UDC 355.421:528.91 **https://doi.org/10.33405/2786-8613/2024/2/4/323358**

V. Obriadin

O. Kolomiitsev

S. Podviaznikov

METHODS OF APPLYING INFORMATION TECHNOLOGIES BY THE FIRE DEFENCE PLANNING DIVISION WHEN DEVELOPING OPTIONS FOR ACTION BY THE UNIT HEADQUARTERS

The article discusses the issues of implementation of information and analytical technologies in the process of making a military decision by a unit (section) planning fire damage to the enemy (to provide fire support to its troops) from the command-and-control body of a combined arms formation at the stage of developing options for actions of a mechanised brigade in a defensive battle. Practical recommendations on the use of information technologies based on the Arc View GIS 3.3 geographic information system and Mathcad and Excel application packages to reduce the time cycle of the Boyd loop in the information warfare of the opposing party's management unit are provided.

Keywords: *geoinformation technologies, Boyd cycle, fire damage planning, military decision-making process, automated workstation, linear programming methods.*

Statement of the problem. The main feature of the current military operations conducted in our country to repel russian aggression is the dominant role of comprehensive fire damage to the enemy with all available forces and means of a combined arms formation. It forms the basis of an operation (battle, combat) and is a decisive factor in defeating enemy forces and assets, determines the course and outcome of hostilities.

The issue of planning the complex fire destruction of the enemy in the headquarters of a combined arms formation (unit) is entrusted to a fire destruction (FD) planning unit (section), otherwise, a fire support unit or section (FS). The use of standardised procedures for planning stages (according to NATO standards) in the work of the FD (FS) planning section of the military unit (MU) raises a number of problems, the solution of which, in our opinion, is possible if the Field Support Officer (FSO) of the command and control body of the general military unit use information technology, in particular, GIS technologies based on the *Arc View GIS 3.3* geographic information system and *Mathcad* and *Excel* application packages.

The focus of our attention on the work of the FD planning section (FS) at the stage of developing options for action by the unit headquarters is not accidental, but due to the significant impact that FD has recently had on the overall numerical and qualitative ratio of the opposing sides in the entire contact line and in its individual combat areas of combined arms formations. We should also note the significant impact of the created enemy fire destruction system (EFD) on adjusting the brigade's combat order through timely manoeuvre with fire rather than forces. The role of EFD (FS) planning is also increasing due to the widespread use of unmanned aerial vehicles (UAVs) and army aviation on the battlefield in close air support missions, as well as long-range firepower systems based on F-16 aircraft in tactical tasks.

Analysis of recent research and publications. According to the authors of numerous publications [7, 8], the general military battle of the opposing sides can be represented in the form of a cybernetic model that involves multiple repetition of the Boyd cycle (a concept developed by John Boyd in 1995, according to which any processes that correspond to reality operate in a continuous cycle, constantly interact with the environment and consider its constant changes), consisting of four sequential interacting processes observation; orientation; decision; action, abbreviated as OODA (see Figure 1).

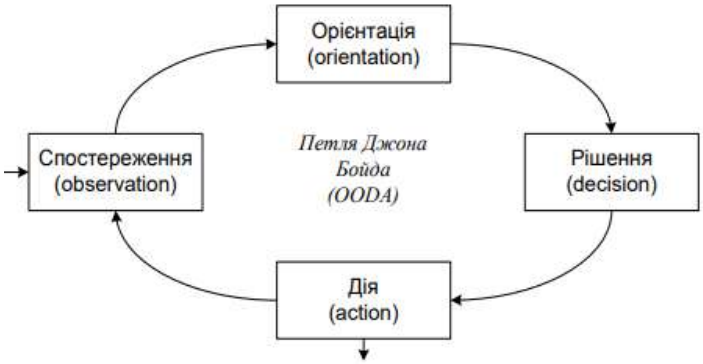

Figure 1 – OODA loop processes

The process of planning EFD (FS), which is implemented at the stage of developing options for action by the unit headquarters, is an integral part of the Boyd cycle (orientation; decision) and is a purposeful activity of the fire destruction planning unit to determine the content and sequence of tasks to defeat the enemy in an operation (battle, combat operations), the distribution of forces and destruction means (DM) to them, considering the importance and danger of enemy groups and objects, determining methods, ways, forms and order of FD.

The analysis of literary sources and military publications on the planning of FD by the EFD unit of the brigade headquarters [6] focuses on the role of *targeting* – the process of selecting, prioritising (importance) of targets and coordinating the appropriate impact on them by DM, considering the operational requirements and capabilities of the latter.

