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ANALYSIS OF THE NEEDS TARGET GROUP IN THE FINANCIAL SUPPORT SYSTEM OF THE ARMED FORCES OF UKRAINE AND ESTIMATION OF THE ECONOMIC EFFICIENCY OF THE PROJECT SOLUTIONS

The paper analyses the current state of the financial support system of the Armed Forces of Ukraine, focusing on the growing challenges and limited budgetary resources. Particular emphasis is placed on the need to introduce multi-criteria optimization methods to improve the efficiency of budget management. The main objective of the paper is to assess the cost-effectiveness of implementing design solutions in the financial support system of military units of the Armed Forces of Ukraine, which allows optimizing costs, minimizing risks and increasing the level of responsibility in budget planning.

The paper is based on the results of an expert survey involving more than 60 representatives of budget holders at various levels of management of the financial support system of the Armed Forces of Ukraine. The survey helped to identify key areas that need to be optimized, including monitoring and accounting of the status of budget execution, reporting, efficient allocation of limited resources between areas and evaluation of suppliers' proposals in public and defense procurement.

A method for evaluating project solutions in the system of financial support of the Armed Forces of Ukraine has been developed. The methodology for analyzing alternative solutions is based on the TOPSIS method (Technique for Order of Preference by Similarity to Ideal Solution), which allows taking into account numerous evaluation criteria and provides an objective ranking of possible options. The results of the calculations show that the most effective alternative is V1, which includes the implementation of software for process automation of the following blocks: a reference book of regulations, tools for allocating limited budget funds between certain areas, and for assessing the effectiveness of expenditures. When calculating according to the developed methodology, based on expert judgements, the expected savings in the institution's budget were obtained at the level of 12-15%.

Keywords: budget, defense expenditures, budget planning, methods of multicriteria optimization, effectiveness of expenditures, effectiveness assessment, expert survey.

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АНАЛІЗ ПОТРЕБ ЦІЛЬОВОЇ ГРУПИ В СИСТЕМІ ФІНАНСОВОГО ЗАБЕЗПЕЧЕННЯ ЗБРОЙНИХ СИЛ УКРАЇНИ ТА ОЦІНКА ЕКОНОМІЧНОЇ ЕФЕКТИВНОСТІ ПРОЕКТНИХ РІШЕНЬ

У статті аналізується сучасний стан системи фінансового забезпечення Збройних Сил України, акцентуючи увагу на зростаючих викликах і обмеженому бюджетному ресурсу. Особливий наголос зроблено на необхідності запровадження багатокритеріальних методів оптимізації для підвищення ефективності управління бюджетними коштами. Основною метою дослідження є оцінка економічної ефективності впровадження проектних рішень у систему фінансового забезпечення військових частин Збройних Сил України, що дозволяє оптимізувати витрати, мінімізувати ризики та підвищити рівень відповідальності при плануванні бюджету.

Дослідження базується на результатах експертного опитування, у якому взяли участь понад 60 представників розпорядників бюджетних коштів різних рівнів управління системою фінансового забезпечення Збройних Сил України. Опитування дозволило визначити ключові напрямки, які потребують оптимізації, серед яких: моніторинг і облік стану виконання кошторису, формування звітності, ефективний розподіл обмежених ресурсів між напрямками та оцінка пропозицій постачальників під час здійснення публічних та оборонних закупівель.

Розроблено методу оцінки проектних рішень в системі фінансового забезпечення Збройних Сил України. За основу зазначеної методику аналізу альтернативних рішень було використано метод TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), який дозволяє враховувати численні критерії оцінки та забезпечує об'єктивне ранжування можливих варіантів. Результати розрахунків свідчать, що найефективнішою є альтернатива V1, яка включає впровадження програмного забезпечення для автоматизації процесів х наступних блоків: довідник нормативно-правових актів, інструменти для розподілу обмежених бюджетних коштів між визначеними напрямками, а також для оцінки ефективності видатків. При розрахунку за сформованою методикою, на основі експертних суджень, було одержано очікувану економію кошторису установи на рівні 12–15%.

Ключові слова: бюджет, оборонні видатки, планування бюджету, методи багатокритеріальної оптимізації, ефективність видатків, оцінка ефективності, опитування експертів.

STATEMENT OF THE PROBLEM

Since the beginning of Russia's full-scale invasion, Ukraine has faced an unprecedented challenge that requires a significant increase in budgetary expenditures on defense. These expenditures include the purchase of modern weapons, ammunition, military equipment and personal protective equipment. For clarity, it is worth noting that according to the State Budget of Ukraine for 2025, more than 80% of all state budget revenues will be directed to the security and defense sector, and even so, these expenditures cover only 60% of the estimated needs of the General Staff of the Armed Forces of Ukraine for 2025 [1].

Resource constraints, the need to respond quickly to external and internal threats, and the requirement for transparency and objectivity in the use of budget funds create preconditions for the search for new methods of budget management. The system of financial support for the Armed Forces of Ukraine, like any other large state institution, requires a clear and rational approach to resource allocation, which is the basis for their sustainable functioning. Effective budgetary management in the financial support system of the Armed Forces of Ukraine is an important condition for ensuring their capabilities in the current environment.

The defense sector and military activities in general are characterized by significant time constraints in decision-making, as well as the criticality of the consequences of a decision. This necessitates the development of various methods that optimize the decision-making process [2].

One of these approaches is the use of multi-criteria analysis methods that allow for an objective assessment of alternatives, ensure objectivity and transparency of the decision-making process. In particular, the TOPSIS method is one of the most effective tools for solving problems that require consideration of various factors. It takes into account both the distance to the ideal solution and the anti-ideal solution, providing an objective ranking of alternatives [3].

Effective resource management requires not only new approaches to optimization, but also a deep understanding of real problems and needs in practice. In this regard, an expert survey has become an important research tool, as it is the experts involved in the management of the financial support system of the Armed Forces of Ukraine at various levels who have unique knowledge and practical experience that cannot be obtained from theoretical sources.

