PAPER ON THE MODELLING OF OPERATIONAL COSTS CALCULATION IN THE DEFENCE SYSTEM

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The defence system of the Republic of Serbia has a complex organizational structure that is constantly in the process of exploiting its own resources, among which spending funds deserves special attention. Considering the achieved level in the process of building a stable manner of financing the defence system of the Republic of Serbia, as well as the current limitations encountered by the authors, the paper emphasizes a special *research problem* aimed at determining a more rational way of calculating the defence system costs.

Considering the complexity of the mentioned *research problem* and the current level of the defence system structure of the Republic of Serbia, *the subject of the research* is based on the proposal of a certain model that will enable more precise calculation of operational costs of the Ministry of Defence and the Serbian Armed Forces. In this regard, the paper starts from *the hypothetical view* that the existing model of calculating the defence system costs can be improved, above all in the part of the calculation of operational costs of the Ministry of Defence and the Serbian Armed Forces.

The objective of this paper is to point out the need to evaluate the current practice in spending funds and propose new solutions that will enable better mechanisms for monitoring expenditure and income, i.e. better calculation of operational costs at all levels of financing in the Ministry of Defence and the Serbian Armed Forces.

The research results have confirmed the set hypothetical framework by implementation of the *method* of content analysis, with focus

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on the comparative analysis of the calculation of operational costs of personnel, weapons and military equipment and infrastructure. The paper *concludes* that there are objective possibilities for improving the model of calculating operational costs of the defence system.

Key words: *model, calculation, operational costs, effects, defence system*

Introduction

Due to the intensive development of technological processes in the past ten years, in the defence systems of most countries material resources gradually take precedence over human resources, especially in the field of managing their performance (effects). This situation has also affected the performance management process of the Ministry of Defence and the Serbian Armed Forces (hereinafter: the MoD and SAF), which conditioned the need for frequent changes in the objectives and priorities of the development of the defence system of the Republic of Serbia.

These changes inevitably require the establishment of a new concept of priority areas of financing and spending funds, in order to ensure the projected effects and balance between personnel, operational and investment costs in the MoD and SAF. Within these costs, operational costs are a particularly sensitive category, both due to the need for frequent changes and the unpredictability of the way of escalation and the calculation of the amount of costs.

Having in mind this trend, there is the need to develop a model that will allow successful monitoring and calculation of operational and other costs of the MoD and SAF within the existing method of the performance management in the defence system, which also indicates the possibility of implementing a similar method of calculating costs in other bodies of the defence system. In this regard, the focus of the paper is the presentation of the calculation of operational costs, i.e. the presentation of expenditure within the existing capabilities of the MoD and SAF and the proposal of more efficient options for maintaining financial performance in a defined planning period.

Cost calculation model of the existing capabilities of the MoD and SAF

The cost calculation of the existing capabilities aims to determine, and in a certain period, predict the costs of capabilities for the defence against all forms of threats, especially in the conditions of the use of modern information technology.[1] The algorithm of the cost calculation steps of the existing capabilities of the MoD and SAF is presented in Scheme 1.

[1] Radiša Saković, Miroslav Terzić, „Upotreba društvenih mreža u hibridnom ratovanju", *Vojno delo br. 7/2018*. Beograd, 2018, p. 318.

Scheme 1 – *Cost calculation algorithm of the existing capabilities*

The basis for the cost calculation of the existing capabilities of the MoD and SAF is the identification and knowledge of unit costs of some resources and services.[2] In this regard, the formulation of data requirement is based on the classification of the defence system resources for which costs will be calculated, chart of accounts analysis, organizational structure, logistics system, programme structure, as well as the execution of the financial plan. Therefore, the classification of the defence system costs can be done according to the purpose criterion into the following categories: personnel costs, weapons and military equipment (hereinafter: materiel) costs and infrastructure costs.[3]

[2] Dejan Nikolić, Mitar Kovač, Vlada Mitić, „Menadžment u odbrani – osnovne funkcije", *Vojno delo br. 01/2019*, Beograd, 2019, pp. 90-126.

