed overall, of which 49 soldiers were killed in the first two hours of combat. The number of dead does not include the fallen aircrew. Red units suffered multiple casualties: 310 dead, with over 150 soldiers killed in the first two hours of combat.

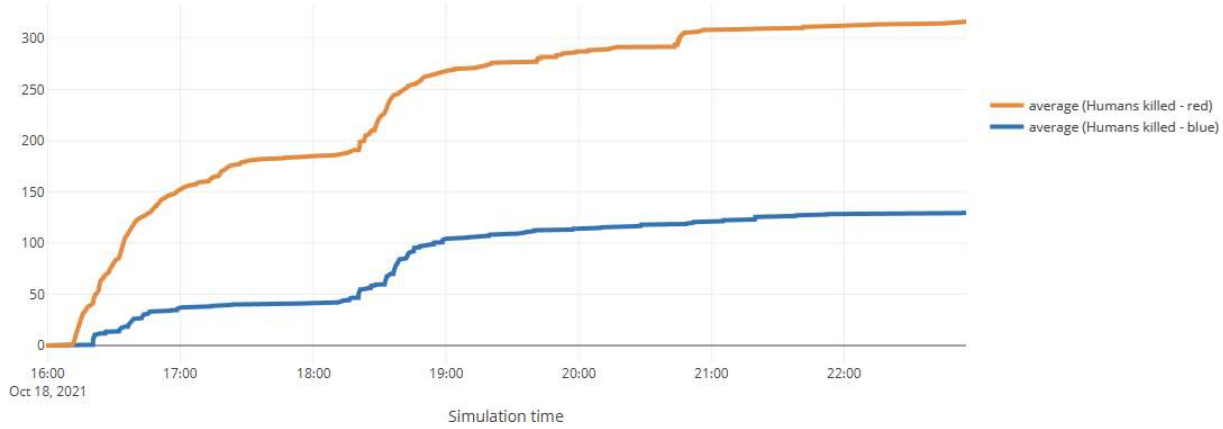

Figure 7. Number of deaths of members of Blue units and Red units

The results of the simulations conducted, but with the brigade supported by a squadron of helicopters, are shown in Figure 8 and Figure 9. In this case, Red units already had operational capabilities reduced to below 30% as early as 16:43, while Blue units again had operational capabilities above 90%. In the simulations, the squadron of helicopters contributed to the destruction of an average of thirty BTR-80 vehicles and nine T72B3 tanks. The helicopter squadron helped to reduce the operational capabilities of the adversary by destroying almost 80% of the combat equipment. Blue units with squadron support did not fall below 80% of operational capability throughout the entire combat.

Figure 8. Simulation results of the Blue brigade engagement supported by a squadron of helicopters against Red units

Blue units supported by a squadron of helicopters further reduced the operational capabilities of the enemy to the 10% mark within two hours with total casualties of around 90 soldiers and 20 soldiers killed in the first two hours of combat. In the simulations of the Blue unit engagement conducted with helicopter squadron support, the number of casualties was reduced by approximately 30% compared to support by only four helicopters.

Figure 9. Number of killed members of the brigade with helicopter squadron support

Simulations of Red and Blue units fighting, but without air support, showed a noticeable effect on the course of the combat – see Figure 10. The operational capabilities of Red units were reduced beyond the 30% threshold approximately 20 minutes later than in previous simulations, and the operational

capabilities of Blue units were reduced during the course of the combat to below 70%, dropping below 80% during the first hour of combat.

