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ASSESSMENT OF EFFECTIVE AMMUNITION STOCK LEVELS

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ABSTRACT

The purpose of this article is to discuss the current approach to determining the amount and composition of ammunition stocks, including the strengths and weaknesses of individual practices within North Atlantic Treaty Organization and its selected member states. The starting points of this article are the practical findings in the preparation of NATO and EU battlegroups, including real foreign operations. The individual methods were analyzed with a partial use of SWOT analysis, with a main focus on the strengths and weaknesses of the inventory process. There were found discrepancies between the general principle of individual methods and their practical application. A major drawback is that the principle for calculating inventory needs for combat activities is yet unestablished, where the internal regulation does provide for 120 SDOS and the introduction of some coefficients. However, doing so without establishing the principle of creating its amount. The article offers possible solutions to increase the efficiency of inventory generation in order to achieve greater objectivity in the planning process of operations management and crisis management, including self-provision of ammunition stockpiles.

KEYWORDS: Ammunition stocks, calculation of ammunition stocks, LoE method, Waymarker system

1. Introduction

Successful handling of operational activities and the accomplishment of an operational objective is the main aim of commanders at all levels of command; it is the duty of armed forces. A sufficient supply of ammunition is one of the key factors in achieving operational success.

Its misjudgment, whether small or disproportionately high, has negative impacts not only on the planning and implementation of military operations, but also on the area of resource planning, real security and the maintenance of ammunition within its life cycle. Properly defining the amount and composition of ammunition stockpiles, which is one of the key assets of the stock, is key and allows to adequately face the threat of a war conflict or to effectively conduct combat activities.

2. Current State of the Discussed Problem

Correctly determined amount and composition of ammunition stockpile is the cornerstone of military planning and military operations. If the principles are not applied correctly an ammunition stock level

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will be incorrectly determined. Therefore, having negative effects in both cases of an overvalued and undervalued amount of ammunition.

Disproportionate stockpiling and surplus may lead to unnecessary inventories and added costs of securing the life cycle of ammunition, storage, shipping, technical status checks, and disposal costs. On the other hand, if there is a scarcity, an inability to deal effectively with the threat of an armed conflict may occur, in the most extreme cases whilst dealing with an armed conflict the negative outcome might dramatically influence all spheres of society. It is desirable that the amount of inventory should be based on mathematical calculations, not on the intuitive estimation of experts in the planning process. The amount and composition of ammunition stockpiles must be based on good practice and supported by credible calculations. In the armed forces, different methods and principles are applied to the inventory itself.

2.1. Basic Principles Applied within North Atlantic Treaty Organization

NATO's core document is the NATO Military Committee's Readiness and Sustainability Policy MC55/4 and Bi-SC (SPG) (NATO HQ, 2003b).

NATO regards a clearly defined doctrine in the field of planning, implementation and support of military operations as the basis for their success. In addition, AJP-01 (Allied Joint Doctrine, 2017), which is the basic doctrine for the planning, implementation and support of allied operations, was issued. This doctrine is not only used by NATO, but also by the EU and possibly other non-coalition states for multinational operations outside of NATO and the EU, such as the United Nations.

NATO's AJP-4 Major Logistics Doctrine (NATO HQ, 2003a) gives dispatching states the responsibility to equip troops with the necessary material, training them and ensuring their sustainability throughout the deployment phase, either separately or together with the use of multinational logistics, or through NATO agencies, such as NATO Support and Procurement Agency (NSPA). National Support Elements (NSE) plays an important role in the security of states which send out troops. All security is coordinated on a multinational level. In order to secure the material Technical Arrangements are concluded based on pre-defined requirements (Statement of Requirements). The area of ammunition security is particularly focused on storage and transport. The actual provision of ammunition is implemented marginally through the NSPA, but for the most part it remains the responsibility of sending states, taking into account the diversity of weapons systems, especially large arms.

The determination of logistic requirements is heavily based on conditions for conducting a specific operation. Consumption logistic planning standards are only focusing on the volume of inventories in kilograms relative to the soldier and the vehicle. Those standards cannot be used for detailed inventory planning. They serve solely to determine the logistical capabilities and unit structures at the operational level.