[3] Mitar Kovač, Dejan Stojković, Vlada Mitić, „Model proračuna operativnih troškova operativnih sposobnosti u fazi izvođenja multinacionalnih operacija", *Vojno delo br. zima/2014*, Beograd, 2014, pp. 227-236.

When it comes to *personnel costs*, it is necessary to collect data related to the personnel structure by categories *n*, personnel number by categories K_n, personnel distribution by years of starting service, the expected outflow rate, retirement years, initial training costs and average income costs.[4] The average income costs of the MoD and SAF members (personnel) – *P* include the greatest part of personnel costs, and are determined by the basic coefficient as the basis for gross salary, while bonuses and allowances are determined by coefficients for specific conditions of service and specific military service.[5] In addition to the mentioned data, personnel costs are also affected by activities performed by personnel, which in terms of costs are manifested as: average costs of participation in operations – *O*, average costs of per diem – *D*, average costs of food, clothing and footwear – *H*,[6] as well as average costs of education and training – *S* (in the country and abroad) and average costs of services – *U*.

The data on *weapons and military equipment* costs should cover a great number of types of materiel – V_k.[7] When determining them, it is necessary to include the funds that generate the greatest costs, i.e. that the costs of all included types of materiel are at least 80 and more percent in relation to the total costs of the defence system. For each type of device of a certain category, it is necessary to determine the requirements with the following data: procurement (production) history, life expectancy, investment costs and average annual operational costs.[8]

According to the criterion of the type of material resources that are used to perform the main functions of materiel, operational costs of materiel can be classified into:[9] costs of fuel and lubricants – *G*, ammunition costs – *M* and maintenance costs – *R*.[10]

For the purpose of cost calculation, infrastructure facilities can also be classified according to the purpose criterion – *i*, and one of the possible ways of classification is presented in Table 1.

[4] Frank Steder Brundtland, „Cost Modeling of Defence Components for Smaller Scale Contingencies", *Norwegian Defence Research Establishment (FFI)*, Kjeller, 2005, pp. 67-78.

[5] Ministarstvo odbrane Republike Srbije, „Pravilnik o platama i drugim novčanim primanjima profesionalnih pripadnika Vojske Srbije", *Službeni vojni list br. 28/2011*, Beograd, 2011, p. 12.

[6] Vlada Mitić, Dejan Stojković, Milan Kankaraš, „Defence strategic management - Application of simulation in the personnel cost optimization", *SYMORG 2014*, Beograd, 2014, pp. 1559-1564.

[7] Frank Steder Brundtland, „Cost Modeling of Defence Components for Smaller Scale Contingencies", gen. quote, pp. 88-90.

[8] Ibid, p. 91.

[9] Mitar Kovač, Dejan Stojković, Vlada Mitić, „Model proračuna operativnih troškova operativnih sposobnosti u fazi izvođenja multinacionalnih operacija", gen. quote, pp. 227-236.

[10] Ministarstvo finansija Republike Srbije, „Pravilnik o standardnom klasifikacionom okviru i kontnom planu za budžetski sistem", Službeni glasnik Republike Srbije, br.16/2016, 49/2016, 107/2017, 46/2017, 114/2017, 20/2018 i 36/2018, Beograd, 2018.

Table 1 – *Example of infrastructure facilities classification*

Types of infrastructure facilities
Headquarters
Residential buildings
Buildings and facilities for education and training
Mess halls
Healthcare buildings
Buildings for storage of material resources
Buildings of institutes, overhaul institutes and workshops
Airport facilities, buildings and installations
Sports and recreation buildings and facilities
Culture and leisure buildings and facilities
Thermal power plants
Civil engineering facilities, not previously classified
Green areas, not previously classified
Other infrastructure facilities

For each type of infrastructure facility, it is necessary to collect the data on investment costs of their construction, as well as operational costs.[11] Costs are expressed per square metre, and it is necessary to collect the data on the areas of each type of facility – H_i. Infrastructure causes some operational costs, which include material and financial resources to achieve its main purpose. According to the purpose criterion, operational infrastructure costs can be classified into: costs of heating and electricity – *E*, costs of water and sewerage – *K*, costs of routine maintenance – *C* and other costs – Z.[12]