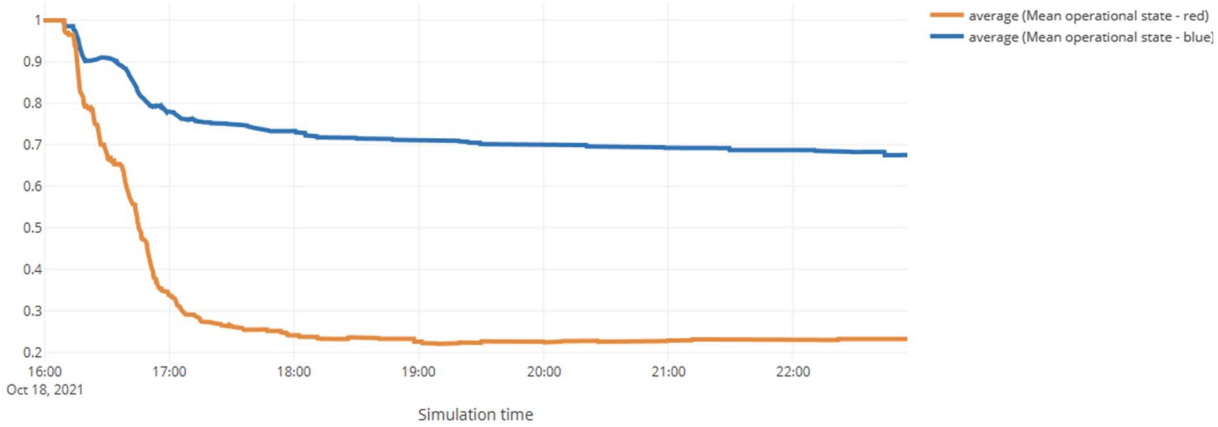

Figure 10. Simulation results of the Blue brigade engagement without air support against Red units

In simulations without air support, Blue units suffered even greater casualties than Red units. In the first two hours of combat, 128 members of Blue units were killed and over 250 for the entire combat, nearly 105% more than with helicopter flight air support – see Figure 16.