ANALYSIS OF THE LATEST RESEARCH AND PUBLICATIONS

Kerim Goztepe in his article entitled A Multicriteria Decision Making Model for Military Logistics Using Analytical Network Process (ANP) explores the complexities of decision making in military logistics. The paper emphasises the challenges associated with uncertainty, rapid change and the need to consider multiple criteria simultaneously. The paper presents the Analytical Network Process (ANP) as an effective method for optimising logistics decisions in military operations. Due to the ability of ANP to take into account interdependent criteria and provide feedback, it is especially appropriate for comparing alternative courses of action (COAs). The conclusions indicate that ANP improves the quality of logistics decisions, but requires specialised training to be used effectively [4].

In Ukraine, researchers and scholars such as V. Pakholchuk, O. Ostapenko, T. Zatonatska, I. Tkach, O. Kharlamova, O. Levchuk have studied the issues of financial support for the armed forces, modelling budget expenditures, and assessing defence expenditures [5-7].

The issues of reforming the national security and defence system were studied by such scholars as V. M. Begma and O. O. Sverhunov [8].

The methodological foundations of the development of the Armed Forces of Ukraine from an economic point of view were studied by I. Chernyshova, I. Marko, I. Skurinevska [9].

Based on the analysis of the works of the above scholars, as well as authors such as: Sefa Awaworyi, Alptekin Aydin, Kerim Göztepe, Januar Febriansyah, it was found that the current direction of modern research in this area is to model the adoption of an optimal, effective decision using modern economic and mathematical methods, including methods of multicriteria optimisation. An analysis of the share of publications in the Scopus database shows a significant increase in scientific interest in this area, namely: until 2010, the annual number of publications ranged from 1 to 5, and already in 2012 - 9 publications per year, and in 2023 and 2024 - 12 and 22, respectively.

In the framework of the current paper, special attention should be paid to the scientific works of Kerim Göztepe, namely the scientific publication ‘Development of a fuzzy decision support system for commodity acquisition using fuzzy analytical network process’, one of the authors of which is Kerim Göztepe, and this publication was one of the driving forces for choosing the research topic.

FORMULATION OF THE GOALS OF THE ARTICLE (STATEMENT OF THE TASK)

The paper highlights several important aspects that have previously remained unresolved in the overall problem of financial support for the Armed Forces of Ukraine. In particular, attention is paid to the insufficient use of multi-criteria analysis methods to increase efficiency of budget management.

The paper is based on the method of an expert survey, in which more than 60 experts (representatives of budget managers of the highest and lowest levels) in the system of financial support of the Armed Forces of Ukraine took part. Alternative options for further optimisation were assessed using the TOPSIS method. The experts were

surveyed using a specialised software product Google Forms and Microsoft Excel, which became the basis for analysing the experts' data.

Relevance and purpose of the paper. In the context of growing challenges for the Armed Forces of Ukraine, there is an urgent need to introduce multi-criteria analysis tools to assess the effectiveness of management decisions, especially in the context of budget management. The paper focuses on the development of a methodological framework for identifying current areas for optimising the financial support system of the Armed Forces of Ukraine and further assessing the economic efficiency of the proposed alternatives.

PRESENTATION OF THE MAIN MATERIAL OF THE RESEARCH

In order to develop a methodology for assessing the economic efficiency of design solutions in the system of financial support of the Armed Forces, the following algorithm was developed, which determined the plan of the current paper (Figure 1).

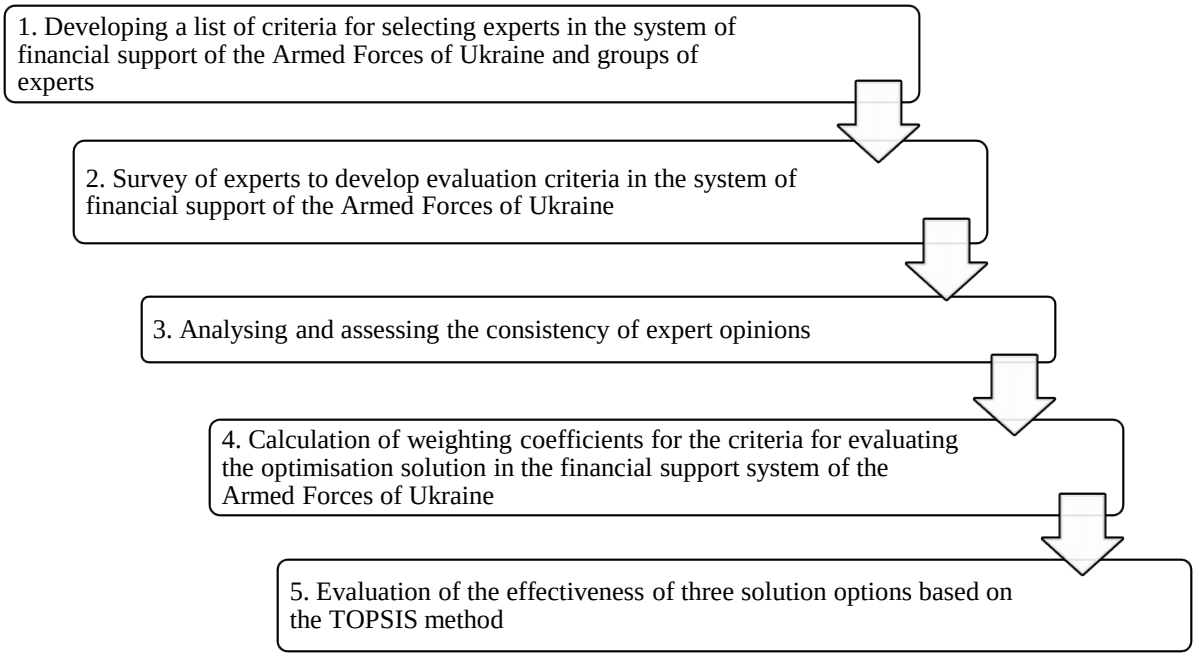

Fig. 1. Sequence of stages in assessing the effectiveness of decisions in the financial support system
Source: developed by the authors

Often, the initial formulation of a particular problem can be too approximate, simplified and requires further refinement. In such conditions, finding a sufficiently accurate solution to the problem is impractical, and obtaining approximate preliminary results and their further analysis with the participation of experts in the relevant field of knowledge allows to refine the model of the problem [10].