The mentioned types and categories of resources have to be assigned to the already existing organizational structure up to the level of battalion, so in the following activity, data requirements are sent to the organizational parts of the defence system to collect them. Taking into account the types and categories of resources, organizational units provide data on personnel and materiel number, the area of infrastructure facilities, as well as data related to resource costs.[13] In order to identify organizational parts that can collect and submit data formulated in a request, a detailed analysis of the organizational structure and performances of the defence

[11] Frank Steder Brundtland, „Cost Modeling of Defence Components for Smaller Scale Contingencies", gen. quote, pp. 88-90.

[12] Other costs can be rent expenses, taxes, drainage, etc.

[13] Steinar Gulichsen, „KOSTMOD 4.0 - User manual", Norwegian Defence Research Establishment (FFI), Kjeller, 2009, pp. 34-56.

system should be conducted, as well as the execution of the financial plan according to economic classification accounts, economic classification account holders, programme structure and logistics system.[14]

The defence system operational costs

The calculation of the defence system operational costs is based on unit operational costs. These costs are grouped by categories of resources, which necessarily include the costs of personnel, materiel and infrastructure and represent the capability factors that contribute most to the development of the defence system capabilities.[15]

Unit operational costs, in principle, are calculated annually, on a basis of the data collected from the organizational units of the MoD and SAF. In the following steps, the data processing at the level of the defence system is focused on the calculation of unit operational costs according to resource categories, and then on the processing of other data related to investment costs and the data to be used to calculate investment and operational costs trends. To calculate costs, different methods of operational research can be used.[16]

Unit operational costs

The method of calculating unit operational costs depends on the category of resources, and is performed in principle for personnel, materiel and infrastructure.

When it comes to human resources, the calculation of *unit annual operational costs by personnel category – JTp_n*, can be calculated using the equation (1):[17]

$$JTp_n = P_n + O_n + D_n + H_n + S_n + U_n, \quad (1)$$

wherein:

n – ordinal number of the personnel category, ranging from *1* to *a*;

P_n – average annual costs of gross salaries and bonuses and allowances of a particular category of personnel;

O_n – the average annual costs of participation in operations of a particular category of personnel;

[14] Milan Kankaraš, Srđan Dimić, Vlada Mitić, „Ocenjivanje performansi sistema odbrane", *XLI Simpozijum o operacionim istraživanjima*, Univerzitet u Beogradu, Saobraćajni fakultet, Beograd, 2014, pp. 321-342.

[15] Radiša Saković, Dejan Stojković, „Razvoj sposobnosti sistema odbrane Republike Srbije u uslovima hibridnih pretnji", *Vojno delo br. 7/2019*, Beograd, 2019, pp. 306-322.

[16] Dragan Pamučar, „Operaciona istraživanja - determinističke metodi i modeli", RABEK – Regionalna asocijacija za bezbednost i krizni menadžment, Beograd, 2017.

[17] Steinar Gulichsen, „KOSTMOD 4.0-User manual", gen. quote, p. 43 (the methodology for selecting an adequate calculation mathematical method for equations from ordinal numbers 1 to 15 is determined by a mathematical model built into the software programme").

D_n – average annual per diem costs of a particular category of personnel;

H_n – average annual costs of food, clothing and footwear of a particular category of personnel;

S_n – average annual costs of education and training of a particular category of personnel;

U_n – average annual costs of services provided to a particular category of personnel.

Average unit operational costs of *weapons and military equipment*, by types of weapons and military equipment - JTn_k, can be calculated using the equation (2):

$$JTn_k = G_k + M_k + R_k, \tag{2}$$

wherein:

k – ordinal number of a particular type of materiel, ranging from *1* to *x*;

G_k – average annual costs of fuel and lubricants of a particular type of materiel;

M_k – annual average costs of ammunition of a particular type of materiel;

R_k – annual average costs of maintenance of a particular type of materiel.

