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A METHOD FOR ASSESSING THE MILITARY-ECONOMIC INDICATORS WITH THE PURPOSE OF LOCATING A LOGISTICS CENTER FOR REDEPLOYING TROOPS

Abstract. The article proposes a methodology for assessing the economic efficiency of a logistics center that provides technical support to redeploying troops. It is noted that the development of this method is based on the assessment of the efficiency of the logistics center, taking into account its economically efficient functionality, without regard to the use of classical profitability. The author analyzes the structure of capital expenditure and operating expenses allocated for the establishment of a logistics center, proposing the maintenance and repair expenses for each unit of equipment as the main criterion, proposing their calculation in the general case, and substantiating the military-economic indicators of the center. An analysis of the structure of capital expenditure and operating expenses aimed at organizing a logistics center, as well as the military-economic indicators of this center, gives grounds to note the following results: the structure of capital expenditure and operating expenses associated with designing a logistics center for the troops has been elaborated; the calculation method has been developed, taking into account the available resources, communications and infrastructure, information reflected in the annual plans for the operation and maintenance of automotive and armored vehicles of military units; the calculation methodology developed on the basis of the structure of capital expenditure and operating expenses on the organization of a logistics center also reflects the infrastructure indicators related to the geographic location of the center (the distance of the logistics center from the transport hub and the military units it services); the proposed method can be used to choose a geographic location that is favorable from the point of view of economic profitability for organizing a logistics center for the troops; using this method, it is possible to compare the economic aspects of various options of organizing military logistics.

Keywords: logistics center; logistics infrastructure; spare parts warehouse; repair sites; structure of operating expenses; depreciation expenses; structure of capital expenditure.

Introduction

Logistics infrastructure in the Armed Forces is the material and technical support to troops in peacetime and wartime, planning, management of procurement, transportation, storage, distribution, as well as other material and non-material activities related to the operation, repair and maintenance of various types of vehicles, machines and equipment, as well as the system performing such operations as processing, transmitting and protecting information related to these processes. From this perspective, a logistics center, which is an important element of the military logistics infrastructure, should have movable (vehicles of various types and purposes, equipment, machines, systems, etc.) and immovable property (warehouses, parking lots, repair sites, administrative buildings, etc.), suitable for fulfilling its purpose of ensuring the combat readiness of troops. When location planning for a logistics enterprise in the civilian sector, its economic profitability is considered the key factor. The profitability of an enterprise means that the funds spent on its organization will be obtained in a short period of time after the launch of the enterprise and returned to the income account, and from that moment the enterprise will operate with a positive balance and will always generate income [1]. It is currently a widespread worldwide practice to draw up a business plan that substantiates the time frame for reaching the profitability threshold in order to finance the organization of a civilian logistics enterprise [2; 3].

Unlike civilian logistics enterprises, the military logistics infrastructure is aimed directly at ensuring the combat readiness of the country's armed forces; therefore, its organization cannot be justified by the principles of independent economic activity. The recent practice of organizing military logistics centers in different countries involves putting forward various principles of efficiency [4 – 8]. These principles vary from country to country and depend on the country's military-political doctrine, geopolitical situation, military security policy and other factors. Changes in the modern geopolitical and military-geostrategic situation have formed a new reality associated with the protection of country's territorial integrity. In accordance with this reality, the efficient organization of logistics services in the armed forces of some countries of Central Asia and the Caucasus region (hereinafter – the Armed Forces) is one of the most relevant problems.