The reasearch involves experts at stages 2 and 3, and the results of their survey will be the basis for further calculation at stages 3 and 4.

Stage 1. Within the framework of the paper, the sample of experts consists of two groups defined by the criterion of belonging to the level of budget holders in the system of financial support of the Armed Forces of Ukraine. The first group of experts consists of specialists of the first and second level of budget spending units, and the second group consists of specialists of the third level of budget spending units, i.e. directly those institutions, establishments and organisations that implement budget programmes and subprogrammes. A budgetary entity is a budgetary institution authorised to receive budgetary allocations, incur budgetary obligations and make budgetary expenditures. According to the scope of the rights granted, BFIs are divided into main budget entities and lower-level budget entities [11].

Expert surveys are an important method of data collection when quantitative information is not available or difficult to collect [12].

In the process of conducting the survey, it was found that experts from the second group (third-level budget managers) needed additional filtering.

The following criteria were developed to form a sample of experts from the second group:

К1 - work experience (military service) in positions in the area of financial support of a military unit: up to one year - 0 points; from one to three years - 1 point; from three to five years - 2 points; from 5 years - 3 points;

К2 - participation in the development of financial and planning documents of the military unit/institution/organisation: participates - 3 points; does not participate - 0 points;

К3 - participation in the organisation of procurement of goods, works and services in the military unit/institution/organisation: participates - 3 points; does not participate - 0 points;

К4 - number of budget programmes within the framework of which the military unit/institution/organisation receives budget allocations: not a budget holder - 0 points; 1 - 1 point; 2 - 2 points; 3 and more - 3 points.

Stage 2: As part of the survey, one of the key elements was a question to assess the prospects for optimising areas (processes) in the financial support system of the Armed Forces of Ukraine.

The criteria (areas) within which the experts formed the assessment were as follows (9):

1. Monitoring and accounting for the status of budget execution
2. Exchange of documents with the higher-level budget holder on planning and execution of the budget
3. Formation of objective proposals for the use of limited financial resources between areas to maximise the needs of the military unit
4. Preparation of reports on the execution of the budget
5. Formation and exchange of documents and data within the military unit on planning and execution of the budget
6. Evaluation of proposals of suppliers of goods, works and services according to certain criteria
7. Evaluation of the effectiveness of the use of budgetary funds by areas
8. Determining whether expenditures belong to the programme/economic classification of expenditures
9. Regularly updated base of regulatory and legal documents in the sphere of financial support of the troops.

It is worth noting that the budget classification is a single systematic grouping of revenues, expenditures, lending, budget financing, debt in accordance with the legislation of Ukraine and international standards [13].

The budget classification of expenditures includes the following types: departmental, programme, economic and functional [14].

Stage 3. When the number of judgements is large enough, there is a risk of illogical or contradictory conclusions due to possible errors of experts or ambiguous understanding of the issues. Such errors usually arise due to subjective factors of experts, due to numerous comparisons of elements at different ratios.

The concordance coefficient is an important statistical tool used to assess the consistency between different observers. Its significance is due to its ability to assess both precision (absence of systematic error) and accuracy (consistency between observations), which makes it a versatile tool for analysis in many fields.

The versatility of the concordance coefficient allows researchers to objectively assess the quality of data, which is the basis for sound scientific conclusions. The use of the coefficient of concordance makes it possible to make more confident decisions about the accuracy of data collection methods and their practical suitability for use in research.

Kendall's coefficient of concordance (W) is a statistical tool used to measure the degree of agreement between several experts or observers who evaluate the same group of objects according to certain criteria. This coefficient was proposed by the American mathematician and statistician Maurice Kendall in 1948. It is used when data are presented in the form of a ranking, which makes it convenient for assessing subjective opinions or expert judgements [15].

The purpose of applying the concordance coefficient in our paper is to determine how consistently experts evaluate objects or criteria and to assess the reliability of the data obtained.

The mathematical formula for the concordance coefficient is expressed as follows:

$$w = \frac{\sum_{i=1}^{n}(S_i - \bar{S})^2}{\frac{1}{12}\cdot m^2\cdot(n^3-n) - m\cdot\sum_{j=1}^{u} T_j} \quad (1)$$

Where W is the Kendall's concordance coefficient (a measure of agreement between experts). The value of Wvaries from 0 to 1:

W=0 - no agreement between experts.

W=1full agreement between experts.

n - number of criteria to be evaluated (in our case, n=10).

m is the number of experts providing ratings (in our calculation, m=).

Si - the sum of ranks for each criterion, calculated on the basis of expert assessments.

The numerator of the formula reflects the variance of the sum of ranks. The greater the variance, the higher the agreement between experts.

The algorithm for calculating the concordance coefficient in our paper is as follows:

1. Compilation of the rank table:

o experts assign scores according to a certain criterion.

o Displaying the scores of each expert in a table.

2. Calculating the sum of ranks (Si):

o For each object, the sum of the ranks received from all experts is calculated.

3. Calculating the variance of the sums of ranks:

o the average value of the sums of ranks is determined.

o The sum of squares of deviations from the mean is calculated.

4. Adjustment for tied ranks:

o If there are tied ranks in the data (equal scores), an appropriate correction is made.

5. Calculating Pearson's coefficient for the survey data
6. Comparison of the concordance coefficient and the calculated value of the Pearson's coefficient.
7. If the value of the concordance coefficient is within the range of the calculated value of the Pearson's criterion to 1, then the data can be accepted for calculation, otherwise, the sample of experts and the list of questions to experts should be reviewed.