Targeting, meanwhile, is divided into combined and dynamic types. Combined targeting is conducted by the FS unit of the headquarters in a constant cycle and consists of six successive stages: analysis of the intent, task and commander's instructions; determination of objectives and their priority; analysis of fire support capabilities; consideration of the commander's decision and assignment of forces and means; planning and execution; evaluation of results.

Dynamic targeting is also performed by the FS unit (section) of the headquarters and is a component of combined arms targeting. Dynamic targeting involves the selection and prioritisation of unplanned targets, as well as targets that were not selected for attack during the combined targeting cycle. Dynamic targeting includes the following stages: target search; target fixation and recognition; target tracking, targeting DM; active engagement and evaluation of engagement results. Typically, the dynamic targeting cycle is shorter than the combined targeting cycle and must be conducted in near real time by a targeting officer within the FS unit. The targeting officer leads the targeting process and is the expert on all matters related to combined targeting. The targeting officer participates in the military decision-making process (MDMP) by developing a list of high-priority targets, a table of targeting instructions, a target synchronisation matrix (targeting matrix) and a standard (rule, algorithm) for target selection.

The targeting officer is supported by an artillery intelligence officer and a fire support officer. The artillery intelligence officer coordinates with brigade headquarters to provide brigade intelligence assets and higher-level interoperable assets with input to develop, identify, and prioritise targets from the intelligence section or battalion or brigade intelligence officer. The FS officer is responsible for advising the combined arms commander, assisting the senior FS officer on fire destruction and FS functions, and must understand the intent of the FS coordinating officer (unit, unit commander, FD means group) to support the battle plan (manoeuvre) and perform his functions as necessary.

Computer technology, as specified in the algorithms (standardised procedures) for the work of FS section officials of the brigade headquarters during the standardised stages of the MDMP, is usually used only to obtain information and reference materials (CARVER methodology for identifying high-priority targets), but not for modelling FD dynamics and performing calculations [2, 3]. Therefore, FS (FD) planning takes a lot of time. The latter (in conditions when the opposing side has the ability to use almost all its firepower and assets in the mode of a single reconnaissance and fire (strike) system and thus outpace us in the process of preparing and opening fire) is a decisive argument in favour of using information technology in the work of the FD (FS) unit (section) at the stage of developing options for actions by the headquarters of the unit in order to reduce the time for planning the enemy's fire damage (in fact, drawing up a targeting matrix) and eliminating possible imbalances.

The purpose of the article is to provide the unit (section) for planning fire damage (fire support) of the unit headquarters at the stage of developing options for action with practical recommendations on the use of information technology based on the geographic information system Arc View GIS 3.3 and application packages Mathcad and Excel in order to reduce the time for planning fire damage to the enemy (reducing the Boyd loop cycle) and to eliminate a possible time imbalance in the work of the enemy's command and control body.

Summary of the main material. It is well known that EFD planning can be divided into general, direct and detailed planning [4]. We will focus only on the latter, which is inherent to the EFD planning unit (section) of the headquarters of a combined arms formation. In the process of detailed planning, the section officers specify the EFD (FS) tasks for the directly subordinated forces and means: distribute the enemy objects identified for destruction among the DMs; determine the consumption of rockets, ammunition, their type, as well as the number of ammunition for each object, based on its nature, condition, firing (attack) task, selected form of FS, and other data.

The planning process is usually accompanied by the resolution of the ever-present contradiction between the objective growth of information and the limited human capacity of the officials [5] of the EFD planning unit to process the information provided (incoming and outgoing) in a timely manner in the interest of preparing and implementing rational decisions (conclusions, proposals, solutions to the objective task, etc.).

To resolve the above contradiction, especially with regard to the direct solution of the objective allocation problem, it is advisable to use the capabilities of the mathematical apparatus of the theory of linear programming, in particular its transport problem (TP). The latter is a class of linear programming problems, the specificity of whose mathematical model allows the use, in addition to the general methods of linear programming, of special methods that significantly reduce the computational process and are carried out using the *Mathcad* and *Excel* application packages.

The sequence in which these application software packages are deployed has been the subject of extensive analysis in a multitude of scientific publications, encompassing both civil and military domains. The distinctive feature of this publication is that, when establishing the cost (payment, transportation matrix) of the transport task of the vehicle, which is directly involved in the formation of the objective function of the vehicle, attribute tables of vector *spatial shape* are utilised. *The Arc View GIS* software package, version 3.3, is employed in the utilisation of files pertaining to the points of interest, encompassing both the instruments of destruction and the intended targets [9].

The procedure for the work of the FD (FS) section officers may be as follows. The FS coordinator (FS officers) at his/her automated workstation (AWS), in accordance with the combat order of the senior officer, the commander's intention regarding the unit's version of the combat order, draws on the electronic tablet the position of the brigade's regular and added weapons of destruction with an indication of their sectors (areas) of responsibility (Figure 2).