Modern world practice shows that the specialization of individual divisions of large industrial complexes in a certain field of activity leads to an improvement in the operation of the entire complex as a whole [9]. This trend is currently used in the armies of different countries, and individual services, including logistics, have begun to be organized as independent areas of activity. In accordance with this approach, the need for the logistics service functioning as an independent entity in the troops is substantiated in [10] and the basic requirements for its establishment is formulated. The organization of a logistics center in a selected area in accordance with these requirements puts forward the following main tasks:

- adaptation (improvement) of the territory;
- construction of administrative, industrial and warehouse facilities;
- construction of the infrastructure;
- setting up a security system;

- bringing operational elements and services into working order;
- bringing the number of automotive and armored vehicles to the required level and preparing them for operation;
- training the personnel and preparing the equipment for planning maintenance and repair, ordering, purchasing and maintaining the relevant property;
- preparation related to the delivery of spare parts to military units, the maintenance of automotive and armored vehicles;
- preparation related to the organization of repair of automotive and armored vehicles at repair sites, as well as in military units, etc.

The expenses on these tasks will vary depending on the location and structure of the military logistics center.

An analysis of the structure of the expenses on organizing the operation of an independent military logistics center in the armed forces and the development of a mechanism for assessing its efficiency constitute a scientific problem. This article highlights the results of the research aimed at solving this problem.

The solution to this problem is related to the study of the expenses on organizing a logistics center. Such expenses are associated with the implementation of various activities and practical work and their structure can vary within a wide range. In this regard, the expenses on building military a logistics center can be divided mainly into capital expenditures and operating expenses. The structure and procedure for calculating these expenses are presented as follows.

The structure of capital expenditure

These expenses include, first of all, costs of constructing administrative, industrial and warehouse buildings, adaptation (improvement) of the territory, purchasing machinery and equipment, setting up communication systems and security systems.

Existing buildings and suitable areas (repair sites, warehouses, etc.) can be used for organizing a logistics center, taking into account the new principles of troop deployment. In this case, the capital expenditure should include expenses not on the construction of the relevant facilities, but on the renovation and repair work of existing facilities. If we denote the cost of the immovable property project by C_0, and the cost of renovation and repair work by C_1, then the initial capital expenditure will drop to $(C_0 - C_1)$. Let us denote the expenses on immovable property by C_D, then

$$C_D = \begin{cases} C_0, & \text{when new facilities,} \\ C_1, & \text{when existing facilities.} \end{cases}$$

The Armed Forces under consideration currently do not have activities based on logistics infrastructure and logistics principles. The material and technical support to the troops is carried out on an ongoing basis and by means of the vehicles of the relevant military units. When creating elements of an independent logistics infrastructure (logistics center), vehicles in the system of logistical support of the troops (logistic battalion in commands and logistic company in formations) can be used in full or in part. In this case, the capital expenditure will include only the costs associated with the purchase of new equipment (maintenance and repair workshops, trucks and other special equipment). Let us denote these expenses by C_A.

During the construction of the infrastructure of the logistics center, a water supply and sewerage system can be built that can meet the needs of its production activities, and in general, depending on the situation, this work can be carried out in different ways:

- laying pipelines from regional water supply systems. In addition to the construction of new pipelines from the water supply nodes to the logistics center, the installation of tanks to collect and store water supply can be considered if necessary;
- pumping water from nearby sources (rivers, canals, artesian wells, etc.). In this case, in addition to the expected traditional work, there are expenses on the purchase and installation of the pump and compressor unit. In this case, installing a technical water filtration system can also be considered (for instance, when using turbid river water);
- regular transportation of water from remote sources by road. In this case, the installation of water tanks or the construction of a pool should be planned as needed.

When the capacity of water sources considered separately is lower than the production demand of the logistics center, water supply from several sources can be considered. Let us denote all expenses on the construction of a water supply and sewerage system by C_S.

Building a gas supply system for the production requirements of the logistics center is one of the essential tasks. As natural gas is cheaper than other types of energy sources, this fuel is used in production whenever possible. If the capacity of the nearest gas distribution plant is lower than the production demand, a gas receiver station can be installed to collect it at the logistics center. A boiler room can also be installed in the territory of the center to heat production areas and office buildings during the cold months of the year.

Let us denote all expenses on the construction of a gas supply system by C_Q.