Pearson's correlation coefficient quantifies the degree of linear dependence between two continuous variables, providing an understanding of the strength and direction of their relationship, with a value ranging from -1 to 1, where 1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation, and 0 indicates no linear relationship [16].

Pearson's correlation coefficient may underestimate the strength of the relationship in the presence of nonlinear dependencies, which emphasises the importance of visual analysis of data before applying statistical tests [17].

Stage 4. The next step is to determine the weighting coefficient for each criterion based on expert judgement.

The issue of determining the weight of the criteria requires special attention, as this stage has a decisive impact on the entire further process. One way to avoid subjectivity at this stage is to determine the weight of the criteria using the entropy method [18]. However, given the importance of expert opinion in the field of military use, preference was given to the expert variant of ranking the criteria.

The weight of each criterion is calculated using the following formula:

$$a_i = {S_i}/{\sum S_i} \quad (2)$$

The total weighting of all criteria is equal to 1.

$$\sum_{i=1}^{n} a_i = 1 \quad (3)$$

where:

- ai - weighting coefficient of the third criterion;
- Si- sum of ranks given by experts for the third criterion;
- n - total number of criteria.

The sum of the weighting factors should always be equal to 1 (or 100% if expressed as a percentage). This ensures that the entire impact of the criteria is evenly distributed among them without gaps or overweighting. This approach is widely used in multi-criteria evaluation methods, such as TOPSIS, to normalise the weights of the criteria and ensure the objectivity of the analysis.

Stage 5.

A typical procedure for applying the TOPSIS method is as follows:

- Establish system evaluation criteria that link system capabilities to objectives;
- develop alternative systems to achieve the goals (generate alternatives);
- evaluate the alternatives in terms of the criteria;
- apply one of the normative methods of multicriteria analysis,
- accept one of the alternatives as ‘optimal’ (best),
- if the final decision is not acceptable, collect new information and move on to the next iteration of multicriteria optimisation [19].

We have formed the following sequence in the current paper.

5.1 Formation of the decision matrix. The formation of the decision matrix is the first stage of the TOPSIS method, where all the necessary data for the evaluation of project alternatives are collected. This matrix consists of values that describe how well each option meets each of the defined criteria. In our case, the matrix contains 3 rows representing 3 decision options (A1,A2,A3) and n columns representing the criteria (evaluation areas) (C1,C2,..., Cn). The elements of the matrix (xij) are scores that reflect the extent to which the i-th option meets the j-th criterion. In this example, the scores are formed on the basis of expert judgements of two groups of options that meet the priority criteria, which are . The formation of the decision matrix is the basis for all subsequent stages and determines the accuracy of the analysis results.

5.2 Normalisation is a key step in the TOPSIS method, which removes the difference in scale of the criteria and makes them comparable. Since the criteria may be expressed in different units (e.g., hryvnias, percentages, scores), they need to be brought into a uniform form. This is achieved by calculating normalised values using the formula:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (4)$$

where xij is the initial value for the i-th option according to the j-th criterion, rij is the normalised value. The formula scales each criterion between 0 and 1.

The result of this step is the normalised matrix R=[rij], which has the same size as the original decision matrix, but all values in it are dimensionless. This makes further analysis easier and more accurate.

The normalisation process also helps to solve the problem of criteria that have different weights on the final result. For example, financial efficiency may have more weight than usability criteria. This aspect is taken into account in the next step - weighting.

5.3. After the decision matrix is normalised, weighting is performed, which takes into account the relative importance of each criterion. The weighting coefficients (wj) are determined on the basis of expert opinions obtained from the survey, i.e. by direct ranking. It is worth noting that a pairwise comparison, an analytical hierarchical process, can also be used.

$$v_{ij} = w_j * r_{ij} \quad (5)$$

where:

where ri is the normalised value, and wj is the weighting factor for the jth criterion. Weight normalisation allows us to take these priorities into account and make the analysis more objective. The obtained values of vij form the weight-normalised matrix V=[vij]. The obtained matrix is the basis for further analysis to determine the ideal and anti-ideal solutions.

5.4 At this stage, two key benchmarks are identified - the ideal solution (A+) and the anti-ideal solution (A). The ideal solution is the set of the best possible values of the criteria, and the anti-ideal solution is the set of the worst possible values:

$$A^+ = \{v_1^+, v_2^+, \dots v_n^+\},\ A^- = \{v_1^-, v_2^-, \dots v_n^-\} \quad (6)$$

where:

vj+=max vij for benefit criteria (higher value is better) or vj+=min vij for cost criteria (lower value is better).

These benchmarks are used to determine the distances of each option to the ideal and anti-ideal solutions in the next step. This allows us to estimate how close each option is to the optimal one.

5.5. Calculating the distance to the ideal and anti-ideal solutions and calculating the relative proximity of the alternatives to the ideal solution.

5.6. Ranking of alternatives and illustration of results.

At this stage, it is calculated how close each variant of the design solution is to the ideal solution (A+) and how far it is from the anti-ideal solution (A-). This is done by calculating Euclidean distances in a multidimensional space where each criterion represents one of the coordinates.

$$d^+ = \sqrt{\sum_{j=1}^{n}(v_j^+ - v_{ij})^2},\ d^- = \sqrt{\sum_{j=1}^{n}(v_j^- - v_{ij})^2} \quad (7)$$

where:

- di+ is the distance of the iii option to the ideal solution (A+), i is the distance of the i option to the anti-ideal solution (A-).

Calculation of proximity indicators (Ci): For each alternative is calculated:

$$C_i = \frac{s_i^-}{s_i^+ + s_i^-},\ 0 \le C_i \le 1 \quad (8)$$

The alternatives are ordered in descending order of Ci. The best alternative is ranked first, the second best in terms of Ci is ranked second, and so on. The ranking results will be presented in the form of a diagram.

Thus, the ranking allows you to choose the optimal solution based on a comprehensive analysis, taking into account all the defined criteria.