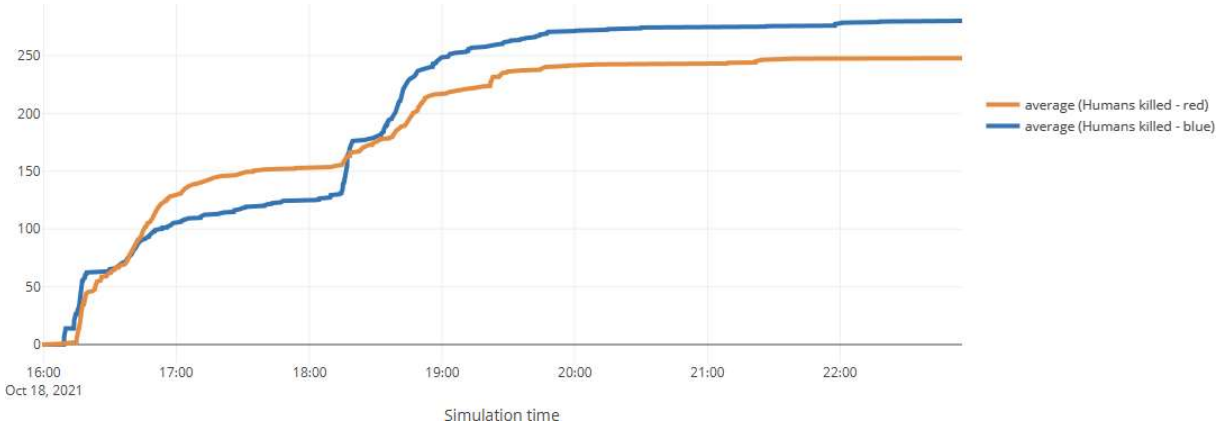

Figure 11. Number of killed members of Blue units without air support

5.2. An experiment of attack with Red units taking advantage of a pre-built defence.

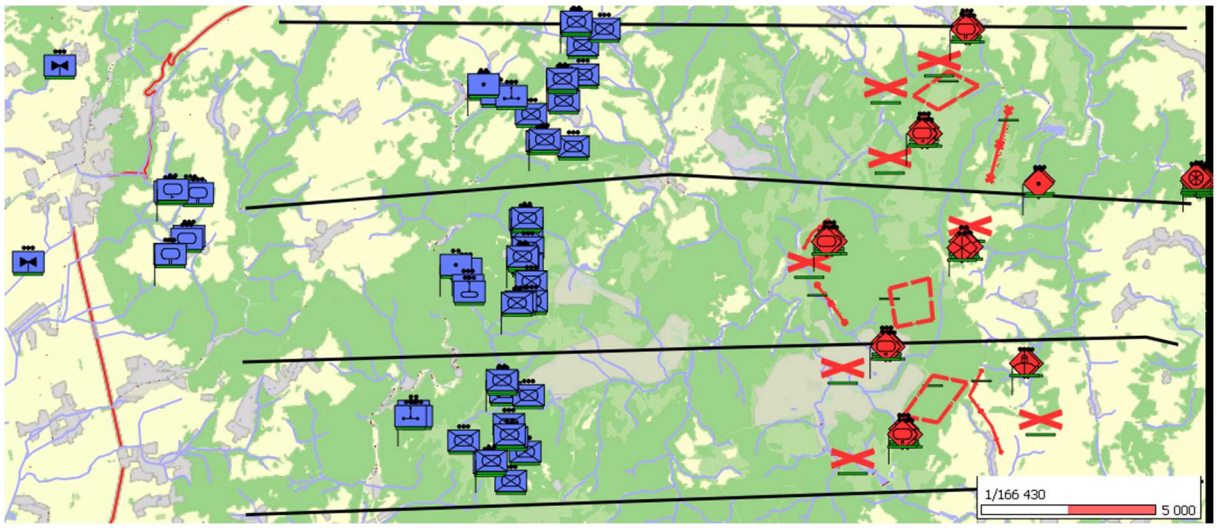

Figure 12. Initial deployment of units before the start of simulations

The results of the simulations of Blue units facing Red units with pre-built defences (Figure 12) are shown in Figure 13 and Figure 14. Blue units fell below 90% of operational capabilities in the first hour of combat, which were then reduced to the 80% mark. It was not until 17:22 that Blue units managed to reduce the enemy's operational capabilities to below 30%. The air force maintained operational capabilities again around 70% until the end of the combat. The air force contributed to the destruction of thirty BTR-80 vehicles during the simulations.

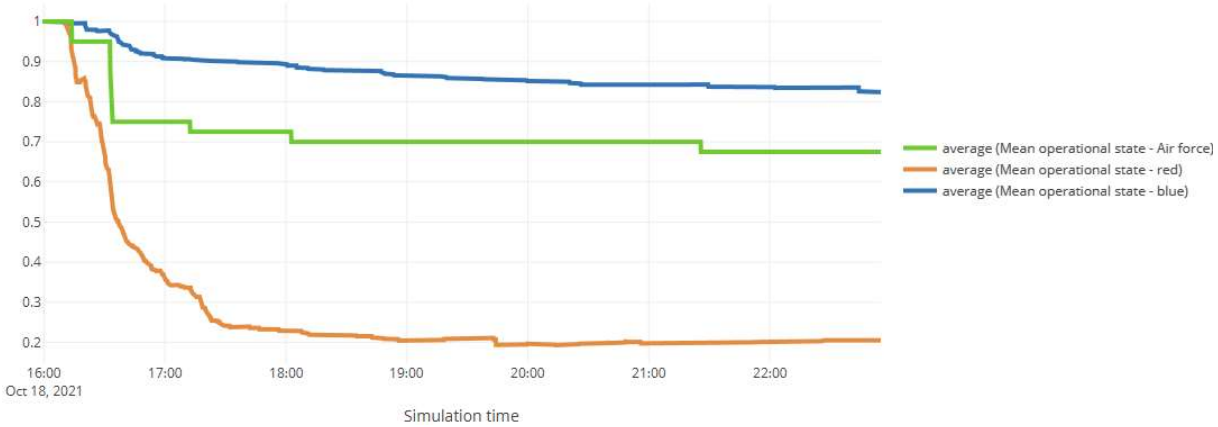

Figure 13. Attack by the Blue brigade supported by a flight of helicopters against Red units in c defence

The losses of Blue units totalled an average of 176 dead, with 51 killed in the first two hours of combat. On the side of Red units, 344 soldiers were killed on the average, 200 of them in the first two hours.