The operation of devices and equipment to be used at the repair sites of the logistics center, lighting of production areas and the territory, the operation of the necessary ventilation and cooling systems, as well as the operation of electronic computing equipment, including the electronic surveillance system in the territory, is ensured by electricity. Thus, the power supply system is one of the key systems, and its implementation can include the installation of a special regulating transformer in the territory of the logistics center. It is also advisable to have backup generators on the site so that the logistics center does not shut down in the event of possible accidental interruptions in the centralized power supply system. Let us denote all the expenses on the installation of a power supply system by C_E.

Fueling of the vehicle fleet of the logistics center should be carried out through a filling station to be built on its territory. Let us denote the costs of the construction of a filling station by C_Y.

Providing devices and equipment for repair sites occupies a special place among capital expenditure. As we know, high-precision, easy-to-use tools, devices and equipment have recently emerged due to rapidly developing technologies. This includes automatic wrenches used for disassembling and assembling machines and mechanisms, mobile devices for cutting and polishing metal, hydraulic lifts, high-precision automated locksmith and milling machines, measuring instruments, etc.

For the efficient operation of repair sites and crews, the logistics center must be equipped with the necessary machines and tools in accordance with the specifics of military equipment. Let us denote the expenses on the purchase and installation of machinery and equipment by C_Z.

The capital expenditure associated with the security system includes the costs of building fences from stone, concrete or other materials along the perimeter of the territory, building checkpoints at the entrance to and exit from the territory of the center, installing video cameras to monitor the territory, organizing communication and information services, arranging premises for various services. Let us denote these costs by C_M.

In view of the above, the capital expenditure required to organize a logistics center can be mathematically expressed as follows:

$$C = \alpha_C \cdot (C_D + C_A + C_S + C_Q + \\ + C_E + C_Y + C_Z + C_M), \tag{1}$$

where α_C is the reserve ratio associated with additional contingency costs, as a rule, taken as $\alpha_C = 1.05$ [11].

The structure of operating expenses

Operating expenses are the costs of overall activities to maintain automotive and armored vehicles in military units "attached" to the logistics center in a constantly serviceable condition.

Annual plans for operation and maintenance of automotive and armored vehicles of a military unit are drawn up for every financial year. These plans indicate the requirements for the number of automotive and armored vehicles of different brands, types and operational groups in the military unit, their mileage since the start of operation, the planned consumption of the engine service life for the operational year, engine service life until the next scheduled maintenance, Scheduled Maintenance 1 and Scheduled Maintenance 2, the number of medium and overhaul repairs, as well as requirements for special technical supply (batteries, car tires, canopies) [12].

Based on annual plans for operation and maintenance of automotive and armored vehicles, as well as standards for various repair and maintenance operations, the required spare parts are ordered in stages in a centralized manner. Delivery of property and spare parts from central warehouses to the logistics center, their storage, delivery of property to military units in the manner prescribed by the plan, maintenance of vehicles there, organization of medium and overhaul repairs are carried out by the management of the logistics center.

Expenses on these operations vary depending on the geographic location of the logistics center.

As a rule, the schedule of vehicle maintenance and property replacement is drawn up on a rotational basis.

This means that the vehicle maintenance is expected to be carried out in such a way that approximately the same amount of equipment on average is serviced per year.

This approach ensures even workload distribution for maintenance units in peacetime over the years. It is considered that the transportation of property and spare parts supplied on purchase order from central warehouses to the logistics center is carried out 4 times a year in approximately equal shares once a quarter [13].

Let us number the automotive and armored vehicles in the military units attached to the logistics center as $i = 1, 2, 3, ..., N$. E.g., KamAZ-43114 with chassis number XTC432534F1328127, engine number K740/345872, military registration plate number 45-55 KS can be denoted by $i = 1$, UAZ-31512 vehicle with chassis number 364656, engine number 123456, military registration number 02-42 BB by $i = 3$, etc. N is the total number of automotive and armored vehicles in military units. The military units serviced by the logistics center can be formally numbered as $s = 1, 2, ...$ To show that the i-th vehicle belongs to the s-th military unit, we will write $i \in H_s$.