5.7. The share of economic efficiency of the selected direction is calculated using the formula 9.

In paragraph 2, during the expert survey, each of the above issues was proposed to be assessed by the experts as a potential increase in the efficiency of budgetary funds use by minimising risk factors in processes and reducing staff time. It was suggested that the assessment be expressed as a percentage of the potential part of the institution's budget (100%). At the same time, the amount of potential savings will be calculated taking into account the weighting factor, which will be formed on the basis of expert judgements.

$$E = \sum_i^n P_i * a_i * \overline{B} \quad (9)$$

where:

- E - total share of potential efficiency gains (in percentage),
- Pi is the expert's assessment of the share of savings for the iii direction (in per cent),

- ai is the weighting factor for the i-th criterion (direction), calculated on the basis of expert judgement,
- B is the average value of the institution's budget,
- n is the number of criteria (areas).

Since the data on the institution's budget was collected in the form of a segment from to. The minimum estimate is calculated as the lower bound of the first range, taking into account the weight of all intervals. To do this, the weights of the lower limits of each interval are summed up with their percentage values, the Maximum estimate is calculated similarly, but the upper limits of each interval are taken into account:

$$\overline{B_{min}} = 0{,}2 * \sum_{i=1}^{n} \left(L_i * \frac{P_i}{100}\right), \overline{B_{max}} = 0{,}2 * \sum_{i=1}^{n} (U_i * \frac{P_i}{100}) \quad (10)$$

where:

- Li: lower boundary of the i-th range,
- Ui: upper boundary of the i-th range
- Pi percentage (proportion) of budgets in the i-th range.
- An adjustment of 20 per cent allows us to allocate a share of the budget that is allocated to personnel costs (average value of 80 per cent of the total).

The described approach is scalable and can be used to analyse complex systems with a large number of criteria.

Research ethics. The paper was conducted without violating the rights of the subjects and in compliance with the ethical principles of research, i.e. the reasearch guaranteed the principle of voluntariness, the right to be heard without asking personal questions that could harm the subjects, anonymity and confidentiality. The experts were informed that their participation in the reasearch and the information provided would not be misused in the future. The experts were familiarised with the purpose of the reasearch and the results of the reasearch.

The data from the questionnaire survey of experts was analysed using a specialised software product Google Forms and Microsoft Excel, which became the basis for analysing the experts' data.

Results.

Stage 1. Based on the results of the survey, a sample of 18 experts of the first group and 45 experts of the second group was formed. The first group of experts consists of specialists of the first and second level of budget spending units, and the second group consists of specialists of the third level of budget spending units, i.e. directly those institutions, establishments and organisations that implement budget programmes and subprogrammes.

The second subgroup of experts was filtered by criteria (those who scored more than 8 points in the survey) and thus the group of experts #2 was reduced to 37 experts.

Stage 2: One of the key elements of the survey was a question on the assessment of the prospects for optimising areas (processes) in the financial support system of the Armed Forces of Ukraine. Experts were asked to assess each of the above questions as a potential increase in the efficiency of using budget funds by minimising risk factors in processes and reducing staff time. It was suggested that the assessment be expressed as a percentage of the potential part of the institution's budget (100%). At the same time, the amount of potential savings will be calculated taking into account the weighting factor, which will be formed on the basis of expert judgements.

$$E = \sum_{i}^{n} P_i * a_i * \overline{B} \quad (11)$$

where:

- E - total share of potential efficiency gains (in percentage),
- Pi is the expert's assessment of the share of savings for the iii direction (in per cent),
- ai is the weighting factor for the i-th criterion (direction), calculated on the basis of expert judgement,
- B is the average value of the institution's budget,
- n is the number of criteria (directions).

1. Monitoring of the budget execution is proposed to be assessed on a 5-point scale:

0: No impact on management decisions and efficiency of budget expenditures.

1: Savings of up to 1%, slight improvement in the objectivity of decision-making based on the monitoring results.

2: Savings in the range of 1-3%, the ability to detect deviations from the budget in a timely manner to adjust decisions.

3: Savings in the range of 3-5%, improved quality of management decisions due to access to more complete information on the status of the budget.

4: Savings in the range of 5-7%, a significant increase in the efficiency of spending due to monitoring, which allows for more informed decisions.

5: Savings of more than 7%, a dramatic increase in the objectivity of decisions and cost optimisation due to full control over the execution of the budget.

2. Exchange of documents with the top-level budget holder on budget planning and execution:

0: No impact on management decisions and efficiency of budget expenditures.

1: Savings of up to 1%, slight acceleration of information exchange that affects decision-making.

2: Savings in the range of 1-3%, improved timeliness of management decisions through the exchange of information on planning and execution.

3: Savings in the range of 3-5%, data exchange allows for better adjustment of management decisions during planning and execution of the budget.

4: Savings in the range of 5-7%, significant increase in efficiency during budget planning and execution due to timely exchange of documents and data.

5: Savings of more than 7%, significant impact on decision-making and cost efficiency due to continuous information exchange with higher levels.

3. Formation of objective proposals for the use of limited financial resources between certain areas to maximise the needs of the military unit/institution/organisation:

0: No impact on management decisions and efficiency of planning and evaluation of budget expenditures.

1: Savings of up to 1%, possibility to take into account basic priorities when formulating proposals.

2: Savings in the range of 1-3%, improvement of the quality of decisions due to partial consideration of objective needs.

3: Savings in the range of 3-5%, significantly improved allocation of limited resources between priority areas.

4: Savings in the range of 5-7%, decision-making becomes more efficient, which ensures more effective use of budget funds.

5: Savings of more than 7%, optimisation ensures the most reasonable use of budget funds with a focus on priority needs.

4. Reporting on budget execution:

0: No impact on management decisions and the effectiveness of planning and evaluation of budget expenditures.

1: Savings of up to 1%, partially influences the quality of management decisions.

2: Savings in the range of 1-3%, allows to evaluate the budget execution at the basic level.

3: Savings in the range of 3-5%, reports contribute to more rational management of budget funds.

4: Savings within 5-7%, optimisation of this area allows you to make informed decisions on correcting the state of planning and budget execution.