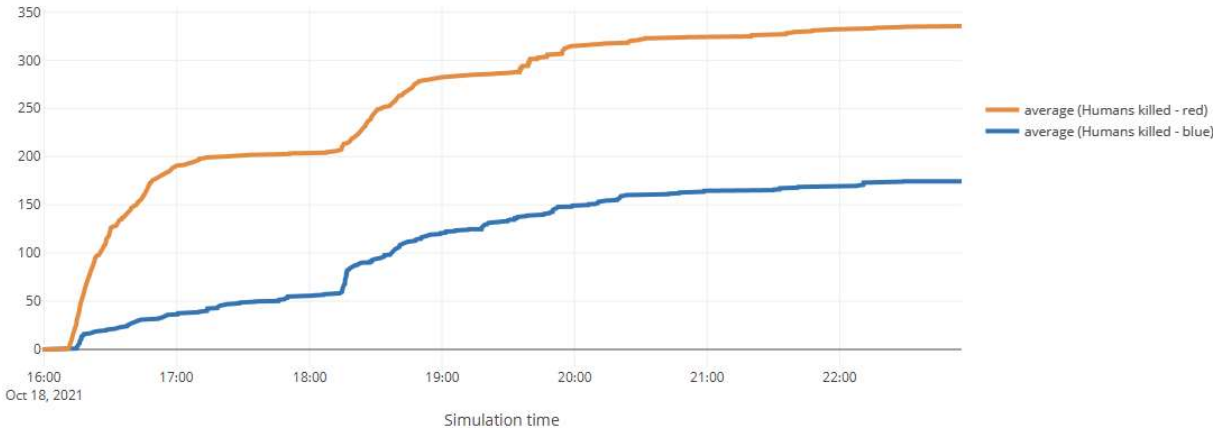

Figure 14. Numbers of fallen soldiers of the Blue Brigade supported by a flight of helicopters

Blue units supported by a squadron of helicopters were again able to reduce the operational capabilities of Red units to below 30% faster, as early as at 16:48, and to below 10% after 18:00. Blue units maintained operational capabilities above 80% - see Figure 15.

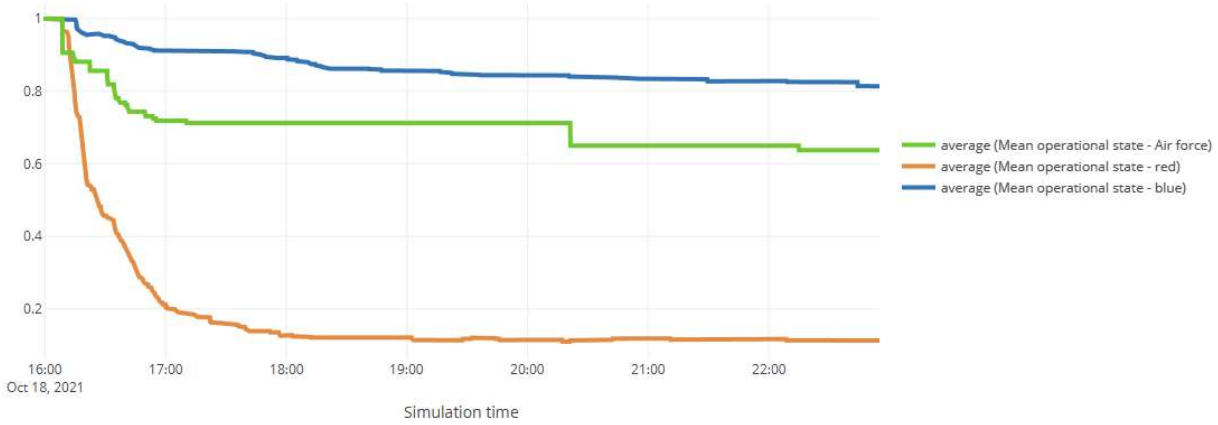

Figure 15. Attack by the Blue Brigade supported by a squadron of helicopters against Red units in defense

With the support of the helicopter squadron, the number of fallen soldiers from the Blue units was reduced to below 150, i.e. by approximately 15% - see Figure 16.