Note that denoting the set of automotive vehicles in the s-th military unit by $H_s^{(1)}$ and armored vehicles by $H_s^{(2)}$, the set H_s can be divided into two parts: $H_s = H_s^{(1)} \cup H_s^{(2)}$. Below, such a division allows clearly writing down the formula for calculating the transportation costs.

Let us number spare parts and other property as $j = 1, 2, 3, ..., J$. E.g., a 12V 6ST-75 accumulator battery can be denoted by $j = 1$, an FP-130 taillight by $j = 2$, 245/45R18 tires by $j = 3$, etc. J is the total number of assorted property and spare parts.

Let us also denote the types of maintenance and repair by natural numbers: suppose $k = 1, 2$ is Scheduled Maintenance 1 and Scheduled Maintenance 2, respectively, $k = 3$ is medium repair, $k = 4$ is overhaul repair.

For the mathematical formalization of costs, we take the following notation. If the i-th vehicle is expected to undergo the k-th type maintenance (repair) in the plan year, then we will write $p_{ik} = 1$, otherwise $p_{ik} = 0$. If the j-th spare part or property is to be used in the k-th type maintenance (repair) of the i-th vehicle, we write $h_{ikj} = 1$, if it is not necessary, then $h_{ikj} = 0$. Let the required number of j-th spare parts for this repair work be denoted by n_{ikj}. Eg., if URAL-4320 needs installing 6 14.00x20 tires during maintenance at $k = 2$, then $n_{ikj} = 6$, respectively.

Since the main indicator in road transport is the weight of the cargo, it has to be taken into account when drawing up the report. To this end, we denote the weight of the j-th type property and spare parts by m_j. Then the total weight of the property and spare parts to be supplied in the plan year will be

$$p_0 = \sum_{k=1}^{4}\sum_{i=1}^{N}\sum_{j=1}^{J} m_j n_{ikj} h_{ikj} p_{ik}.$$

If we take into account the existing transport infrastructure in the areas where the troops are deployed and connecting these areas with the center, we can say that the delivery of property will be carried out mainly by combined transport. In this case, if we denote the costs of transporting one ton of cargo from the central warehouse to the nearest cargo terminal (site or node for transferring cargo from one mode of transport to another) by λ_0, and the costs of transportation from the cargo terminal to the warehouses of the logistics center per 1 km of the route by λ_0, then the total transportation expenses will be

$$P_E = (\lambda_0 + l_0 \cdot q_0) \cdot p_0. \qquad (2)$$

Here l_0 is the distance from the cargo terminal to the logistics center.

As a rule, vehicle maintenance is carried out in the territory of the military units where the vehicle is located. To do this, it is necessary to deliver to these military units the property necessary for maintenance, spare parts, a specialized maintenance crew and special equipment. It should be noted that depending on the geographical location of the spare parts warehouse and the military units, and the existing road infrastructure, the route for the delivery of spare parts can be chosen in such a way that the costs are minimal, i.e. the issue of minimizing the route can be considered. The problems of optimization of cargo transportation from the warehouse to various consumer enterprises have been studied in different formulations in the scientific and technical literature [14–17]. The solution to this type of problem, which is usually referred to as the traveling salesman problem, may vary even depending on the optimality criteria set for the same locations. Since the annual operation and maintenance plan involves approximately the same regularity of maintenance of vehicles located in different military units, the weight of the property to be transported to these military units on one vehicle can be assumed approximately equal. Then the minimum transportation expenses can be calculated on the basis of the criterion of the minimum total length of the distance traveled.