The unit operational costs of *infrastructure* are calculated per square metre of the area of a particular type of facility – JTi_m, using the equation (3):

$$JTi_m = E_m + K_m + C_m + Z_m, \tag{3}$$

wherein:

m – ordinal number of a particular type of infrastructure facility, ranging from *1* to *c*;

E_m – average annual costs of heating and electricity of a particular type of facility per square metre;

K_m – average annual costs of water and sewerage of a particular facility per square metre;

C_m – average annual costs of routine maintenance of a particular facility per square metre;

Z_m – other average annual costs of a particular type of facility per square metre.

Some elements necessary for the calculation of unit costs of personnel, materiel and infrastructure are easy to process, and are obtained directly by collecting data (for example, for personnel the calculation of average gross salary, bonuses, allowances, etc. is done). Other elements, which cannot be directly collected, are obtained indirectly by calculation, on the basis of collected data and analysis of the execution of some economic classification accounts, number of goods and services procured, as well as estimate of category and number of personnel, materiel and infrastructure. The authors also point out certain exceptions when it comes to data processing, which are mostly related to the elements in connection to the average costs of the maintenance of materiel, as well as some infrastructure facilities.

Operational costs escalation

The processing of data to be used to calculate investment and operational costs trends is much more complex and is based on cost escalation calculation. Cost escalation is conducted separately for each of the categories of resources, as follows: for personnel, operational costs escalation is calculated, and for materiel and infrastructure, operational and investment costs escalation is calculated.[18]

The escalation of personnel operational costs largely depends on the increase in labour cost and the rise in prices of goods and services used by personnel.[19] When it comes to the increase in labour cost, it is necessary to collect historical data on the average gross salaries of the defence system employees, i.e. in the MoD and SAF, in order to implement regression analysis, in which the independent variables are years (time series), while the dependent variables are average gross salary.[20]

On the basis of the data on gross salaries by past years, regression analysis can predict their movement in the future. A useful tool for easier implementation of regression analysis, and calculation of the movement in the future can be *Microsoft Excel* or other professional statistical software.[21] Regression analysis provides data on the most likely average gross salary each year in the future. Based on the results of regression analysis, it is necessary to calculate the growth trends of gross salaries *Tgob* for each year in the future (*y* ranging from *b* to *z*, where *b* is the base year related to the present, and *z* is the final year in the planning period), using the equation (4):

$$Tgob = \sqrt[j]{\frac{B_p}{B_n}} - 1 \qquad (4)$$

wherein:

j – number of years of the period for which the trend is calculated, in the case when it is calculated for each year in the future (*y*), then j = 2;

B_p – the amount of gross salaries calculated by regression analysis in the initial (previous) year of the period;

B_n – the amount of gross salaries calculated by regression analysis in the last (considered) year of the period.

[18] Steinar Gulichsen, „KOSTMOD 4.0 - User manual", gen. quote, pp. 50-56.

[19] Hove Kjetil, Lillekvelland Tobias, „Defence specific inflation (DSI) of goods and services", *Norwegian Defence Research Establishment (FFI)*, Kjeller, 2016, pp. 25-43.

[20] Mann S. Prem, „Introductory Statistic", *Wiley,* Hoboken, 2017, pp. 121-128.

[21] Using *Microsoft Excel* or other statistical software, graphs can be successfully made and added to *Trendline*, taking into account the amount of the coefficient of determination, which ranges from zero to one.

Using the presented method of calculating the growth trend of gross salaries, data are obtained on the escalation of their costs, as one of the elements for calculating the escalation of personnel operational costs. The same methodology is also implemented for the increase in prices of goods and services *Tgod*, taking into account historical data on the costs of goods and services procured for personnel. If there is no historical data on the costs of goods and services procured for the needs of personnel in the defence system, the data from the Republic Statistical Office related to some goods and services can be used.[22] When using the data from statistical sources, it is necessary to initially determine the share of certain goods and services in the total costs of goods and services procured for the needs of personnel.

