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AMMUNITION SUPPLIES, NEW PROPOSAL OF AMMUNITION SUFFICIENCY

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Abstract:

Introduction/purpose:The paper is one of the outcomes of the project in the area of ammunition supply and standard day of supply (SDOS) design for ACR needs. It discusses the current approach of determining the amount and composition of ammunition stocks. Possible solutions to increase efficiency are considered. The aim is to achieve greater objectivity of the planning process where operations management and crisis management are included.

Methods: Basic scientific methods were usedtogether with specific methods such asthe target-oriented method (TOM) and the effort level method (LoE).

Results: The result of the scientific research is to determine the effective ammunition stock of the battalion level in order to achieve higher objectivity of the planning process of conducting operations and coping with crisis situations. The authors deal with a description of the current system of ammunition supply creation in the Czech Armed Forces and NATO, strengths and weaknesses included. A new consolidated system is proposed to improve a stock pile planning process for effective provision and sustainment to achieve operational success and risk mitigation. Objectives from NATO and EU task forces and current operations have been taken into account. The research used the target-oriented method (TOM) and the effort level method (LoE).

Conclusion: The result of the scientific research is to achieve higher objectivity of the planning process of conducting operations and coping with crisis situations.

Key words: supplies, standard day of supply (SDOS), combat day of supply (CDOS), risk, war conflict.

Introduction

Successful completion of operation activities and the fulfillment of operational tasks is the main objective of military commanders at all levels of command. A sufficient supply of ammunition is one of the key factors in achieving operational success. Its misinterpretation, whether small or disproportionately high, has negative impacts, not only on planning and implementation of military operations, but also on the area of resource planning, real support and the maintenance of ammunition within its life cycle. Furthermore, properly defining the amount and composition of inventory is crucial and will enable either adequately addressing the threat of a war conflict or leading to effectively concluded combat activities (Zlatník, 2018).

Current state of the discussed issue

Correctly determined levels and the composition of inventory are the cornerstones of military planning and conduct of military operations. If the correct principles are not applied, the amount with negative impacts will be incorrectly determined, both in the case of overvalued and undervalued amounts. In the case of a disproportionate level of inventory, it becomes ineffective to make inessential inventory with additional costs spent on: warehousing, shipping, safety measurements and disposal. Understocking of inventory may result in an inability to effectively cope with the threat of warfare, in extreme cases leading up to a conflict which could potentially have fatal consequences and significant impacts on all spheres of society. It is desirable that inventory levels should be based on mathematical calculations or modeling rather than on an intuitive estimation made in the planning process by experts. The amount and composition of inventories of all kind must be based on good practice and be supported by credible calculations. In order to determine the level of inventory, various methods and principles are applied within armed forces.

The situation is similar in other partner armies and it is necessary to revise ammunition stockpiles (Andrews & Hurley, 2004), (Malbašić & Đurić, 2019).

To obtain basic knowledge and be able to familiarize with the concept of inventory-based issues, it is essential to explain how the concept was developed. The creation of ammunition stocks has evolved over time in terms of its definition, nomenclature and internal division.

Until the year of 2010

In 1997, a military directive Fire averages and distribution of movable ammunition stockpiles was issued (Vševojsk 5-3, 1997) which followed the regulations of the same designation and title issued in 1980, 1985, and 1992. The amendments consisted mainly of minor text modifications and new additions of different types of ammunition. The regulation (Vševojsk 5-3, 1997) was issued in order to determine firing averages and distribution of movable supplies for units, formations and volumes of the Army of the Czech Republic. Until 1997, the firing average was defined as a calculation unit for ammunition supply. Subsequently, the modified text from 1997defined it as a calculation unit to plan the security of combat operations, determining the daily consumption and size of supplies, as well as the amount of ammunition for one weapon.