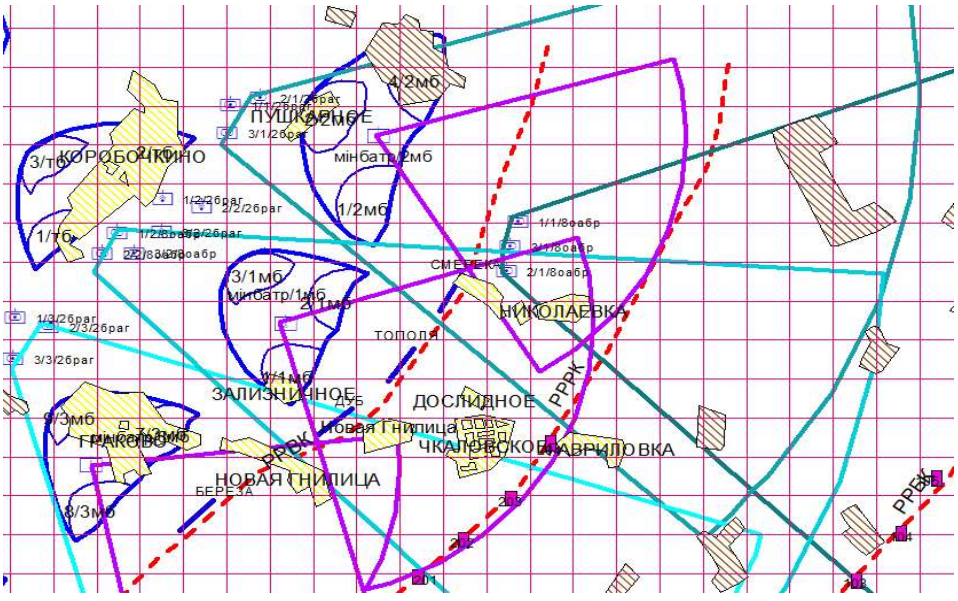

Figure 2 – Displaying a variant of the brigade's combat order with firepower (DM) on the AWS monitor of the FS coordinator officer

The artillery reconnaissance officer and the targeting officer, working together with the G2/S2 section officer, mark the position and characteristics of the target objects on the FS coordinator's electronic tablet (Figure 3).

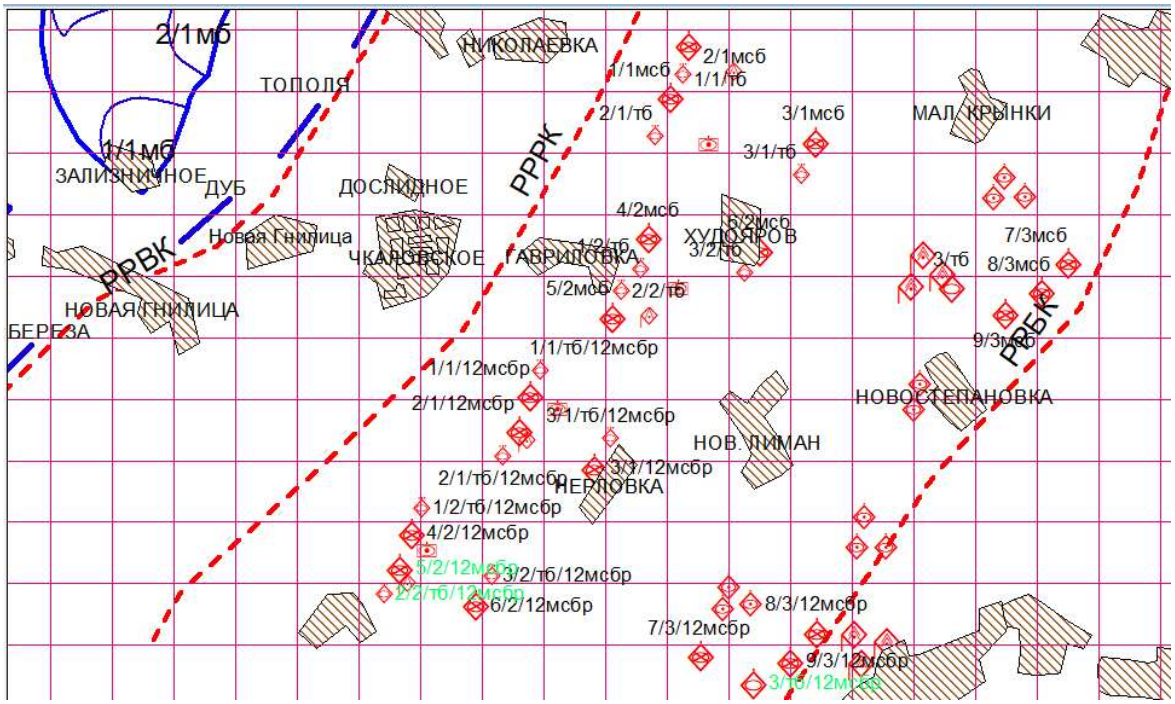

Figure 3 – Displaying the position and characteristics (forms) of target objects on the AWS monitor of the FS coordinator officer