2.2. Analysis of the Basic Principles Applied by Selected NATO Member States

United States. Currently, the United States forces are making considerable efforts to determine the real ammunition stockpiles. The responsibility for correct determination is spread over multiple constituents. Therefore, they do not use any specific tools. It is all based on the structure of the armed forces, capabilities of the enemy and the threat they face. The overall demand for inventory needs is a sum of the strategic needs of the armed forces to effectively eliminate threats, requirements for current operations, and implementation of armed forces training (Andrews & Hurley, 2004).

Great Britain. The British Armed Forces use Level of Effort (LoE), which are based on the historical consumption. In addition to LoE, Waymarker system is also implemented. This system is not a sophisticated consumption computing tool. However, it is a specific development plan that unifies the amount of inventory to planned operations with logistical resources (Andrews & Hurley, 2004).

Slovenia. The original calculation of the stock of ammunition stockpiles of the Yugoslav Army was based on the practices of military exercises. Primary unit was the dose in combat technology. This basic dose was adjusted by coefficients depending on the type of an operation, and subsequently being adjusted by the expected intensity of the combat activity.

Nowadays, the Slovenian Army uses two basic methods, LOE for small caliber weapons and TOM for large arms such as guns, tanks, rockets and more. The strategic planning cycle is six years long, just like the SAF Defense Program, which is synchronized with the long-term development and armaments plan for NATO Force Goals. The defense program establishes foreign operations, development goals, national capabilities development, and possibly other NATO operations (GS Study, 2012).

3. Methods used to Calculate Ammunition Stocks

Two main methods are used to determine the inventory calculation. Target Oriented Methodology (TOM) and the Effectiveness Method called Level of Effort (LoE). The Target Oriented Methodology (TOM) or the Capability Oriented Methodology (COM), is preferred to calculate the amount and composition of stocks of critical ammunition, especially large arms. For other ammunition, a Level of Effort (LoE) method is used. These methods are also implemented by the NATO ACE Resource Optimization Software System (ACROSS).

3.1. Target Orientated Method

A target-oriented method (TOM) calculates the amount of ammunition needed to destroy enemy targets. It is a probabilistic method with the assumption of destroying each given objective with a calculated ammunition. This method is used in the ACROSS system, which is a specially developed NATO's programming tool, especially designed 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). Target-oriented method takes into account factors such as enemy goals, own strengths, resources and operational parameters. It does not however consider the time parameter and the results are given in the number of different kinds of ammunition. ACROSS mainly uses mathematical methods that calculate either total ammunition costs or the value of destroyed targets. In the case of total costs, they are calculated by cost of the ammunition needed to destroy all targets. If the pointer is a value of destroyed targets to costs, the relationship between goals and value is taken into account, so as to achieve maximum enemy losses while attaining the minimum costs. ACROSS uses a large database containing customized parameters and the prices of individual types of ammunition that need to be kept up-to-date and accurate. It puts considerable demands on users. The weak point of this system is the use of indirect fire, which targets a certain area rather than a clearly defined target. Its effectiveness is fluctuating and difficult to define depending on the degree of protection of the target (Andrews & Hurley, 2004).

3.2. Level of Effort Method (LoE)

The method is based on historical ammunition consumption data, or on modeled operations to determine the amount of individual types of ammunition. It does not provide concrete concepts for specific operations and is more appropriate

for generic data. Not suitable for the prediction of consumption in specific operations which differ in many parameters and can influence the end result significantly. The method was used mainly during the Second World War and War in Korea, both are characterized by the massive deployment of troops and consumption of considerable amount of ammunition. The manner in which the offensive and defensive operations were conducted was well predictable. It is no longer relevant at this time. The reason that it is no longer applicable is because there are many changes in the way of classic combat activity and not enough data. Modeling of combat activities depends on the ability and experience of the individual actors. It does not have to take into account all the indirect factors of the conduct of combat activities, which may be essential in determining the correct calculations. Such factor is indirect fire, continuous training of units in shooting, losses in the ammunition supply due to combat enemy activities, fires, weather and transport services. It can also be the conditions for storage, including strategic parameters such as production and supply capability. These factors are already included in the historical data, but their relevance rate decreases due to the time and place of operational deployment (Andrews & Hurley, 2004).