By using the calculated values of the escalation of the gross salaries costs *Tgob* and the escalation of the costs of goods and services *Tgod*, it is possible to calculate the escalation of the personnel operational costs *Tgop*. In order to calculate the escalation of personnel operational costs, it is first necessary, on the basis of the collected data, to determine the share of *Wob* gross salaries costs and *Wod* goods and services costs in total personnel costs. In this regard, the escalation of personnel operational costs *Tgop* in each year in the future (*y*) can be calculated using the equation (5):

$$Tgop = Tgob \times Wob + Tgod \times Wod \quad (5)$$

The escalation of materiel operational costs and the escalation of infrastructure operational costs are calculated in the same way as the escalation of personnel operational costs, with differing calculation elements. When it comes to the escalation of materiel operational costs, it is necessary to collect the historical data on the costs of goods and services used for the needs of materiel,[23] primarily fuel and lubricants – *Tgog*, maintenance – *Tgoo* and ammunition – *Tgom*. For each of the mentioned elements for calculating the escalation of materiel operational costs, it is necessary, by using and adjusting the equation (4), to calculate trends, then the share of each of the elements in total materiel costs (*Wog, Woo, Wom*), and finally, by using the equation (6), calculate the escalation of materiel operational costs – *Tgon* for each year in the future (*y*):

$$Tgon = Tgog \times Wog + Tgoo \times Woo + Tgom \times Wom \quad (6)$$

The escalation of infrastructure operational costs is calculated in the same way as the escalation of personnel and materiel operational costs, taking into account the specifics of the elements that affect the escalation of infrastructure operational costs. The escalation of infrastructure operational costs *Tgoi* is mainly influenced by the growth trend in the costs of heating and electricity *Tgoe*, the growth trend in the costs of water and sewerage *Tgok* and the growth trend in the costs of routine maintenance *Tgoc*. The growth trends of the elements for the calculation of the

[22] Republički zavod za statistiku Republike Srbije, „Publikacije", 4.mart 2020, www.stat.gov.rs/publikacije, 23/10/2018.

[23] Hove Kjetil, Lillekvelland Tobias, „Defence specific inflation (DSI) of goods and services", gen. quote, pp. 25-43.

escalation of infrastructure operational costs are calculated by using the equation (4), making it more precise. After determining the share of some costs (*Woe, Wok, Woc*), the escalation of infrastructure operational costs for each year in the future (*y*) can be calculated by using the equation (7):

$$Tgoi = Tgoe \times Woe + Tgok \times Wok + Tgoc \times Woc \quad (7)$$

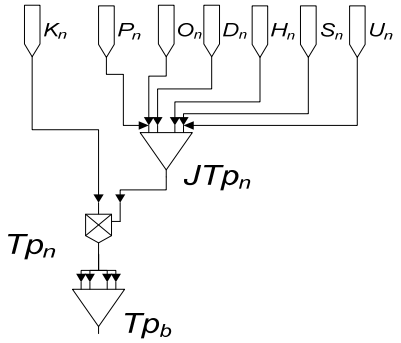
The calculation of operational costs can also be performed in a longer period (short-term, medium-term and long-term planning of the defence system development), regardless of the fact that they are calculated annually in principle, based on the collected data from the MoD and SAF. In such conditions, especially during the process of medium-term and long-term planning, the focus of paper should be on the calculation of trends in operational costs of the MoD and SAF, as well as other entities of the defence system.[24]

Proposed model for the calculation of the defence system operational costs

After processing the collected data on unit costs, the calculation of the defence system long-term costs is conducted. Firstly, the total costs of the defence system in the initial (base) year are calculated, with the correction in relation to the execution of the financial plan. Then, the calculated long-term operational costs are accompanied by investment costs of materiel, whose resources are running out.

The calculation of the total costs of the defence system in the initial (base) year is done by the calculation of the total operational costs of personnel, materiel and infrastructure.

The total operational costs of personnel Tp_b, in the base year *b*, can be calculated using information on unit personnel costs for each category of personnel obtained during data processing, according to the algorithm in Scheme 2.



Scheme 2 – *Model of calculation of total personnel operational costs in the base year*

[24] Dejan Stojković, Vlada Mitić, Radiša Saković, „Measuring the performance of the Police", *Međunarodni naučni skup „Dani Arčibalda Rajsa"*, Beograd, 2019, pp. 149-160.