The attribute table of the *shp*-file of the DM point topic (Figure 4), which is completed by FS officers, along with rectangular coordinates (fields: *X-coord*; *Y-coord*), may contain information on the technical specifications of weapons (field *D_urag*), the readiness of the DM to perform a fire mission (considering the sectors of responsibility and the impact of terrain in Figure 2) and the available number of combat packs (missiles, ammunition) in the estimated ammunition (*RB* field).

Shape	Tip_bbm	Kil_obt	Potenc_pid	Nalegnist	Org_chtat	D_urag	X-coord	Y-coord	RB
Point	БМ-21	6.00	7.200	1/2/26рат	реабатр	20.00	7343544.64070	5517649.79950	432.0
Point	БМ-21	6.00	7.200	2/2/26рат	реабатр	20.00	7344453.58060	5517442.49740	432.0
Point	БМ-21	6.00	7.200	3/2/26рат	реабатр	20.00	7343528.69440	5516820.59120	432.0
Point	152мм	6.00	7.800	1/3/26рат	сабатр	17.30	7340164.02230	5514619.99990	360.0
Point	152мм	6.00	7.800	2/3/26рат	сабатр	17.30	7340929.44530	5514380.80520	360.0
Point	152мм	6.00	7.800	3/3/26рат	сабатр	17.30	7340116.18330	5513567.54320	360.0
Point	122мм	6.00	7.800	1/1/26рат	сабатр	15.20	7345139.34940	5520063.50541	336.0
Point	122мм	6.00	7.800	2/1/26рат	сабатр	15.20	7345809.94555	5520244.25822	336.0
Point	122мм	6.00	7.800	3/1/26рат	сабатр	15.20	7345064.41701	5519349.71606	336.0
Point	152мм	6.00	8.400	1/1/8оабр	сабатр	17.30	7351761.46102	5517071.49790	378.0
Point	152мм	6.00	8.400	2/1/8оабр	сабатр	17.30	7351499.98173	5515795.20647	378.0
Point	152мм	6.00	8.400	3/1/8оабр	сабатр	17.30	7351596.85953	5516436.72820	378.0
Point	152мм	6.00	8.400	1/2/8оабр	сабатр	17.30	7342508.54121	5516778.10349	378.0
Point	152мм	6.00	8.400	2/2/8оабр	сабатр	17.30	7342180.42396	5516246.86604	378.0
Point	152мм	6.00	8.400	3/2/8оабр	сабатр	17.30	7342899.15698	5516270.30299	378.0

Figure 4 – Attribute table of the point theme shp-file of the brigade's regular and added firepower

The attribute table of the *shp*-file of the point topic of target objects (Figuere 5, share of targets) is populated by intelligence and targeting officers. It comprises several fields, including rectangular coordinates (fields: *X-coord; Y-coord*) and time of target fixation (*Hhxx_ddmm* field). Additionally, it contains information on the required number of estimated munitions (*Rb-o* field) to hit a target of a certain degree of damage, as well as the total combat potential. The potential of the target (*Potenc_sum* field), the source of information (*Dgerelo* field) and the probability of the latter (*Dostovir* field), as well as other characteristics of the targeted objects, can be used to prioritise targets using the built-in logical function *Query Builder* from the Arc View GIS software package. This can be achieved, for example, using the CARVER matrix [10,11] or additive or logical convolution of the detected target parameters.