The amount and composition of the ammunition stockpile was based on the definition of the regulation in 1980 according to the experience of World War II battlefields, taking into account the use of nuclear weapons and other weapons of mass destruction. Moreover, in 1985, this provision was taken out from the regulation, but the actual amount remained the same. The examples are the amount set for tank ammunition and ammunition for rapid-fire cannon infantry fighting vehicles, i.e. the T72M1 tank's daily firing average was 44 and that of the BVP2 was 486 pieces of ammunition.

Years 2010 - 2015

In 2010, the military directive (Vševojsk 5-3, 1997) was superseded by a normative decree (Ministry of Defense of the Czech Republic, 2010). It already reflects the NATO standards. Nonetheless, it still continues to use the term fire average.

The Standard Day of Supply (SDOS) is listed as a calculation standard for the amount of military stock deployed in the Armed Forces of the Czech Republic, based on the average daily consumption of military equipment, where the number of targets and operational parameters of the action is unknown, and expresses the daily requirement for military equipment according to national standards.

The Day-of-Supply (DOS) is a calculation standard for the amount of stock of military equipment to ensure direct combat activity, established by the North Atlantic Treaty Organization (NATO), expressing the exact daily need for military equipment to cover actual consumption, losses and damage as a function of an already-known overview of enemy targets,

expected losses and operational parameters of the task (foreign operations).

The firing averages in this decree are determined by the number of ammunition pieces for each weapon. The sum of all firing diameters of all weapons is the firing diameter of the unit. In comparison with the previous amendment of the regulation (Vševojsk 5-3, 1997), the amount of fire averages for tank ammunition and ammunition for rapid-fire cannon combat vehicles virtually consist of the same amount. Only in BVP2 the level was increased by 14 pieces of ammunition, from 486 to 500 pieces, as in the regulation of 1985. The firing averages were based on World War II with the addition of new types of ammunition during the Cold War. One of the more significant findings is the link between the average fire and the SDOS (DOS) which was solved through the coefficients of operational and mobile stocks, which was based on economic possibilities, not on operational factors.

From 2015 until now

Generally, the issue of inventories is regulated by RMO No. 48/2013 (Ministry of Defense of the Czech Republic, 2013), as amended by RMO No. 54/2017 (Ministry of Defense of the Czech Republic, 2017), MO normative decree No. 16/2017 (Normativní výnos MO č.16/2017). According to the aforementioned RMO, inventories are selected and stored types of movable assets that are prepared to meet the necessary property needs in performing the functions of the department. The creation of ammunition reserves is regulated by the normative decree of the Ministry of Defense 015 (Normativní výnos MO č.39/2015), which was issued in 2015. The regulation fully reflects the NATO's standardized approach meanwhile taking into account the national conditions as well (Normativní výnos MO č.16/2017). The Standard Day of Supply (SDOS) is characterized by the amendment of the Ministry of Defense No. 10/2010 (Normativní výnos MO č.10/2010) as a calculation standard of the amount of ammunition reserves introduced in the Armed Forces of the Czech Republic. When the number of targets and operational parameters of the action is unknown, it is based on the average daily ammunition consumption. It expresses the average daily ammunition requirement according to the national standards.

A newly introduced concept of the Combat Day of Supply (CDOS), which is the total amount of ammunition supplies for one day of combat, introduces intensity factors, the so-called modification coefficients, to the standard daily supply volume. The CDOS expresses the daily need for ammunition to cover actual consumption, losses and damage, depending

on the accurate data concerning enemy's targets, expected losses and operational parameters of the combat task.

Types of supplies are divided into ammunition reserves of common needs, training and technical reserves of ammunition, ammunition reserves for securing combat operations and ammunition reserves for securing foreign operations and task forces.

Unlike the previous modification in (Normativní výnos MO č.10/2010), the firing averages are no longer given. They were replaced by the Table Standard Daily Supply Volume (SDOST), which is modified by the reserve coefficient Kr for the calculation of the SDOS. The reserve coefficient Kr is determined by the class V manager based on the total stock of ammunition and the available resources designated for ammunition.