The shown algorithm can be represented by equation (8):

$$Tp_b = \Sigma_{n=1}^{a} \left(K_n \times JTp_n \right), \tag{8}$$

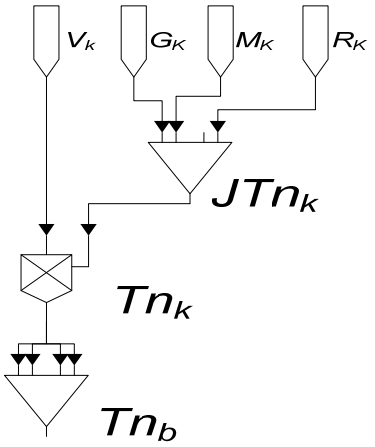
wherein:

n – ordinal number of the personnel category, ranging from *1* to *a*;

K_n – number of personnel of a particular *n* category of personnel;

JTp_n – unit annual personnel operational costs of a particular *n* category of personnel.

The total operational costs of materiel Tn_b, in the base year *b*, can be calculated on the basis of the unit costs of some parts of materiel and the number of these assets, according to the algorithm in Scheme 3.



Scheme 3 – *Model of calculation of total costs of materiel in the base year*

Taking into account the presented model, the operational costs of materiel can be calculated using the equation (9):

$$Tn_b = \Sigma_{k=1}^{x} \left(V_k \times JTn_k \right) \tag{9}$$

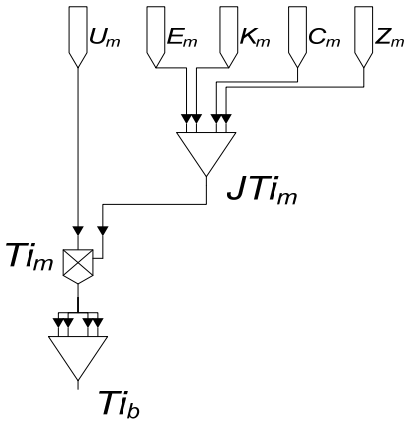
wherein:

k – ordinal number of a particular type of materiel, ranging from *1* to *x*;

V_k – number of materiel of a particular *k* type;

JTn_k – unit annual operational costs of a particular *k* type of materiel.

The total operational costs of infrastructure Ti_b, in the base year *b*, can be calculated based on the algorithm shown in Scheme 4.



Scheme 4 – *Model of calculation of the total infrastructure costs in the base year*

The shown algorithm can also be presented by the equation (10):

$$Ti_b = \Sigma_{m=1}^{c} \left(U_m \times JTi_m \right), \tag{10}$$

wherein:

m – ordinal number of a particular type of infrastructure facility, ranging from *1* to *c*;

U_m – total area in square metres of a particular type of facility *m*;

JTi_m – unit annual infrastructure costs of a particular type of facility *m*.

Based on the calculated total costs of personnel, materiel and infrastructure, it is possible to calculate the total operational costs of the defence system in the base year To_b using the equation (11):

$$To_b = Tp_b + Tn_b + Ti_b \tag{11}$$

After calculating the total costs of the defence system, it is necessary to analyze the execution of the financial plan in the base year in order to determine the discrepancies between the calculated costs and the execution of the financial plan, and adjust the calculated values of the total costs of the defence system in the base year. The execution of the financial plan has to be analyzed by four-digit and three-digit accounts of economic classification and to determine the purpose for which the funds have been used in the context of the elements for the calculation of unit costs of all three cost categories.[25] In case of deviations, it is necessary to adjust the data related to the calculated values of the elements for the calculation of operational costs, or to add new elements for the calculation of operational costs or new categories of personnel, materiel and infrastructure.

[25] „Pravilnik o platama i drugim novčanim primanjima profesionalnih pripadnika Vojske Srbije", Ministarstvo odbrane Republike Srbije, gen. quote, pp. 34-48.

In order to calculate the long-term operational costs of the defence system, it is necessary to increase unit operational costs for each year in the future by the calculated escalation of operational costs. The increase in unit operational costs is done for each cost category individually.