Shape	Org_chkar	Kil_bbm	Tip_bbm	Nalegnist	Potenc_sum	X_coord	Y_coord	Hhxx_ddmm	Dgerelo	Dostovir	Rb_o
Point	MCP	15.000	БМП-3	1/1мсб	11.025	7354829.55225	5516662.61946	1530.0609	РГ 8омбр	0.90	1050.0
Point	MCP	15.000	БМП-3	4/2мсб	18.000	7354319.29971	5515235.49824	1530.0609	РГ 8омбр	0.90	1050.0
Point	MCP	15.000	БМП-3	5/2мсб	18.000	7353733.62494	5513946.86623	1530.0609	РГ 8омбр	0.90	1050.0
Point	MCP	15.000	БМП-3	1/1/12мсбр	18.000	7351956.86465	5512398.02033	1530.0709	РГ 8омбр	0.90	1050.0
Point	MCP	15.000	БМП-3	2/1/12мсбр	18.000	7351768.03248	5511834.47433	1530.0709	РГ 8омбр	0.90	1050.0
Point	MCP	15.000	БМП-3	2/1мсб	12.600	7355120.17675	5517506.46320	1530.0609	РГ 8омбр	0.90	1050.0
Point	TB	4.000	T-72	1/1/тб	6.720	7355055.26570	5517034.38278	1545.0609	БАК 8омбр	0.70	650.0
Point	TB	3.000	T-72	2/1/тб	5.040	7354603.83880	5516038.58816	1545.0609	БАК 8омбр	0.60	650.0
Point	TB	4.000	T-72	1/2/тб	9.600	7354213.81924	5514733.91280	1545.0609	БАК 8омбр	0.60	650.0
Point	TB	3.000	T-72	2/2/тб	7.200	7353885.57583	5514379.85249	1545.0609	БАК 8омбр	0.60	650.0
Point	TB	4.000	T-72	1/1/тб/12мсбр	9.600	7352129.46905	5512812.56594	1530.0609	БАК 8омбр	0.50	650.0
Point	TB	3.000	T-72	2/1/тб/12мсбр	7.200	7351524.61602	5511425.82972	1530.0609	БАК 8омбр	0.50	650.0
Point	MCP	15.000	БМП-3	3/1мсб	12.600	7356472.79778	5516087.27145	1530.0609	БАК 8омбр	0.50	1050.0
Point	TP	10.000	T-72	3/тб	16.800	7358796.80765	5514171.25677	1530.0609	БАК 8омбр	0.50	1300.0

Figure 5 – Attribute table of the *shp*-file of the point topic objects-targets

Subsequently, using the *Join* function and preliminary selection of the *Shape* fields of both attribute tables (*Attributes of Ksp_3ad.shp* and *Attributes of Roty_prot.shp* in Figure 6), the vector point themes *Ksp_3ad.shp* (*COP of the 3rd SPAB/2nd BAG* in the defence sector of the *3rd MB* in Figure 2) and *Roty_prot.shp* (enemy targets in *3rd SPAB`s/2nd BAG`s* sector of fire, which supports the actions of units in the *3rd MB's* defence zone in Figure 6). The result is the appearance of a new parameter *Distance* in the combined table *Attributes of Roty_prot.shp* (Figure 6). The latter characterises the scalar distance from the *COP of the 3rd SPAB/2nd BAG* to each target located in the sector of responsibility of the *3rd SPAB/2nd BAG* (Figure 6).

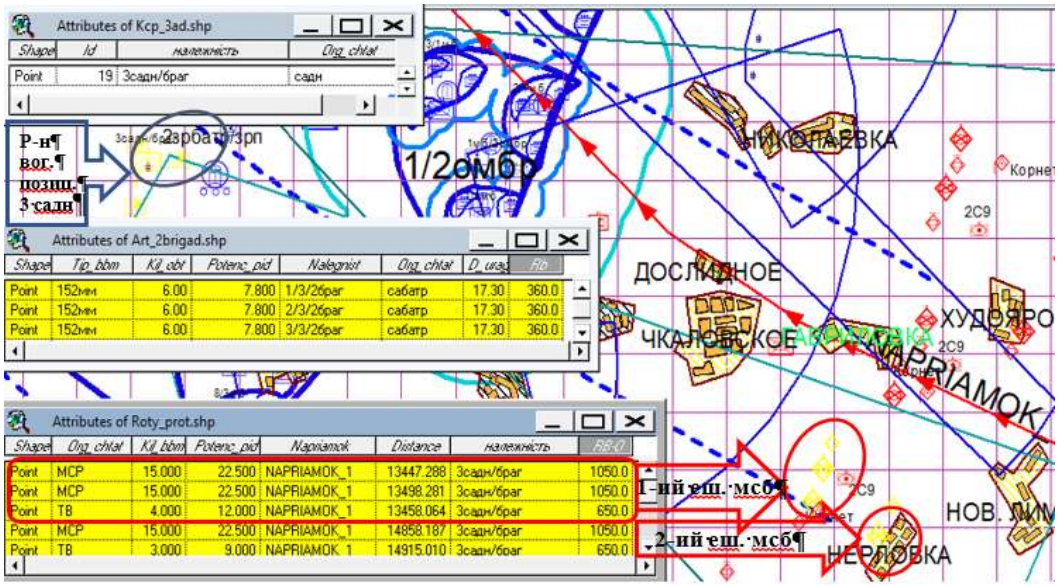

Figure 6 – Situational awareness of the FS coordinator in the sector of responsibility (fire) of the *3rd SPAB/2nd BAG*, who supports the actions of units in the *3 MB* defence zone

Similarly, using the *Join* function, when combining the tables, the parameter *Distance* to all artillery units (*RAB, SPABat* in Figure 4) from the *2nd BAG* is found (added to the attribute tables of point topics of target objects in Figure 5). The latter affects the dissemination of the target forms' content (available characteristics of target objects in the latter's attribute tables) and facilitates the work of the officers of the S2(G2) intelligence unit of the unit's headquarters in determining the priority of targets.