4. The Czech Armed Forces and the Solution of a Proposal

Normative Decree No 39/2015 is a basic document establishing the stocks of ammunition within the armed forces of the Czech Republic. Both target-oriented method (TOM) and effort method (LoE) are used for inventory calculation. For calculation of standard SDOS deliveries, LoE method is used and for calculation of Combat Day of Supply (CDOS), denominated as day-to-day combat volumes ammunition method, target-oriented method (TOM) is used.

Normative Decree No. 39/2015 describes in detail the division of inventories including methods of calculation. Stocks are broken down into ammunition stockpiles and stockpiles of ammunition for security combat activities. Ammunition stockpiles are further broken down into ammunition training stock and technical supplies. The method LoE is used to calculate training stocks and technical supplies. Statistical consumption data is evaluated within the past 3 years of training and the results of laboratory tests of ammunition for technical supplies are taken into account. In order to calculate the inventory to secure the conduct of combat activities, the Level of Effort Method is used. It is based on the national standards and procedures described in the aforementioned normative yield. In terms of distribution within the operational activities of troops, they are divided into moving stocks, intended to directly secure combat activities for 7 days of combat activities and operational stocks that are used to replenish moving stocks and are maintained at 23 days. Moreover, 120 days of ammunition supplies are provided to cover the reimbursement of combat activities through the mobilization supply.

Another ammunition stock category is ammunition for securing foreign operations and task forces. They are physically separated from technical, training and operational ammunition stockpiles. They are created in the amount of 30 CDOS where organizational composition of the task force, duration of operational deployment and management intensity of combat activities is taken into consideration. In essence, it is the use of LoE modified on the basis of an estimation made by experts on the possible course of combat management activities. Normative yields also show their own formulas of calculations. SDOS inventory for one weapon is based on a standard daily bulk table supply adjusted by the stock of assets,

the volume and its method calculation are not clearly defined. For the calculation of CDOS ammunition stock for foreign security operations, the table standard daily volume of deliveries is taken into account and modified by coefficients of KI combat intensity, KT field, KK climate and nuclear, biological and chemical threats of the KN (MO ACR, 2015).

These principles and methods of inventory calculation can be characterized by weak and strong aspects.

4.1. Weaknesses and Strengths

There is not an established way of calculating the ammunition payments for the conduct of combat activities.

1. It is strictly stated that it is created at 120 SDOs in the form of mobilization supplies. This level was established on the basis of an estimate of the experts who took into account the time needed to start deliveries from the civil sector, to the currently available resources and real storage capacities.

2. In the case of the SDOS calculation, the coefficient Kr, which determines the asset manager, is used. However, its method for calculating is not defined anywhere and is apparently based on money availability resources and the stockpile of ammunition.

3. In the ND, the target-oriented method (TOM) is given for the calculation of CDOS but within the description of the calculation method, no known targets are taken into account, there are only calculated factors of intensity of combat activity, terrain, climate and nuclear, biological and chemical threats. Therefore, it is not a target-oriented method, but a LoE method.

4. The standard table delivery volume for an individual weapon is derived from the original firearms average, which were adjusted by qualified experts to fit certain weapons and different weapon systems. The original firing averages date back to the Cold War, those rates relied on well-known data, especially from the Second World War and later on Cold War, and possibly other military exercises. Nowadays, that the combat activity and the transition to new weapon systems have gradually started using accurate and intelligent ammunition, these values are no longer relevant.

5. The method of determining the individual coefficients KI, KT, KK and KN for CDOS calculation is not clearly stated anywhere. Such coefficients are solely derived from a qualified estimate, not from modeled combat activities. Therefore, there might occur a significant discrepancy between calculated and consumed ammunition.