When it comes to personnel costs, for each year in the future Tp_y the personnel operational costs are calculated according to the equation (12):

$$Tp_y = \begin{cases} y = b; \Sigma_{n=1}^{a}(K_n \times JTp_{n(b)}) \\ y = b+1; \Sigma_{n=1}^{a}\left(K_n \times \left(JTp_{n(b)} \times (1+Tgop_{b+1})\right)\right) \\ y = b+2; \Sigma_{n=1}^{a}\left(K_n \times \left(JTp_{n(b+1)} \times (1+Tgop_{b+2})\right)\right) \\ y = z-1; \Sigma_{n=1}^{a}\left(K_n \times \left(JTp_{n(z-2)} \times (1+Tgop_{z-1})\right)\right) \\ y = z; \Sigma_{n=1}^{a}\left(K_n \times \left(JTp_{n(z-1)} \times (1+Tgop_{z})\right)\right) \end{cases} \quad (12)$$

wherein:

y – the year in the future in which the costs are calculated, ranging from *b* to *z*, where *b* is the base year related to the present, and *z* the final year in the planning period;

K_n – number of personnel of a particular *n* category of personnel;

Tgop – escalation of personnel operational costs in a particular year in the future (*y*);

JTp_n – unit annual personnel operational costs of a particular *n* category of personnel in the previous year (*y-1*) in relation to the considered year (*y*), or the base year.

The materiel operational costs for each year in the future Tn_y can be calculated using the equation (13):

$$Tn_y = \begin{cases} y = b; \Sigma_{k=1}^{x}(V_k \times JTn_{k(b)}) \\ y = b+1; \Sigma_{n=1}^{x}\left(V_k \times \left(JTn_{k(b)} \times (1+Tgon_{b+1})\right)\right) \\ y = b+2; \Sigma_{k=1}^{x}\left(V_k \times \left(JTn_{k(b+1)} \times (1+Tgon_{b+2})\right)\right) \\ y = z-1; \Sigma_{k=1}^{x}\left(V_k \times \left(JTn_{k(z-2)} \times (1+Tgon_{z-1})\right)\right) \\ y = z; \Sigma_{k=1}^{x}\left(V_k \times \left(JTn_{k(z-1)} \times (1+Tgon_{z})\right)\right) \end{cases} \quad (13)$$

wherein:

y – the year in the future in which the costs are calculated, ranging from *b* to *z*, where *b* is the base year related to the present, and *z* the final year in the planning period;

V_k – number of materiel of a particular *k* type;

Tgon – escalation of materiel operational costs in a particular year in the future (*y*);

JTn_k – unit annual materiel operational costs of a particular *k* type of materiel, in the previous year (*y-1*) in relation to the considered year (*y*), or the base year.

The infrastructure operational costs for each year in the future Ti_y can be calculated using the equation (14):

$$Ti_y = \begin{cases} y = b; \Sigma_{m=1}^{c} (U_m \times JTi_{m(b)}) \\ y = b+1; \Sigma_{m=1}^{c} \left(U_m \times \left(JTi_{m(b)} \times (1 + Tgoi_{b+1}) \right) \right) \\ y = b+2; \Sigma_{m=1}^{c} \left(U_m \times \left(JTi_{m(b+1)} \times (1 + Tgoi_{b+2}) \right) \right) \\ y = z-1; \Sigma_{m=1}^{c} \left(U_m \times \left(JTi_{m(z-2)} \times (1 + Tgoi_{z-1}) \right) \right) \\ y = z; \Sigma_{m=1}^{c} \left(U_m \times \left(JTi_{m(z-1)} \times (1 + Tgoi_{z}) \right) \right) \end{cases} \quad (14)$$

wherein:

y – the year in the future in which the costs are calculated, ranging from *b* to *z*, where *b* is the base year related to the present, and *z* the final year in the planning period;

U_m – total area in square metres of a particular type of facility *m*;

Tgoi – escalation of infrastructure operational costs in a particular year in the future (*y*);

JTi_m – unit annual infrastructure costs of a particular type of facility *m*, in the previous year (*y-1*) in relation to the considered year (*y*), or the base year.