The targeting matrix is filled in by the targeting officer using the *Select By Theme* function (allows for the selection of targets in the sector of responsibility of each artillery unit) and the *Query Builder* function (selecting targets by their characteristics contained in the tables). In Figure 7, the targets located in the firing sector of the *1st SPABat* of the *3rd SPABn* (*Nalegnist* field) and constituting the first echelons of the *1st MRBn* and *2nd MRBn* of the *12th MRB* of the enemy (Figure 3) in the offensive (*Distance<14000m* field) are highlighted in yellow.

Attributes of Bup_1_3prot.shp

Shape	Kil_bbm	Tip_bbm	Potenc_sum	Rb_o	Distance	Tip_bbm	Kil_obt	Nalegnist	D_vrag	RB
Point	15.000	БМП-3	18.000	1050.0	13753.312	152мм	6.00	1/3/26par	17.30	360.0
Point	15.000	БМП-3	18.000	1050.0	13818.207	152мм	6.00	1/3/26par	17.30	360.0
Point	4.000	Т-72	9.600	650.0	13753.129	152мм	6.00	1/3/26par	17.30	360.0
Point	3.000	Т-72	7.200	650.0	13786.878	152мм	6.00	1/3/26par	17.30	360.0
Point	15.000	БМП-3	18.000	1050.0	15178.490	152мм	6.00	1/3/26par	17.30	360.0
Point	3.000	Т-72	7.200	650.0	15223.576	152мм	6.00	1/3/26par	17.30	360.0
Point	15.000	БМП-3	11.025	1050.0	13179.609	152мм	6.00	1/3/26par	17.30	360.0
Point	15.000	БМП-3	11.025	1050.0	13369.263	152мм	6.00	1/3/26par	17.30	360.0
Point	4.000	Т-72	5.880	650.0	13083.545	152мм	6.00	1/3/26par	17.30	360.0
Point	3.000	Т-72	4.410	650.0	13440.147	152мм	6.00	1/3/26par	17.30	360.0
Point	15.000	БМП-3	11.025	1050.0	14701.543	152мм	6.00	1/3/26par	17.30	360.0

Figure 7 – The targets in the firing sector of the *1st SPABat* of the *3rd SPABn* and the first echelons of the 1st MRBn and 2nd MRBn of the 12th MRB in the offensive

The output data summarised in this way are sent using the *Export To Excel* function of the GIS package to the *Excel* spreadsheet, where a *payment* matrix is finally created (including spatial (distance matrix (field C4÷F6 in Figure 8) of the DM (field B4÷B6 in Figure 8) from the target objects (field C3÷F3 in Figure 8) or time, or probabilistic, or qualitative parameters of the targets), the *target function* (TF in field C16 [*C16=SUMPRODUCT(C4:F6;C11:F13)*] in Figure 8) and the *constraints* imposed on the solution of the transport problem (targeting problem), considering the available number of combat kits (CK) on each DM (fields G4÷G6 in Figure 8), the required number of calculated ammunition (CA) to assign each target object the desired degree of damage (fields C7÷F7 in Figure 8).

	A	B	C	D	E	F	G	H
1								
2								
3			Ц1	Ц2	Ц3	Ц4	Б/К_батр	
4		сабатр1	11	10	9	5	720	
5		сабатр2	3	5	7	14	720	
6		сабатр3	5	12	8	9	720	
7		РБ_ціль	650	650	1000	650	0	2950
8							2160	
9								
10			Ц1	Ц2	Ц3	Ц4	Б/К_батр	
11		сабатр1	0	0	70	650	720	
12		сабатр2	70	650	0	0	720	
13		сабатр3	580	0	140	0	720	
14		РБ_ціль	650	650	210	650		
15								
16		ЦФ	11360					

Figure 8 – Solution of a transport problem (target allocation problem) using *Excel* spreadsheets

The problem is solved in *Excel* using the built-in *Solver* function. The content of the solution to the unbalanced transport problem (the amount of available CK (fields G4÷G6) on DM is less (2160<2950) than the required amount of CA (fields C7÷F7) to assign the target object the desired degree of damage) is to find the minimum value of the TF, that will lead to the damage (distribution of the CK) of the target objects at the shortest distances from our front line of defence (yellow colour in the upper table shows the distances of opening fire on the targets; in the lower table, the value of CA consumed for firing by each DM).