Principles applied within NATO and the EU

Within NATO, the AJP-01 doctrine (NATO HQ, 2017) has been published, which is essential for planning, implementation and support for Allied operations (NATO HQ, 2017), which is not only used by NATO, but also by the EU and UN operations.

NATO's main logistics doctrine AJP-4 (NATO HQ, 2018) delegates to the sending states the responsibility of equipping troops with the necessary equipment, training and ensuring their sustainability throughout their deployment, either individually or jointly using multinational logistics or NATO agencies such as NSPA primarily. Its own inventory security in the case of initial conflict management within multinational operations is implemented through the NATO Support and Procurement Agency (NSPA) under the Operational and Logistics Support Program (OLSP), but largely the responsibilities of the sending nations remain with regard to the diversity of armaments and equipment.

The arrangement of logistical requirements is based on the conditions for conducting a specific operation based on operational planning. Logistics planning standards in the area of consumption are only focusing on the amount of supplies in kilograms relative to the soldier and the vehicle number. As such, they cannot be used for detailed inventory planning. The standards are used solely to determine logistics capabilities and unit structures at the operational level.

The amount and composition of stocks to deal with crisis situations remaina national responsibility.

Methods used to determine ammunition consumption

To carry out predictions of ammunition consumption within the conduct of combat activities, two basic methods are used, which, based on the simulations and expert predictions, allow the determination of the SDOS ammunition levels.

Target Oriented Methodology

Target Oriented Methodology (TOM) allows the determination of the amount of ammunition needed to destroy an enemy target. It is a probabilistic method assuming the destruction of each given target by an individual ammunition piece. The method is used in the ACROSS system, which is a specially developed NATO software tool, especially for artillery, anti-tank weapons, mortars and tank ammunition. The method is not used for infantry weapons, grenades and short-range anti-tank missiles (RPGs). The goal-oriented method takes into account factors such as enemy targets, own forces and operational parameters. It does not consider the time parameter; the results are given in the number of individual types of ammunition. The ACROSS primarily uses mathematical methods that calculate either the total cost of ammunition or the value of destroyed targets. In the case of total costs, the cost of ammunition required to destroy all targets is calculated. If the indicator is the value of the destroyed targets against the costs incurred, then the relationship between the targets and the value of the ammunition is taken into account so as to achieve the maximum losses of the enemy at the minimum cost. The ACROSS uses an extensive database containing parameters of its own resources and prices of individual types of ammunition, which must be kept up-to-date and accurate. This places considerable demands on the user. The weak point is the use of indirect fire, which targets a space, not clearly defined targets, and whose effectiveness is difficult to define and varies considerably according to the level of protection of the target (Andrews & Hurley, 2004).

Level of Effort Method

The Level of Effort (LoE) method is based on historical ammunition consumption data, or modeling of operations to determine the amount of each type of ammunition. It is not based on specific concepts for conducting specific operations and is more suitable for generating general data. It is not suitable for predicting consumption in specific operations, which differ in many parameters, which can significantly influence the final consumption. The method was mainly used during the

Second World War and the War in Korea, which were characterized by a massive deployment of troops with a significant amount of ammunition consumed. The way of conducting offensive and defensive operations was constant and well predictable. It is no longer relevant. The reason is the lack of data and changes in the way of classical conducting combat operations, without making adjustments to the amount of needs above and the composition of inventory through the modeling of combat activities. The actual modeling of combat activities, however, depends on the ability and experience of individual actors. It does not have to take into account all indirect factors of conducting combat operations, which can significantly affect the resulting calculations. These are primarily the use of indirect fire, continuous training units in shooting, losses in the supply of ammunition due to the enemy's combat activities, fires, weather and transport services. These may also be storage conditions, including strategic parameters such as production and supply capability.

These factors are already included in historical data, but their relevance to time and an operational area is decreasing (Andrews & Hurley, 2004).