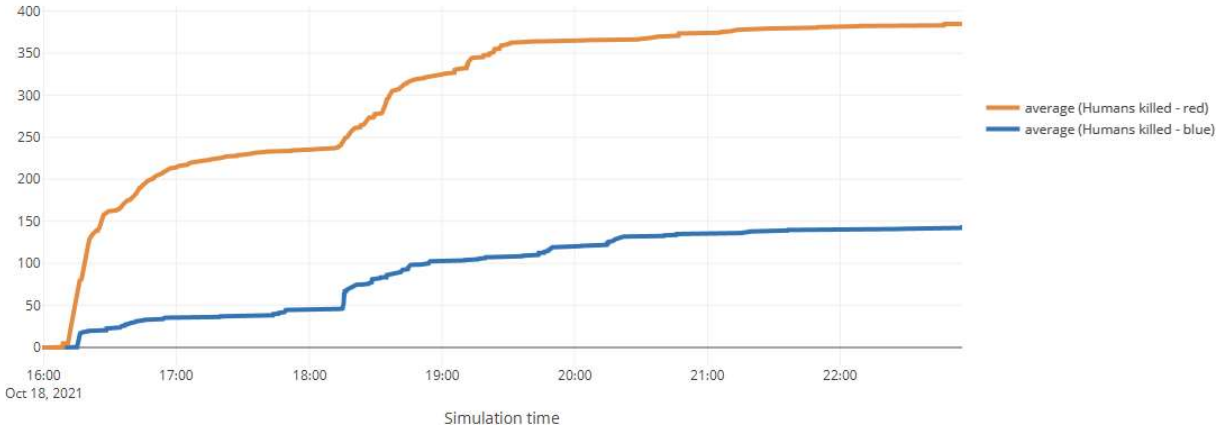

Figure 16. Numbers of fallen soldiers of the Blue Brigade supported by a squadron of helicopters

Conclusions

The effect of air support on the destruction of enemy units was demonstrated by simulations of combat of a brigade task group against a battalion tactical group. The time required to destroy the enemy is reduced by up to 20 minutes with air support and the number of casualties is halved. At the same time, the effect of the number of helicopters deployed to support ground forces has been demonstrated, and with helicopter squadron support, ground force losses were reduced by 30% compared to those with helicopter flight support. The helicopter squadron in the simulations contributed to the destruction of an average of thirty BTR-80 vehicles and nine T72B3 tanks.

The employment of Mil Mi-24 helicopters to support the brigade task group reduced the time to destroy BTG by minutes, but casualties by tens.

It has been proven that by deploying air support of any strength, the success rate of destroying enemy units is higher and in less time while saving lives.

Practical applications of the simulation results can be applied to the decision-making process of ground commanders on whether to request air support and in the targeting process.

Author Contributions: Abstract, Z.Korecki; Process, Z.Korecki; Close Air Support Planning Procedure, Z.Korecki; Experiment Design, T.Hoika; MasaSWORD Calculations, T.Hoika; Results, T.Hoika and Z.Korecki; Conclusion, T.Hoika and Z.Korecki.

Funding: This research received no external funding

Acknowledgments: The authors wish to express their deep gratitude to Mr. Miloslav Bauer for giving them the opportunity to carry out their project on air support simulations. They sincerely thank Mr. Ondřej Mach for his guidance and advice on air combat tasks. They would also like to express their gratitude to the Dean of the Faculty of Military Technology of the University of Defence.

Conflicts of Interest: The authors declare no conflict of interest.

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