A comparable solution to the identified issue can be achieved by initially transferring data from *Excel* spreadsheets to the *Mathcad* software package.

The resolution of the transport issue (targeting a matrix with spatial parameters of targets) is of practical consequence for the brigade commander, for instance, when determining whether to engage targets that are moving towards the line of deployment in battalion columns (attaining the maximum of the objective function) or when enemy units reach the line of attack (attaining the minimum of the objective function).

It can be concluded that the deployment of geographic information technology capabilities for spatial analysis and data processing by officers of the fire damage planning (fire support) unit (section) of the unit headquarters at the stage of developing brigade action options will result in a notable reduction in time. The reduction in time required for planning fire damage to the enemy (i.e. the reduction of the Boyd loop cycle) can be achieved not only by solving linear planning problems (as described in the article), but also by creating conditions for the use of the full range of mathematical apparatus which form the practical foundation of the theory of operations research in military contexts.

Conclusions

Geoinformation technologies are an essential component of the AWS utilized by officials within the command-and-control structure of a tactical military formation. This includes officers within the fire planning section (fire support) of the brigade headquarters.

The utilisation of software for the creation of attribute tables (databases) pertaining to vector themes enables the expeditious collation, processing and analysis of input data. This can be employed by officers of the command-and-control body of a tactical military formation during the implementation of standardised stages of MDMP in accordance with NATO standards.

The hardware and software of GIS systems within the AWS of automated BCP afford user officers the ability to leverage the mathematical apparatus of the AWS` built-in software products to inform rational decision-making and significantly reduce the time required for implementation.

The presence of a part of the automated command and control system of the headquarters as part of the information and analytical system for management processes allows to speed up the process of making military decisions by the brigade's command and control body, as well as to ensure effective interaction and better realisation of the combat capabilities of subordinate units.

The material presented in the article, which concerns the process of making a military decision by a unit (section) planning fire damage to the enemy (fire support of its troops) from the command and control body of a combined arms formation at the stage of developing options for a mechanised brigade in a defensive battle, is of relevance not only in the context of military threats to the state security of the country [1], but can also be used in the event of real and potential non-military threats.

References

1. *Zakon Ukrainy "Pro natsionalnu bezpeku Ukrainy" № 2469-VIII* [Law of Ukraine about the national security of Ukraine activity no. 2469-VIII]. (2018, June 21). Retrieved from: http://surl.li/syavwc (accessed 12 September 2024) [in Ukrainian].

2. *Tymchasovyi Boiovyi statut mekhanizovanykh viisk Sukhoputnykh viisk Zbroinykh Syl Ukrainy, chastyna I (bryhada) (BP 3-(01,04)11(55).01), zatv. nakazom komanduvacha Sukhoputnykh viisk Zbroinykh Syl Ukrainy № 152* [Temporary Combat Statute of the mechanized troops of the Ground Forces of the Armed Forces of Ukraine, part I (brigade), approved by the order of the Commander of the Ground Forces of the Armed Forces of Ukraine activity no. 152]. (2021, March 9) [in Ukrainian].

3. *Metodychni rekomendatsii shchodo planuvannia ta orhanizatsii boiu za standartamy NATO (shtab bryhady (batalionu) ta yim rivnykh), zatv. komanduvachem Sukhoputnykh viisk Zbroinykh Syl Ukrainy*

(VP 7(5)-00(11)03.01) [Methodological recommendations for planning and organizing a battle according to NATO standards (brigade (battalion) headquarters and their equivalents), approved by the Commander of the Ground Forces of the Armed Forces of Ukraine activity no. VP 7(5)-00(11)03.01]. (2020, November 14) [in Ukrainian].

4. *Doktryna z vohnevoho urazhennia, zatv. tymchasovo vykonuiuchym oboviazky nachalnyka Heneralnoho shtabu Zbroinykh Syl Ukrainy (VKP 3-00(03).01)* [Doctrine of fire damage. Approved by the acting chief of the General Staff of the Armed Forces of Ukraine activity no. VKP 3-00(03).01]. (2020, December 16) [in Ukrainian].

5. Tkachenko V. I., Smirnov Ye. B. (2008). *Teoriia pryiniattia rishen orhanamy viiskovoho upravlinnia* [Theory of decision-making by military administration bodies]. Kharkiv : KhUPS [in Ukrainian].

6. Riman O. O., Prymirenko V. M., Tsvietkov Ye. O. (2023). *Planuvannia vohnevoi pidtrymky na taktychnomu rivni* [Fire support planning at the tactical level]. Kyiv : SKIF [in Ukrainian].