Practical application of methods

Individual methods can be practically used in their suitable combinations. This was done as part of a project implemented by the General Staff of the Army of the Czech Republic (ACR). The project was prepared and directed by the Multinational Center for Coordination of Logistics with the support of a wide range of experts from various units of the General Staff of the Army of the Czech Republic in logistics, reconnaissance, planning operations, conducting combat operations, special forces, including the involvement of selected commanders, to brigade and regiment.

Scenario creation

The calculations were preceded by a preparatory phase, in which the following was defined: geopolitical situation, the parameters of combat operations, the structure of own forces and the adversary, the period, including the development of a scenario of conducting combat operations within 30 days. This scenario was identified by the Army of the Czech Republic General Staff as probable in the event of a large-scale conflict under Article 5 of the Washington Treaty (NATO HQ, 1949).

In terms of geopolitical situation, the complex security situation resulting from the long-term economic crisis caused by global changes

and the collapse of the world economy leading to the instability of the north-eastern region of the European Union states, including national animosity, was incorporated into the scenario.

In terms of operational factors, the flat terrain, agriculturally managed landscapes with partial afforestation and numerous water bodies were defined. The operation was situated in the spring with average rainfall.

The structure of own forces was defined at the level of the Brigade Task Force (Ministry of Defense of the Czech Republic, 2019). The structure of the enemy was determined on the basis of a balance of available forces and corresponding to the established structure of units of the strength of the Panzer Division supported by 2 Infantry Divisions and Tactical Air Force (General Staff of Army of the Czech Republic, 2019),

At the same time, the ability of the host nation to provide Host Nation Support under AJP 4-5 has been defined (NATO HQ, 2013).

The scenario is to be understood as a fiction, not a prediction of the future development of the security environment in Europe and its resulting in any military operations.

After the determination of the above decisive factors in the scenario, the probable development of the operational situation over a period of 30 days was started. The time space was based on the NATO strategy currently in place to ensure the sustainability of troops in operations (NATO HQ, 2010), taking into account the maximum predicted duration of deployment of troops in a high-intensity military operation involving all types of combat operations.

Execution of the war game

Two workshops were held to identify new approaches for ammunition consumption. Based on their experience, selected experts defined a possible course of conducting combat operations broken down by type of operation to lead 8 days of defensive operations, 13 days of delayed combat and 9 days of offensive operations at different intensities. An overview and analysis of the conduct of combat operations maneuver units is shown in Table 1.

Table 1 – Course of conducting combat operations
Таблица 1 – Ход ведения боевых действий
Табела 1 –Ток вођења борбених операција

Combat units			
Day	Mission profile	Intensity	Activity
1	Defense	Low	Movement
2	Defense	Low	Emplacement
3	Defense	Low	Defense Built up
4	Defense	Low	Defense Built up
5	Defense	Medium	Defense
6	Defense	High	Position Defense
7	Defense	Very high	Position Defense
8	Defense	Very high	Maneuver Defense
9	Defense	High	Delaying Operation
10	Defense	High	Counter Attack
11	Defense	Medium	Delaying Operation
12	Retreat	Medium	Withdrawal from action
13	Retreat	Medium	Movement
14	Retreat	Low	Movement
15	Retreat	Low	Movement
16	Retreat	Low	Movement

Combat units			
Day	Mission profile	Intensity	Activity
17	Retreat	Low	Movement
18	Retreat	Low	Movement
19	Retreat	Low	Movement
20	Retreat	Medium	Counter Attack to Assault
21	Attack	Low	Movement
22	Attack	Low	Emplacement
23	Attack	Low	Deployment
24	Attack	Medium	Deployment
25	Attack	High	Deployment
26	Attack	Very high	Counter Attack
27	Attack	High	Attack
28	Attack	Medium	Attack
29	Retreat	Medium	Relief of troops
30	Retrograde	Low	Restoration

Creation of the conducting combat operation in relation to its intensity

Depending on the conduct of the operation while taking into account its individual phases, different intensities of conducting combat activities by individual types of troops were created and recorded into the charts. The troop activities were consolidated on the basis of the prediction of

the operation of maneuvering units. Individual phases of conducting combat activities divided by individual types of troops are shown in Figures 1-4.