6. In a non-logical way, in the normative yield the CDOS calculation is solely used for inventory security and for foreign operations and task forces. The calculation should be utilized for comprehensive planning of combat leadership regardless of whether the combat is taking place abroad or an inclusion of combat units to the structure of task force.

Strengths: Established system linked to the information logistic system.

4.2. Possible Steps to Make the System More Efficient

Based on the above analysis of the weaknesses and strengths of the described methods applied within the framework of the Czech Armed Forces, it would be necessary to start a revision of established procedures.

Considering that the adversary cannot be precisely defined, including his composition of forces, it seems more advantageous to use the degree of effort method. We should be taking into account the course of combat activities over time, no matter what adversary are being faced. As a basic calculation unit for further calculations when planning specific military operations through the Combined Daily Supply Volume (CDOS) it is first required to define Standard Daily Deliveries (SDOS). Before determining the

amount of SDOS, it is essential to detect the course of combat activity in terms of intensity over time. Considering the adversary is currently unknown, it is necessary to consider that his composition of forces is the same as his capabilities, possibly lower than our own strengths. Thenceforth the formation of forces corresponds to the enforcement of security interests based on the balance of power, without the tendency of dominance with the primary goal to destroy the enemy alongside with the principle of indispensable defence.

The actual development of tactical military operations is influenced by many factors such as- terrain, climate conditions, troop preparedness, and availability of resources. When ideal conditions are present, however it is not realistic for a long time to intensely affect the opponent. Reduction in abilities occurs, especially due to depletion of resources, combat losses, technical failures, inventory consumption, exhaustion of soldiers, and loss of motivation. It is possible to support such claim from many historical sources. Moreover, Allied Joint Doctrine for Land Operations, (2016) mentions various ways of conducting combat activities such as attack, defense, stabilization of forces, preparation for further conflict which in terms of intensity of action is varied depending on the enemy. The actual course of combat activity is characterized more as a mosaic which is permanently changing than a uniform steady, seen from Figure no. 1.