Suppose that the optimal route has been calculated and that the distance to the s-th military unit on this route is l_s. Then the following formula can be applied to calculate the transportation expenses:

$$P_H = \sum_{s=1,2,\dots}\left\{q_s l_s \cdot \sum_{k=1}^{2}\sum_{i \in H_s}\sum_{j=1}^{J} m_j n_{ikj} h_{ikj} p_{ik}\right\}, (3)$$

where q_s is the transportation expenses for an average of one ton of cargo per 1 km of the route from the warehouse of the logistics center to the s-th military unit. In general, the values of q_s may differ from each other and from the value of q_0, which is due to the varying degrees of comfort of the roads between the transportation points.

Another aspect of organizing maintenance of vehicles located directly in the territory of a military unit is the timely delivery of specialists to the site to carry out this work. Depending on the scope of the work to be carried out, the maintenance crew can be brought to the military unit by appropriate transport (e.g., a minibus) by selecting an appropriate route. Maintenance or repair work in military units can take several days. Therefore,

in contrast to the organization of the transportation of spare parts, the maintenance crew needs to be transported to the military unit several times. In general, the number of repeat days can be considered proportional to the number of vehicles in this military unit. Denoting the coefficient of proportionality by β, we obtain the expression $\beta \sum_{i \in H_s} p_{ik}$ for the number of trips of the maintenance crew to the s-th military unit. If we denote the costs of transporting a maintenance crew per 1 km of the route by q_b, and the distance to the s-th military unit along the shortest route by r_s, then their transportation expenses P_B are calculated as follows:

$$P_B = 2 \cdot q_b \cdot \beta \cdot \sum_{s=1,2,\dots}\left\{r_s \cdot \sum_{k=1}^{2}\sum_{i \in H_s} p_{ik}\right\}. \qquad (4)$$

According to the annual plan for operation and maintenance of automotive and armored vehicles, vehicles are to be regularly delivered to the repair plant (i.e., to the repair sites to be set up at the logistics center), where they are to undergo medium (overhaul) repair. As a rule, automotive vehicles that have survived to medium and overhaul repair are able to move on their own, and they arrive at the repair plant under its own power. However, according to statistics, approximately $f_1 = 35\%$ of the vehicle fleet, which underwent medium (overhaul) repairs in peacetime, lose the ability to move on their own at that time [18]. This means that those vehicles must be towed to the repair plant during the year. Armored vehicles ($f_2 = 100$) sent to the repair plant in order to preserve their engine service life are towed in all cases. The annual towing expenses (P_T) can be calculated based on the total number of vehicles located in the s-th military unit and the distance from the repair plant to this military unit along the direct route as follows:

$$P_T = \sum_{s=1,2,\dots}\left\{r_s \cdot \left[\sum_{i \in H_s^{(1)}} f_1 + \sum_{i \in H_s^{(2)}} f_2\right]\right\}. \qquad (5)$$

As noted above, maintenance of automotive and armored vehicles is carried out at the repair sites of the logistics center, which have the necessary equipment, machinery, devices and tools. There are two groups of expenses associated with the operation of this equipment. The first group includes such expenses as the purchase of fuels and lubricants, quickly failing spare parts, tools and equipment, as well as other expendable supplies. Including this property in the list of property and spare parts used for maintenance, the expenses for delivering them to the logistics center can be calculated from formula (2).

The second group includes depreciation expenses on the equipment of the logistics center. Tools, devices and machinery, vehicles, equipment of filling stations, as well as security system devices, computer equipment and other equipment, which are the main means of production, become obsolete (wear out) over time and need to be removed and replaced with new ones. For this purpose, the enterprise is expected to annually allocate depreciation expenses in the amount equal to a certain portion of the book value of these assets. Let us denote these expenses by R_A. The calculation of depreciation expenses is based on the acts of the relevant legislation of the country to which the Armed Forces belong. The straight-line method can be used to calculate these

expenses. Under this method, the depreciation amount allocated to each piece of equipment owned by the enterprise can be determined as the ratio of its book value to its useful life, measured in years. Then the amount of R_A will be equal to the sum of the depreciation amounts calculated for all equipment.