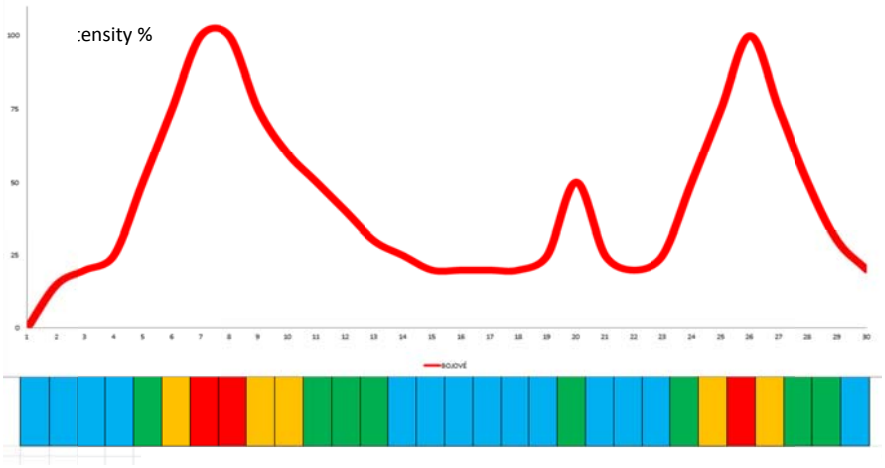

Figure 1 – Course of the intensity of combat operations by ground combat units
Рис. 1 – Ход интенсивности боевых действий сухопутных войск
Слика 1 – Ток интензитета борбених операција копнених борбених јединица

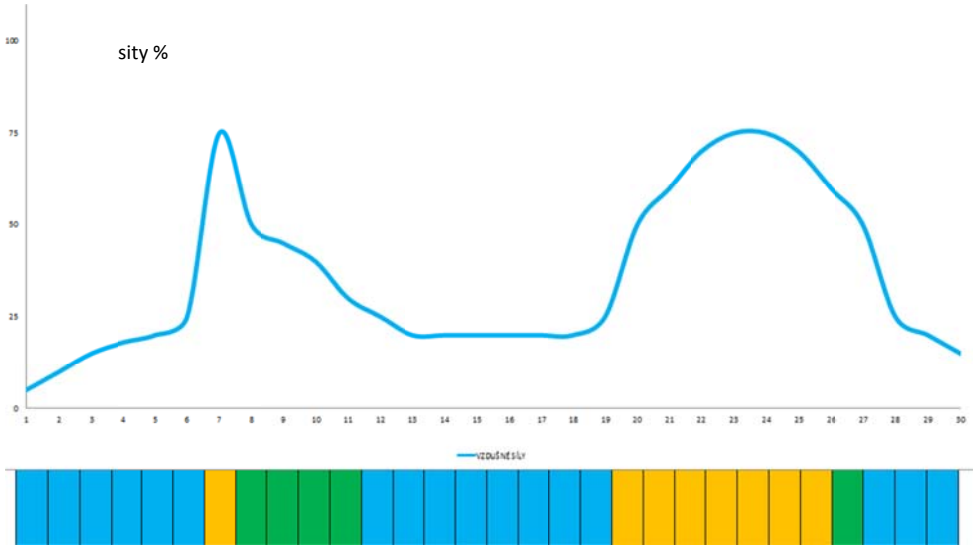

Figure 2 – Course of the intensity of conducting combat operations by air forces
Рис. 2 – Ход интенсивности боевых действий ВВС
Слика 2 – Ток интензитета вођења борбених операција ваздухопловних снага