Based on the calculated total costs by cost categories, it is possible, using the equation (15), to calculate the total operational costs of the defence system in each year in the future To_y:

$$To_y = \begin{cases} y = b; Tp_b + Tn_b + Ti_b \\ y = b+1; Tp_{b+1} + Tn_{b+1} + Ti_{b+1} \\ y = b+2; Tp_{b+2} + Tn_{b+2} + Ti_{b+2} \\ \dots \\ y = z-1; Tp_{z-1} + Tn_{z-1} + Ti_{z-1} \\ y = z; Tp_z + Tn_z + Ti_z \end{cases} \quad (15)$$

In order to calculate the long-term costs of the defence system, it is necessary to add to the calculated operational costs the investment costs for materiel, whose resources are running out.[26]

[26] Improving the calculation of the investment costs of materiel, whose resources are running out, represents a specific field of spending funds, where it is necessary to analyze the historical data related to the years of procurement/production and the life cycle of particular resources of materiel, which can be studied as a separate research problem.

The calculated long-term costs are used in the following steps to propose more efficient options for maintaining the existing capabilities, as well as to propose possible options for developing capabilities of the defence system. The proposed model of calculation of the defence system costs can significantly contribute to the improvement of the performance management process of the MoD and SAF, as well as other entities of the defence system.[27]

Conclusion

The calculation of the costs of the existing capabilities is determined in a particular period and serves as a basis for projecting the costs of the required capabilities of the defence system, which is characteristic from the point of view of the long-term planning of the defence system development. Regardless of the fact that the greatest costs of the defence system are in the MoD and SAF, with a comprehensive approach the calculation of the total costs should also be directed to other entities of the defence system, but only within the capabilities that have to be developed.

The proposed model provides a certain level of flexibility that will enable its further upgrading and improvement, in the function of supporting more efficient execution of financial tasks. This model indicates more efficient options for maintaining the existing capabilities of the MoD and SAF and seeks to build a unique information system, which would provide model testing and automation of the calculation process of operational and other costs of the defence system.

The research concludes that the need for the development of such a model is justified, because a more complete picture of the current situation and the use of financial resources of the MoD and SAF is obtained. At the same time, the shortcomings of the current manner of financial management in the MoD and SAF have been presented. Therefore, new solutions that will provide better cost calculations and more efficient performance management, and thus more successful functioning and sustainability of the entire defence system of the Republic of Serbia, have been proposed.

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Summary

The defense system of the Republic of Serbia has a complex organizational structure operating as a single entity, where relations and correlations between the organizational units are clearly defined. According to its purpose, the defense system is constantly exploiting its own resources, where the use of financial resources deserves undivided attention.

With respect to the achieved level in the process of building a stable defense system of the Republic of Serbia, as well as the current cognitive limitations met by the authors about the possibility to explore other entities of the defense system, the paper solely focuses on the Ministry of Defense and the Serbian Armed Forces.

The objective of the paper is to propose a model, which will enable a more precise calculation of the defense system costs. The model proposal will indicate that there is a need for reviewing the current policy related to the allocation of financial

resources and will recommend new solutions enabling better mechanisms for monitoring revenues and expenditures, i.e. better calculations at all finances-related levels. Essentially, the model proposal will ensure a certain level of flexibility enabling thus its further upgrading and improvement, with the aim to support the management of financial assignments more efficiently. The topic is elaborated in four sections: a cost calculation model of actual capabilities, operational costs, investment costs and a model proposal for calculating costs of the defense system. The proposed model would indicate to more efficient options of maintaining the current capabilities of the defense system.

It has been concluded in the research that a need for establishing such a model is justified because it makes it possible to get a clearer picture of the current state and allocation of financial resources of the Ministry of Defense and the Serbian Armed Forces. At the same time, some faults have been indicated in the current financial management in the Ministry of Defense and the Serbian Armed Forces. Also, new solutions providing better cost calculations have been given and more efficient performance management, enabling thus better work of the entire defense system of the Republic of Serbia.

Key words: *model, calculation, operational costs, performance, defense system*