Payroll expenses can be added to the list of operating expenses. These expenses can in principle be divided into two groups. The first group includes the salaries of the officers managing the logistics center, the employees of the security service, filling stations and other auxiliary units (sanitary maintenance of the territory and buildings, etc.). The salaries of the employees in this group can be considered equal for all similar enterprises.

Let us denote the annual payroll allocated to those employees by M_H.

The second group includes the salaries of drivers and engineers and specialists of the repair plant. Let us denote them by M_S and M_Z, respectively. The number of drivers and, accordingly, the size of their payroll can be considered proportional to the number of cars in the vehicle fleet:

$$M_S = \gamma_0 \cdot N_0. \tag{6}$$

Here, N_0 is the total number of vehicles owned by the logistics center, γ_0 is the coefficient of proportionality. For instance, the average annual salary of a driver on a rotating schedule can be taken as γ_0.

Similarly, we can calculate the payroll for the repair plant workers. It can be assumed that the required number of workers can be calculated as a linear combination of the number of medium and overhaul repairs stipulated in the annual plan for operation and maintenance of automotive vehicles:

$$M_Z = \sum_{i=1}^{N}(\gamma_1 \cdot p_{i3} + \gamma_2 \cdot p_{i4}). \tag{7}$$

The numerical coefficients γ_1 and γ_2 here can be determined based on the average number of employees required by the standards for medium and overhaul repairs.

Thus, the following formula can be written to calculate the average annual operating expenses:

$$Q = \alpha_P \cdot (P_E + P_H + P_B + P_T) + \\ + R_A + \alpha_M \cdot (M_H + M_S + M_Z). \tag{8}$$

Here, α_P and α_M are the reserve ratio associated with additional contingency costs.

As a rule, for industrial enterprises, it is taken as $\alpha_P = \alpha_M = 1,4$ [11].

The key military-economic indicators

The procedure for calculating the two key indicators related to the location of the logistics center in the area is given above. The first is the capital expenditure, calculated from formula (1), and the second is the annual operating expenses, calculated from formulas (2) – (8). Although these indicators are to some extent informative for solving the financing problems, they are absolute and do not allow assessing the efficiency of the logistics center. To give a general idea, in addition to the amount Q, it is important to know how many military units are serviced by the logistics center in question or the total number of automotive and armored vehicles it will service. From this point of view, *the average annual expenditure on maintenance and repairs provided by the logistics center per unit of equipment*, which acts as a relative economic indicator, can be considered more informative:

$$Q^* = \frac{Q}{N} = Q_1^* + Q_2^* + Q_3^* + Q_4^*, \tag{9}$$

where the formulas for calculating $Q_1^*, Q_2^*, Q_3^*, Q_4^*$ can be written separately as follows:

$$Q_1^* = \alpha_P \frac{P_E}{N} = \frac{\alpha_P}{N}(q_1 + l_0 \cdot q_0) \cdot p_0 =$$

$$= \alpha_P \frac{q_1 + l_0 \cdot q_0}{N} \cdot \sum_{k=1}^{4} \sum_{i=1}^{N} \sum_{j=1}^{J} m_j n_{ikj} h_{ikj} p_{ik},$$

$$Q_2^* = \alpha_P \frac{P_B + P_T}{N} =$$

$$= \frac{\alpha_P}{N}\{2 \cdot q_b \cdot \beta \cdot \sum_{s=1,2,...}[r_s \cdot \sum_{k=1}^{2} \sum_{i \in H_s} p_{ik}] +$$

$$+ \sum_{s=1,2,...}[r_s \cdot (\sum_{i \in H_s^{(1)}} f_1 + \sum_{i \in H_s^{(2)}} f_2)]\} =$$

$$= \frac{\alpha_P}{N}\{\sum_{s=1,2,...}[2 q_b \beta r_s \cdot \sum_{i \in H_s} \sum_{k=1}^{2} p_{ik}] +$$