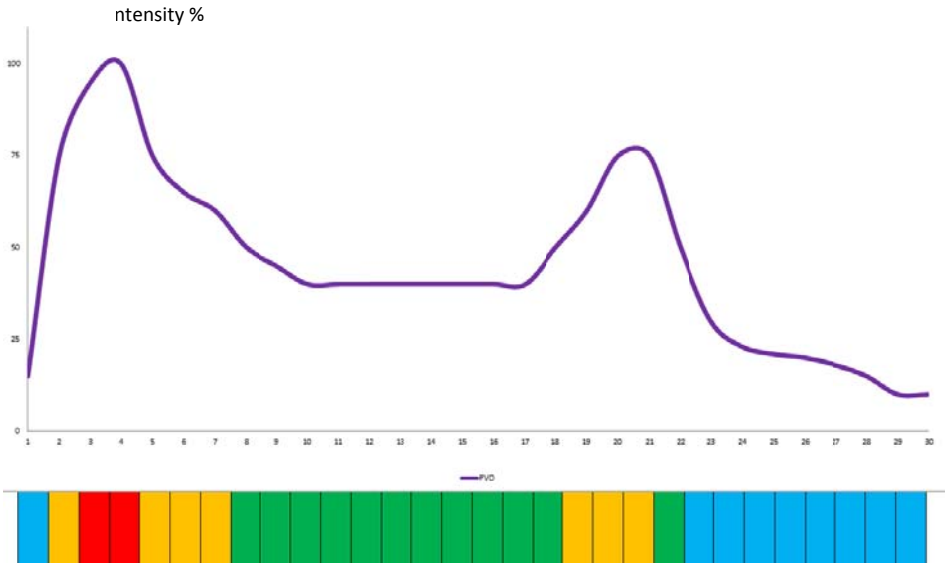

Figure 3 – Course of the intensity of combat operations of air defense
Рис. 3 – Ход интенсивности боевых действий ПВО
Слика 3 – Ток интензитета борбених операција ПВО

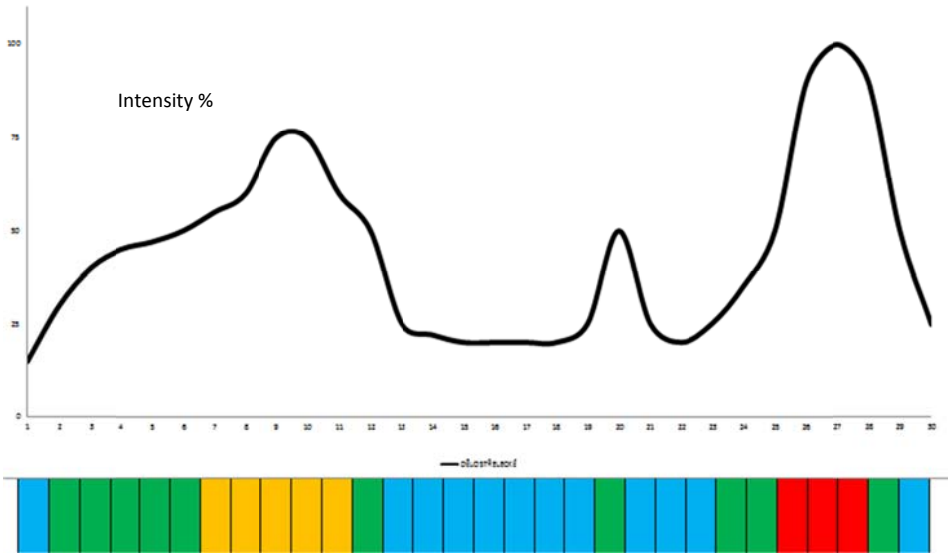

Figure 4 – Course of intensity of combat operations of artillery
Рис. 4 – Ход интенсивности боевых действий артиллерии
Слика 4 – Ток интензитета борбених операција артиљерије

Consumption prediction, SDOS calculation

Based on the intensity of conducting combat activities and the composition of the enemy forces, i.e. targets, expert estimates of ammunition consumption were made based on individual days, weapons and weapon systems.