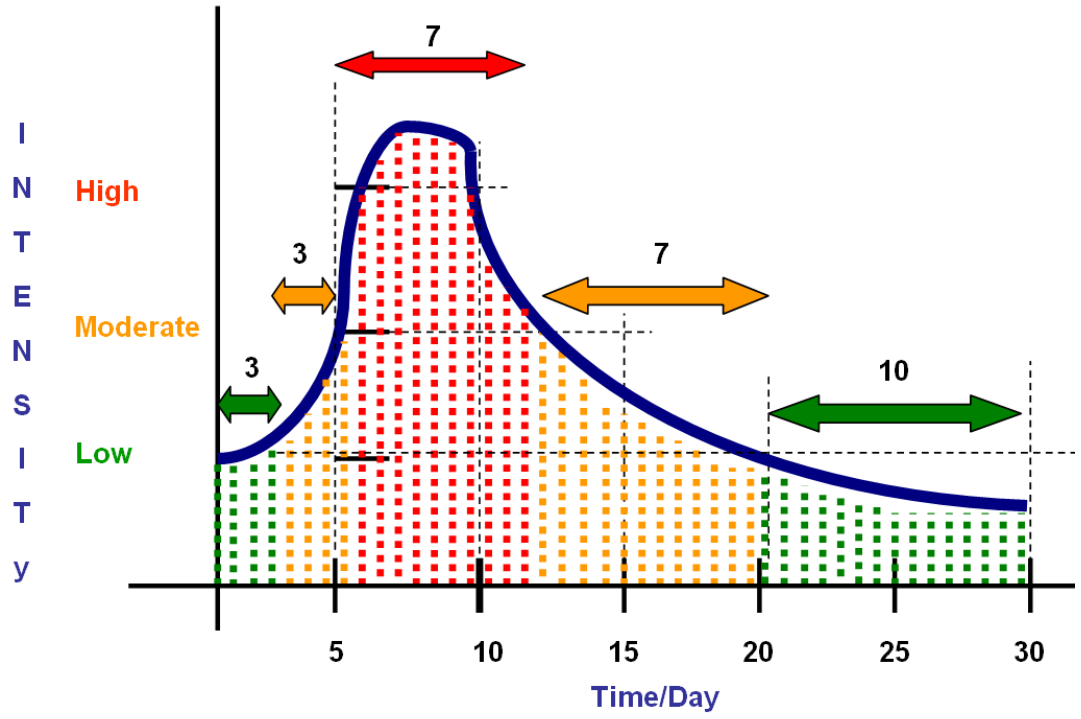

Figure no. 1: Course of the combat activity

The graph above is based on the aforementioned thought about the progress of combat activity over time. The time required to engage the combat group, so called the RSOM-I process "receiving, concentrating, sending and integration" (Reception, Staging, Onward, Movement-Integration) is not directly depicted in the event of a long-term conflict because that would cause an apparent distortion in the inventory result. The amount of inventory for this phase would be calculated using CDOS, according to specific conditions at the site and the deployment of forces. Timing of the course of combat was estimated, and its refinement will be

necessary by further exploration of combat modeling activities within the framework of the scientific activities of the University of Defense and the Czech Armed Forces.

Based on the course of the combat activity, it is then necessary to determine the volume of consumed ammunition. However, there is a recurring lack of information from current operations. At the same time operations such as Resolute Support in Afghanistan, EU NAVFOR, KFOR are not characteristically meant for the determination of the ammunition levels. Ammunition in such operations is consumed primarily for the purpose of maintaining combat capability, eventually used while leading special operations. A possible example is the appointment of the amount of ammunition consumed in Table no. 1.

Determining the amount of consumption in each stage of the intensity of the combat activity will be possible with the use of simulation technology and tactical combat training specialists.

Table no. 1

Predicted amount of ammunition consumption in pieces

WAPON	INTENSITY OF COMBAT ACTIVITY									30 SDOS	1 SDOS
	HIGH			MODERATE			LOW				
	Av./Day	Days	Sum	Av./Day	Days	Sum	Av./Day	Days	Sum		
Assault rifle	240	7	1680	120	10	1200	30	13	390	**3270**	**109**
Tank 72M4CZ	37		259	18		180	5		65	**504**	**17**

The currently set SDOS is shown, see Table no. 2.

Table no. 2

Current level of SDOS ammunition of Armed Czech Forces in pieces

Weapon	1 SDOS	30 SDOS
Assault rifle	240	7200
T 72M4CZ	37	1110

By comparing the predicted consumption data according to the intensity of the combat activity, see the Table no. 1, with the current ammunition stock level, according to the internal rules of the (MO ACR, 2015), Table no. 2, it can be concluded that there are significant deviations. Deviations are due to the use of values according to the originally used firing average, based on the amount of ammunition in combat means, or carried by a soldier. Significant differences in 606 pieces of tank ammunition and 3930 pieces of infantry ammunition, which is 43 % of the originally calculated inventory, can negatively affect not only the need for capacities within logistics chains and thus the planning of operations, but also the amount of money needed to acquire ammunition accounting for other indirect costs. Therefore, the ability to adjust the amount of ammunition stocks according to particular combat activities and operational tasks remain untouched with the possibility to utilize coefficients for the CDOS calculation.

5. Conclusions

The Alliance considers the correct determination of ammunition stocks as one of the keystones of operational success. Its principles are applied by individual Member States, and national particularities are always taken into account while also retaining the responsibility for equipping troops with the material needed.

The main methods to calculate ammunition stockpiles are the target-oriented method TOM and the Level of Effort method LoE both are used depending on the types of weapon systems. Also, weaknesses were pointed out in the principles of inventory of the armed forces of the Czech Republic with a proposal for a possible change in the inventory approach based on the principle of varying intensity of combat management activities over time.

The findings will be further developed scientifically and will be the output of a new approach to inventory calculation that allows for an effective determination of the amount on the basis of modeling, expert prediction, followed by a correction of consumer ammunition in the case of real combat activities.

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