$$+ \sum_{s=1,2,...}[r_s \cdot (\sum_{i \in H_s^{(1)}} f_1 + \sum_{i \in H_s^{(2)}} f_2)]\} =$$

$$= \frac{\alpha_P}{N}\{\sum_{s=1,2,...}[r_s \cdot \sum_{i \in H_s}(2 q_b \beta \cdot \sum_{k=1}^{2} p_{ik})] +$$

$$+ \sum_{s=1,2,...}[r_s \cdot (\sum_{i \in H_s^{(1)}} f_1 + \sum_{i \in H_s^{(2)}} f_2)]\} =$$

$$= \frac{\alpha_P}{N} \sum_{s=1,2,...}\{r_s (\sum_{i \in H_s^{(1)}}[f_1 + 2 q_b \beta \sum_{k=1}^{2} p_{ik}] +$$

$$+ \sum_{i \in H_s^{(2)}}[f_2 + 2 q_b \beta \sum_{k=1}^{2} p_{ik}])\},$$

$$Q_3^* = \alpha_P \frac{P_H}{N} =$$

$$= \frac{\alpha_P}{N} \sum_{s=1,2,...}\{q_s \cdot l_s \cdot \sum_{k=1}^{2} \sum_{i \in H_s} \sum_{j=1}^{J} m_j n_{ikj} h_{ikj} p_{ik}\},$$

$$Q_4^* = \frac{R_A}{N} + \frac{\alpha_M}{N}[M_H + M_S + M_Z] =$$

$$= \frac{R_A}{N} + \frac{\alpha_M}{N}[M_H + \gamma_0 \cdot N_0 +$$

$$+ \sum_{i=1}^{N}(\gamma_1 \cdot p_{i3} + \gamma_2 \cdot p_{i4})].$$

Writing this indicator in the form of (9) shows how the maintenance costs of each unit of equipment depend on the road infrastructure in the area where the logistics center is located. Q_1^* is the costs of delivery of the movable property and spare parts from the central warehouse to the logistics center.

A reduction of these costs can be achieved by locating the logistics center near a transport hub. Q_2^* is the costs of transporting maintenance crews to military units for the maintenance of automotive and armored vehicles and depends on the distance from the logistics center to individual military units. Q_3^* is related to the delivery of spare parts to military units and can be minimized by selecting the optimal transportation route. It is clear that C and Q_4^* are actually independent of this infrastructure. If we take into account that the annual plans for operation and maintenance of automotive and armored vehicles are drawn up in such a way that each logistics center has

approximately equal workload over the years, then, with the exception of the quantities l_0, l_s, r_s $(s = 1,2,...)$, the remaining quantities can be considered constant.

This can ensure an efficient geographic location of the logistics center.

However, it should be noted that the choice of the location of the military logistics center requires the fulfillment of not only economic but also other factors, such as the requirements of environmental and military security; therefore, the proposed approach to choosing the location cannot be used independently.

Conclusions

Thus, an analysis of the structure of capital expenditure and operating expenses aimed at organizing a logistics center, as well as the military-economic indicators of this center, gives grounds to note the following results:

• the criterion of profitability, which is taken as a basis in civilian enterprises for assessing economic efficiency, cannot be determined when designing the location of a military logistics center in the area;

• the structure of capital expenditure and operating expenses associated with designing a logistics center for the troops has been elaborated; the calculation method has been developed, taking into account the available resources, communications and infrastructure, information reflected in the annual plans for the operation and maintenance of automotive and armored vehicles of military units;

• the calculation methodology developed on the basis of the structure of capital expenditure and operating expenses on the organization of a logistics center also reflects the infrastructure indicators related to the geographic location of the center (the distance of the logistics center from the transport hub and the military units it services);

• the proposed method can be used to choose a geographic location that is favorable from the point of view of economic profitability for organizing a logistics center for the troops;

• using this method, it is possible to compare the economic aspects of various options of organizing military logistics;

• it is advisable to continue research in this area, since when locating a military logistics center, along with economic factors, it is important to also take into account environmental factors and factors of military security.