The actual predictions were identified as non-public confidential information within the project; therefore, they are not included in the article. As an example, a calculation using data that has been modified with respect to the above is shown in Figure 5.

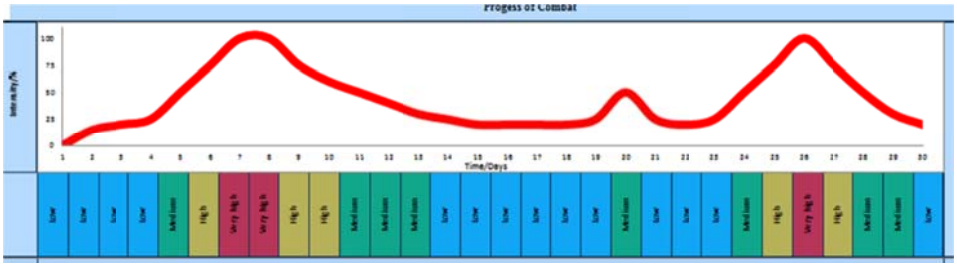

Figure 5 – Calculation of the SDOS of selected weapons of ground forces combat units
Рис. 5 – Расчет стандартной суточной нормы снабжения выбранныхбоеприпасов сухопутных войск
Слика 5 – Израчунавање снабдевачког дана (стандардног дана) за изабрано наоружање борбених јединица копнених снага

A mathematical formula was then used to calculate one SDOS of each type of ammunition

SDOS = (SDOS1 + SDOS2 +… + SDOS30) / 30

where each variable means:

SDOS - Standard daily delivery volume

SDOS1… .30 - average daily ammunition consumption for each day of operation.

Based on the calculations, one SDOS was obtained for each type of ammunition, the details of which are shown in Figure 5. For example, for one 5.56 mm caliber assault rifle, one SDOS is 64 pieces of ammunition, for a 7.62 mm light machine gun, it is 111 pieces of ammunition, for a

wheeled combat vehicle Pandur armed with 30 mm quick-firing cannon one SDOS is 60 missiles, and for a medium tank armed with a 125 mm cannon one SDOS is 7 missiles.

The application of these methods reduced the amount of SDOS ammunition compared to the original approach by approximately 60%. This has a major impact on resources, in particular in terms of the direct cost of purchasing ammunition, but also on the indirect costs associated with the storage and maintenance of the ammunition as part of its life cycle, the means necessary to transport it and the cost of its eventual disposal. At the same time, efficient inventory levels will reduce logistics chain requirements for operations management, i.e. strategic transportation between Level 4 and Level 3 logistics, including storage and transportation within the operations area. This will reduce the logistical presence in the operation and at the same time increase the maneuverability of the entire task force, i.e. increase operational capabilities.

Conclusions

The research revealed that the current principle of ammunition stockpiling is based on historical data without qualified adjustment based on the use of contemporary methods. Economic resource options are considered as modifying parameters for determining the amount of SDOS stocks, which are a limiting factor in terms of meeting complex operational needs to achieve operational success, but they cannot primarily influence the amount of the basic calculation unit.

The application of new methods revealed that the revision of SDOS ammunition is real and leads to more efficient system of ammunition stockpiling. By an appropriate combination of effort and target-oriented methods, it is possible to make more accurate estimates of consumption within each combat day, thereby defining a calculation unit that reflects the prediction of combat operations and which will be the basic calculation unit for determining its own mobile, operational and strategic stocks.

Before the actual implementation of the data obtained by this method into practice, it seems appropriate to use simulation technology and verify individual professional predictions, or to deal with the prediction of combat losses of equipment and its own ammunition stockpiles.

Determining the effective level of stocks is one of the crucial prerequisites for crisis management and for achieving operational

success. The approach to ammunition stockpiling needs to be constantly improvedto respond to the ever-changing security environments and related threats.