5: Savings of more than 7%, promotes high accuracy of decisions and efficient use of funds.

5. Formation and exchange of documents and data within the military unit on planning and execution of the budget:

0: No impact on management decisions and the effectiveness of planning and evaluation of budget expenditures.

1: Savings of up to 1%, minimal increase in the efficiency of budget use.

2: Savings in the range of 1-3%, improved coordination between departments through data exchange and, as a result, a slight increase in the efficiency of budget use.

3: Savings in the range of 3-5%, ensuring more effective interaction between structural units and, as a result, a relative increase in the efficiency of planning and use of budget funds.

4: Savings in the range of 5-7%, facilitates more objective management decisions on planning and use of budget funds.

5: Savings of more than 7%, ensures optimal use of resources and time, and as a result, a significant increase in the efficiency of planning and use of budget funds.

6. Evaluation of proposals of suppliers of goods, works and services according to certain criteria:

0: No impact on procurement efficiency.

1: Savings of up to 1%, minimal increase in the efficiency of budget funds use due to the reasonableness of the choice of suppliers.

2: Savings in the range of 1-3%, partial increase in the efficiency of budget funds use.

3: Savings in the range of 3-5%, increased objectivity in the selection of suppliers, which contributes to more efficient use of budget funds.

4: Savings in the range of 5-7%, allows for a significant reduction in budget expenditures and contributes to a more efficient use of budget funds.

5: Savings of more than 7%, the introduction of an effective, multi-criteria evaluation system has a decisive impact on ensuring the optimal use of budgetary resources.

7. Evaluation of the efficiency of budget funds use by areas:

0: Optimisation has no significant impact on the management of budgetary resources.

1: Savings of up to 1%, partial reduction of delays in communication with the State Treasury Service.

2: Savings in the range of 1-3%, minimal improvement in the efficiency of planning and execution of the budget due to optimisation of the receipt and transfer of documents for planning and execution of expenditures.

3: Savings in the range of 3-5%, contributes to the efficiency of budget planning and execution.

4: Savings in the range of 5-7%, interaction with the State Treasury Service is significantly improved, providing a more objective approach to budget management.

5: Savings of more than 7%, significantly improves the efficiency of budget management and saves working time in the context of this process.

8. Determination of expenditures belonging to the programme/economic classification of expenditures:

0: Optimisation of this area does not have a significant impact on budget management and expenditure efficiency.

1: Savings of up to 1%, optimisation of this area has a minimal impact on budget management and expenditure efficiency.

2: Savings in the range of 1-3%, minimal improvement in the efficiency of budget planning and execution.

3: Savings in the range of 3-5%, reduction of the risk of misuse of funds through accurate costing, and relative improvement in the efficiency of budget management and saving of working time in the context of this process.

4: Savings in the range of 5-7%, reduction of the risk of misuse of funds through accurate determination of expenditures provides a significant increase in the efficiency of budget management and saving of working time in the context of this process.

5: Savings of more than 7%, optimisation of the classification process is one of the decisive factors for ensuring the effectiveness of budget management.

9. The base of regulatory and legal documents in the system of financial support of the Armed Forces of Ukraine is updated on a regular basis:

0: No impact on the effectiveness of financial support or management decision-making.

1: Savings of up to 1%, minimal improvement in the efficiency of planning and budget execution.

2: Savings in the range of 1-3%, the updated regulatory framework ensures a relative increase in the efficiency of budget management and saves working time in the context of this process.

3: Savings in the range of 3-5%, facilitates more objective management decisions.

4: Savings in the range of 5-7%, provides a significant increase in the efficiency of budget management and savings in working time in the context of this process.

5: Savings in excess of 7%, critical to increasing the efficiency of budget management.

A generalised score from 0 to 5 can be summarised as follows:

1. From 0 to 1%. No significant impact on the overall condition of the FGD.

2. From 1 to 5%. May have a slight positive impact on the overall condition of the FGD.

3. From 5 to 10%. Relatively average for FGDs.

4. 10 to 15%. Significantly affects risk mitigation and improves the efficiency of financial support.

5. From 15% and more. Optimisation of this process is a priority, as it has a direct impact on the effectiveness of the CDF.

Stage 3. Based on the results of the survey, the following database of expert opinions was formed (Table 1).

Based on the experts' assessment of 9 topical areas of optimisation of the financial support system of the Armed Forces of Ukraine, the importance and prospects of each area for minimising risks and improving the efficiency of budget management were analysed. The total number of points assigned to each criterion based on expert judgement was obtained by adding up the scores of all experts.

Top priority areas and further evaluation criteria:

'Allocation of limited financial resources between areas to maximise the needs of the military unit' (K9) and "Assessment of the effectiveness of budgetary funds by area" (K8) received the highest scores of 245 and 244 respectively, which demonstrates the importance of these areas.

Updating the regulatory framework (K7) received the next highest score of 233 points. The constant maintenance of an up-to-date legal and regulatory framework is one of the key tools for improving the efficiency of budget management.

Table 1

Database of expert opinions

#	Title	Total score of experts of group 1	Total score of experts of group 2	Total score
K1	Monitoring and accounting of the budget execution status	58	128	186
K2	Exchange of documents with a higher-level budget holder on budget planning and execution	56	119	175
K3	Generating reports on budget execution	44	118	162
K4	Formation and exchange of documents and data within the military unit on planning and execution of the budget	65	133	198
K5	Determination of expenditures belonging to the programme/economic classification of expenditures	34	104	138

K6	Evaluation of proposals of suppliers of goods, works and services according to certain criteria	81	148	229
K7	Regularly updated base of regulatory and legal documents in the field of financial support of troops	68	165	233
K8	Formation of objective proposals for the use of limited financial resources between areas to maximise the needs of the military unit]	83	162	245
K9	Evaluation of the effectiveness of the use of budgetary funds by areas	80	164	244

Source: calculated and compiled by the authors

This score indicates that experts recognise the importance of analysing the effectiveness of expenditures and the significant potential for optimising these processes in the context of improving the efficiency of budgetary funds.