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Методика оцінки військово-економічних показників розташування логістичного центру при передислокації військ

А. М. Талібов, Б. В. Гулієв

Анотація. У статті пропонується методика оцінки економічної ефективності логістичного центру, що є невід'ємною частиною військової логістичної інфраструктури. Відзначається, що розробка цього методу заснована на оцінці економічної ефективності логістичного центру з урахуванням її надзвичайно високої функціональності і не враховує використання класичної рентабельності. У статті проаналізовано структуру капітальних вкладень на створення логістичного центру і виробничих витрат. В якості основних критеріїв виробничих витрат запропоновані витрати на обслуговування і ремонт кожної одиниці техніки, і обгрунтовані військово-економічні показники логістичного центру. Аналіз структури капітальних і операційних витрат на організацію логістичного центру, а також військово-економічних показників цього центру дає підставу відзначити наступні результати: критерій рентабельності, прийнятий за основу на цивільних підприємствах для оцінки економічної ефективності, не може бути визначений при проектуванні розміщення військово-логістичного центру на території; опрацьована структура капітальних і операційних витрат з проектування тилового центру для військ; методика розрахунку розроблена з урахуванням наявних ресурсів, комунікацій та інфраструктури, інформація відображається в річних планах експлуатації і технічного обслуговування автомобільної та бронетанкової техніки військових частин; методика розрахунку, розроблена на основі структури капітальних і операційних витрат на організацію логістичного центру, також відображає показники інфраструктури, пов'язані з географічним розташуванням центру (віддаленість логістичного центру від транспортного вузла і військові частини і служби); запропонований метод може бути використаний для вибору вигідного з точки зору економічної рентабельності географічного положення для організації логістичного центру військ; використовуючи цей метод, можна порівнювати економічні аспекти різних варіантів організації військової логістики.

Ключові слова: логістичний центр; логістична інфраструктура; склад запчастин; ремонтні площадки; структура операційних витрат; амортизаційні відрахування; структура капітальних витрат.

Методика оценки военно-экономических показателей расположения логистического центра при передислокации войск

А. М. Талибов, Б. В.Гулиев

Аннотация. В статье предлагается методика оценки экономической эффективности логистического центра, являющегося неотъемлемой частью военной логистической инфраструктуры. Отмечается, что разработка этой методики основана на оценке экономической эффективности логистического центра с учетом ее высшей степени функциональности и не учитывает использование классической рентабельности. В статье проанализирована структура капитальных вложений на создание логистического центра и производственных затрат. В качестве основных критериев производственных затрат предложены затраты на обслуживание и ремонт каждой единицы техники, и обоснованы военно-экономические показатели логистического центра. Анализ структуры капитальных и операционных затрат на организацию логистического центра, а также военно-экономических показателей этого центра дает основание отметить следующие результаты: проработана структура капитальных и операционных затрат по проектированию тылового центра для войск; методика расчета разработана с учетом имеющихся ресурсов, коммуникаций и инфраструктуры, информация отражается в годовых планах эксплуатации и технического обслуживания автомобильной и бронетанковой техники воинских частей; методика расчета, разработанная на основе структуры капитальных и операционных затрат на организацию логистического центра, также отражает показатели инфраструктуры, связанные с географическим расположением центра (удаленность логистического центра от транспортного узла и воинские части и службы); предложенный метод может быть использован для выбора выгодного с точки зрения экономической рентабельности географического положения для организации логистического центра войск; используя этот метод, можно сравнивать экономические аспекты различных вариантов организации военной логистики.

Ключевые слова: логистический центр; логистическая инфраструктура; склад запчастей; ремонтные площадки; структура операционных расходов; амортизационные отчисления; структура капитальных затрат.