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СНАБЖЕНИЕ БОЕПРИПАСАМИ: НОВОЕ ПРЕДЛОЖЕНИЕ ПО ДОСТАТОЧНОСТИ ОБЕСПЕЧЕНИЯ БОЕПРИПАСАМИ

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РУБРИКА ГРНТИ: 78.00.00 ВОЕННОЕ ДЕЛО;
78.75.73 Статистика, учет и отчетность. Технико-экономический анализ в военном деле
ВИД СТАТЬИ: оригинальная научная статья
ЯЗЫК СТАТЬИ: английский

Резюме:

Введение/цель: Данная статья является результатом проекта в области снабжения боеприпасами и формирования стандартной суточной нормы снабжения (SDOS) для нужд армии Чешской Республики. В статье обсуждается действующий подход к определению количества и состава запасов боеприпасов. Обсуждаются возможные решения, способствующие повышению эффективности, с целью достижения большей объективности при планировании процессов управления операциями и кризисными ситуациями.

Методы: В исследовании применялись основные научные методы, а также специальные методы, такие как: целевой метод (метод выбора мощности боеприпаса на основании разведывательных данных (TOM)) и метод уровня усилий (LoE).

Результаты: Результатом данного научного исследования является определение эффективного запаса боеприпасов на уровне батальона для достижения большей объективности в процессе планирования при проведении операций и управлении кризисными ситуациями. Авторы описывают существующую систему снабжения и запасовбоеприпасов в вооруженных силах Республики Чехия и НАТО, включая как ее достоинства, так и недостатки. Предлагается новая система консолидации, с целью улучшения процесса планирования создания запасов с целью обеспечения эффективного снабжения и логистической устойчивости, что приведет к успешному функционированию и снижению рисков. В ходе исследования были приняты во внимание цели тактических целевых групп и текущие операции

НАТО и ЕС. В данной статье были применены методы ТОМ и LoE.

Выводы: Результатом данного научного исследования является достижение большей объективности в процессе планирования при проведении операций и управлении кризисными ситуациями.

Ключевые слова: боеприпасы, стандартная суточная норма снабжения (SDOS), военная суточная норма снабжения (CDOS), риск, военный конфликт.

СНАБДЕВАЊЕ МУНИЦИЈОМ: НОВИ ПРЕДЛОГ ОВЕЗБЕЂЕЊА ЗАЛИХА

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ОБЛАСТ: војне науке, статистика
ВРСТА ЧЛАНКА: оригинални научни рад
ЈЕЗИК ЧЛАНКА: енглески

Сажетак:

Увод/циљ: Овај рад представља један од резултата пројекта у области снабдевања муницијом и креирања стандардног снабдевачког дана (standard day of supply – SDOS) за потребе војске Републике Чешке. Бави се важећим приступом одређивању количине и састава залиха муниције, а разматра и могућа решења која воде повећању ефикасности. Циљ је да се постигне већа објективност при планирању процеса управљања операцијама и кризама.

Методе: Коришћене су основне научне методе, као и посебне методе, попут методе усмерене на циљ (target-oriented method – TOM) и методе нивоа напора (effort level method – LoE).

Резултати: Резултат научног истраживања јесте да се одреде ефективне залихе муниције на нивоу батаљона како би се постигла већа објективност процеса планирања при вођењу операција и управљању кризним ситуацијама. Аутори описују постојећи систем стварања залиха муниције у оружаним снагама Републике Чешке и НАТО-у, укључујући и његове предности и недостатке. Предлаже се нов систем консолидације како би се побољшао процес планирања стварања залиха ради ефикасног снабдевања и логистичке одрживости који воде оперативном успеху и ублажавању ризика. Узети су у обзир циљеви оперативних тактичких група и тренутних операција НАТО и ЕУ. У истраживању су примењени методи ТОМ и LoE.

Закључак: Резултат овог научног истраживања јесте постизање веће објективности процеса планирања вођења операција и деловања у кризним ситуацијама.

Кључне речи: залихе, стандардни снабдевачки дан (SDOS), борбени снабдевачки дан (CDOS), ризик, ратни сукоб.

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