It is worth mentioning several open responses with the following suggestion: 'Ensuring an automatic process of opening budget allocations for the next month, based on the indicators of the allocation plan and current budget execution indicators'. This proposal deserves a detailed analysis in further research.

Step 4. Assessing the consistency of comparisons using the concordance coefficient (Table 2).

Table 2.

Results of the analysis of the consistency of expert assessments of the criteria

Titple	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	**K9**
Sum of marks	186	175	162	198	138	229	233	245	244
Average amount	201,11								
Quartile deviation	228,35	681,79	1529,68	9,68	3983,01	777,79	1016,90	1926,23	1839,46
Concordance coefficient	0,0661								
Weighting coefficient of criteria	0,103	0,097	0,090	0,109	0,076	0,127	0,129	0,135	0,135
Pyroson's criterion	29,07								
x2 table	20,1								

Source: calculated and compiled by the authors

The sum of scores for each criterion based on expert judgements was obtained by adding up the scores of all experts.

The average score was calculated for all criteria as the arithmetic mean of the sum of the scores. This value is the baseline for the analysis of deviations and allows for comparison of criteria in terms of their consistency. The average value is 201.11.

Squares of deviations were calculated for each criterion to assess how much the sum of scores for a particular criterion deviates from the average. Criterion K5 has the largest deviation (3983.01), which indicates a significant gap between this criterion and the average value.

The concordance coefficient is an indicator of the level of consistency of assessments between experts. In this case, the value of the concordance coefficient is 0.0661, which indicates moderate consistency, the opinions of the experts partially coincide, but there is a certain level of disagreement.

- The value of the Concordance Coefficient varies from 0 to 1:
- W=0 - complete lack of agreement between experts.
- W=1 complete agreement between experts.
- The value of 0.0661 indicates a moderate consistency of assessments, which prompts further calculation by Pearson's criterion and comparison with the table value □2, for degrees of freedom n-1. Since 9 criteria were proposed for the formation of expert opinion, to determine the tabular value of □2, we take into account the number of degrees of freedom 8=9-1, as well as the significance level □=0.01, which is 20.1.

The concordance coefficient, combined with the high values of the Pearson's criterion (exceeding the table value), confirms the reliability of the results.

The calculated χ^2 is 29.07. 29.07>20.1, so we can consider the consistency of experts' assessments statistically significant.

The next step is to calculate the weight of each criterion using formulas 2 and 3. In this case, the total sum of the weighting coefficients of all criteria is equal to 1. Thus, based on the results of the calculations, the weighting coefficients were formed as follows (Table 3).

Table 3

Weighting of criteria based on the results of expert assessment

Criterion	K1	K2	K3	K4	K5	K6	K7	K8	K9
Weighting of criteria	0,103	0,097	0,090	0,109	0,076	0,127	0,129	0,135	0,135

Source: calculated and compiled by the authors

Thus, a selection of criteria was formed to assess the design solution in the system of financial support of the Armed Forces of Ukraine.

Stage 5. 5.1. Given the high pace of technology development and the need to respond quickly to changes in the operational environment, specialised software, including mobile applications, provide a convenient tool for accessing information and communication. In addition, mobile applications can help automate routine processes, which reduces staff workload and increases data accuracy. To illustrate the proposed methodological approach to assessing a project solution in the financial support system of the Armed Forces of Ukraine, in the area of planning and cost estimation, the degree of economic efficiency of 3 conditional variants of a project solution with a certain functionality was assessed:

V1 (software (mobile application), which consists of the following content blocks: a mobile reference book of regulatory legal acts of the financial support system of the Armed Forces of Ukraine; formation of objective proposals for the use of limited financial resources between areas to maximise the needs of the military unit; implementation of linear programming methods for financial planning and cost-effectiveness assessment).

V2 (software consisting of the following content blocks: monitoring and accounting of the status of budget execution; exchange of documents with the higher-level budget holder on planning and execution of the budget; reporting on budget execution).

V3 (software (mobile application), which consists of the following content blocks: formation and exchange of documents and data within the military unit on planning and execution of the budget; determination of the expenditures belonging to the programme/economic classification of expenditures; implementation of multi-criteria evaluation of proposals of suppliers of goods, works and services for public and defence procurement).

The evaluation of alternatives was based on the list of areas (criteria) already formed for evaluation by experts using the TOPSIS methodology. The number of experts is 55, the number of criteria is 9.

Table 4

Evaluation of the project solution to optimise key risk factors in the financial support system of the Armed Forces of Ukraine: expert analysis of the mobile application

Criterion	K1	K2	K3	K4	K5	K6	K7	K8	K9
V1	1	1	1	1	1	1	4,34	4,59	4,58
V2	3,18	3,11	2,85	1	1	1	1	1	1
V3	1	1	1	3,64	2,96	4,43	1	1	1
Weight	**0,103**	**0,097**	**0,09**	**0,109**	**0,076**	**0,127**	**0,129**	**0,135**	**0,135**

Source: developed and compiled by the authors

5.2 -5.3. Normalisation of the decision matrix. Normalisation is a necessary step to eliminate differences in the scale of scores for the criteria presented in the decision matrix. The result of normalisation is a matrix where the values of the criteria range from 0 to 1, which simplifies further calculations. After normalisation, weighting is performed to take into account the relative importance of each criterion in the evaluation process. The resulting matrix is the basis for further analysis. The following results were obtained from the calculations (Table 5).

Table 5

Results of normalising the decision matrix and weighting the criteria

Criterion	K1	K2	K3	K4	K5	K6	K7	K8	K9
V1	0,030	0,028	0,028	0,028	0,023	0,027	0,122	0,129	0,129
V2	0,094	0,088	0,080	0,028	0,023	0,027	0,028	0,028	0,028
V3	0,030	0,028	0,028	0,102	0,069	0,121	0,028	0,028	0,028
max	0,094	0,088	0,080	0,102	0,069	0,121	0,122	0,129	0,129
min	0,000	0,000	0,000	0,000	0,000	0,000	0,028	0,000	0,000

Source: developed and compiled by the authors

The normalisation of the decision matrix and weighting of the criteria resulted in values ranging from 0 to 1. This indicates that differences in the scale of the criteria scores have been eliminated and the data has been unified for further analysis.