7. Lytvyn V. V. (2016). *Vykorystannia adaptyvnykh ontolohii pid chas modeliuvannia petli Boida* [Using adaptive ontologies when modeling Boyd's loop]. *Visnyk Natsionalnoho universytetu "Lvivska politekhnika". Seriia: informatsiini systemy ta merezhi,* vol. 854, pp. 88–97. Retrieved from: http://nbuv.gov.ua/UJRN/VNULPICM_2016_854_11 (accessed 12 September 2024) [in Ukrainian].

8. Revutskyi O. V. (2013). *Tsykl pryiniattia rishen za umov nevyznachenosti – petlia "OODA"* [The cycle of decision-making under conditions of uncertainty – the "OODA" loop]. *Suchasni informatsiini tekhnolohii u sferi bezpeky ta oborony*. Kyiv : NUOU, vol. 18, pp. 104–108 [in Ukrainian].

9. Drobakha H. A., Morozov I. Ye., Poberezhnyi A. A., Obriadin V. V., Horielyshev S. A. (2017). *Heoinformatsiine zabezpechennia sluzhbovo-boiovoi diialnosti NGU* [Geo-information support of service and combat activities of NGU]. Kharkiv : NA NGU [in Ukrainian].

10. Repilo Yu. Ye., Prymirenko V. M., Demianiuk O. V. (2023). *Metodyka vyznachennia priorytetnosti obiektiv protyvnyka dlia pryiniattia yikh yak mozhlyvykh tsilei z metoiu vohnevoi pidtrymky za dopomohoiu matrytsi CARVER* [Methodology for determining the priority of enemy objects for accepting them as possible targets for the purpose of fire support using the CARVER matrix]. *Suchasni informatsiini tekhnolohii u sferi bezpeky ta oborony*. Kyiv : NUOU, vol. 47, pp. 155–166 [in Ukrainian].

11. Repilo Yu.Ye., Salkutsan S. M., Shevchenko O. M. (2018). *Pohliady providnykh fakhivtsiv NATO na vohnevu pidtrymku z zakrytykh vohnevykh pozytsii* [Views of leading NATO experts on fire support from closed fire positions]. Kyiv : NUOU [in Ukrainian].

The article was submitted to the editorial office on 19.09.2024

УДК 355.421:528.91

В. В. Обрядін, О. В. Коломійцев, С. М. Подвязніков

СПОСОБИ ЗАСТОСУВАННЯ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ ПІДРОЗДІЛОМ ПЛАНУВАННЯ ВОГНЕВОГО УРАЖЕННЯ НА ЕТАПІ РОЗРОБЛЕННЯ ВАРІАНТІВ ДІЙ ШТАБОМ ЧАСТИНИ

Розглянуто питання впровадження інформаційно-аналітичних технологій у процес прийняття військового рішення підрозділом (секцією) планування вогневого ураження противника (вогневої підтримки своїх військ) зі складу органу управління загальновійськового формування на етапі розроблення варіантів дій механізованої бригади в оборонному бою. Запропоновано практичні рекомендації щодо застосування інформаційних технологій на базі геоінформаційної системи Arc View GIS 3.3 і пакетів прикладних програм Mathcad та Excel задля скорочення часового циклу петлі Бойда в інформаційній боротьбі органу управління протиборчої сторони.

Розв'язання транспортної задачі (цілерозподіл із використанням матриці з просторовими параметрами цілей) набуває практичного значення для командира бригади під час прийняття рішення на обстріл об'єктів-цілей, які починають висування до рубежу розгортання у батальйонні колони (досягнення максимуму цільової функції) або з виходом підрозділів противника на рубіж переходу в атаку (досягнення мінімуму цільової функції).

Використання органом управління штабу частини можливостей геоінформаційних технологій дає змогу офіцерам підрозділу (секції) планування вогневого ураження (вогневої підтримки) у процесі прийняття військового рішення застосовувати весь спектр математичного апарату, що становить практичну основу теорії дослідження операцій у військовій справі, як на етапі розроблення варіантів дій бригади, так і протягом усього періоду ведення загальновійськового бою.

Ключові слова: *геоінформаційні технології, цикл петлі Бойда, планування вогневого ураження, процес прийняття військового рішення, автоматизоване робоче місце, методи лінійного програмування.*

OBRIADIN Volodymyr – Candidate Military Sciences, Associate Professor, Associate Professor of the Department of State Security and Management of the National Academy of the National Guard of Ukraine
http://orcid.org/0000-0002-0135-3524

KOLOMIITSEV Oleksii – Doctor of technical Science, Professor, Honored Inventor of Ukraine, Professor of Department Computer Engineering and Programming of the National Technical University "Kharkiv Polytechnic Institute"
https://orcid.org/0000-0001-8228-8404

PODVIAZNIKOV Serhii – Senior Lecturer of the Department of State Security and Management of the National Academy of the National Guard of Ukraine
https://orcid.org/0000-0001-6799-6429