The normalised matrix allows comparing criteria expressed in different units, ensuring their comparability. For example, the K8 criterion received one of the highest normalised weights, indicating its importance in the evaluation system.

The max and min values demonstrate the threshold values for each criterion, which is the basis for determining the ideal and anti-ideal solutions in the following stages of the analysis.

5.4-5.6. Determination of the ideal and anti-ideal solutions. At this stage, the benchmarks for evaluating alternatives are formed - the ideal and anti-ideal solutions. The ideal solution is a set of the best possible values of the criteria that maximises benefits and minimises costs. The anti-ideal solution, on the other hand, represents the worst possible performance across all criteria. These benchmarks serve as the basis for further calculating the distances of each alternative to the ideal and anti-ideal solutions, which allows us to assess their compliance. The following results were obtained from the calculations. Calculation of the distance to the ideal and anti-ideal solutions and calculation

of the relative proximity of alternatives to the ideal solution. The distances are calculated separately for the ideal and anti-ideal solutions, which allows for a comprehensive characterisation of each option. The following results were obtained from the calculations (Table 6).

Table 6.

Evaluation of the proximity of alternatives to the ideal solution using the TOPSIS method

Alternatives	S+	S-	Ci
V1	0,163	0,216	0,570
V2	0,213	0,163	0,433
V3	0,199	0,184	0,480

Source: developed and compiled by the authors

The degree of closeness of each alternative to the ideal solution (Ci) is determined on the basis of TOPSIS calculations. Results:

1. Alternative V1 has the highest proximity index (Ci=0.570), which indicates its greatest correspondence to the ideal solution. This allows us to consider it the highest priority for implementation.
2. Alternative V3 has an average value (Ci=0.480), which indicates its moderate correspondence to the ideal solution. It can be considered as a backup alternative.
3. Alternative V2 has the lowest proximity score (Ci=0.433), which indicates its lower priority compared to the others.

Thus, the TOPSIS method allowed for an objective assessment of the alternatives and the development of recommendations for decision-making. The best alternative for implementation is V1, which has the highest correspondence to the ideal solution.

The ranking of the alternatives is based on the calculation of the proximity of each option to the ideal solution. This allows the alternatives to be ordered according to their compliance with the evaluation criteria, with the best alternative receiving the highest rating. The following results were obtained from the calculations (Figure 2).

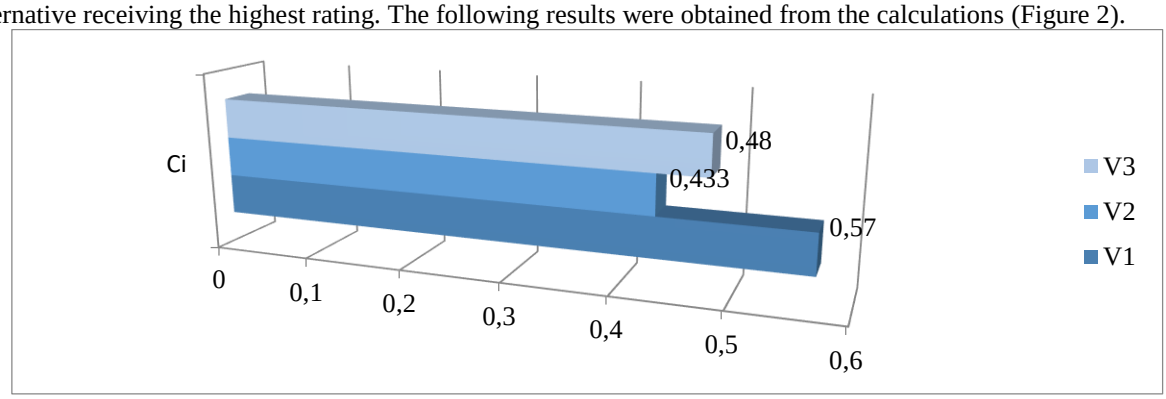

Fig. 2. Visualisation of the ranking of alternatives based on TOPSIS calculations

Source: developed and compiled by the authors

5.7. Calculating the potential for economic efficiency of the solution. The last step is to determine the share of economic efficiency of each selected direction in the proposed solution, which was chosen as the closest to the ideal solution. This stage allows to quantify the impact of optimisation on the overall financial support system. The results obtained are the basis for making informed management decisions on the implementation of optimisation measures. The main purpose of this stage is to quantify the potential cost savings that can be achieved as a result of implementing a specific optimisation solution.

Since the data on the institution's budget was collected in the form of a segment from to. The minimum estimate is calculated as the lower bound of the first range, taking into account the weight of all intervals. To do this, the weights of the lower limits of each interval are summed up with their percentage values, the Maximum estimate is calculated similarly, but the upper limits of each interval are taken into account:

Based on the calculations, the following results were obtained using formulas 9-11:

B average minimum = 32.252 million UAH. Budget average maximum = UAH 83.622 million

The results of the calculation of the potential economic efficiency range from UAH 3.87 million to UAH 12.533 million, the initial indicators are based on expert estimates and are from 12% to 15% of the budget allocated for the procurement of goods, works and services.

Based on the calculations, the potential economic effect of implementing the optimisation solution in the financial system of the Armed Forces of Ukraine was assessed. According to the results, the average budget for these assessment conditions is UAH 32.252 million (minimum) and UAH 83.622 million (maximum). At the same time, the potential savings calculated on the basis of expert judgements vary from UAH 3.87 million to UAH 12.533 million, which corresponds to 12-15% of the budget for procurement of goods, works and services.

The obtained results demonstrate a significant potential for improving the efficiency of budget funds use by implementing the optimisation solutions presented in alternative V1. Alternative V1, which was determined to be the best using the TOPSIS method, indicates the possibility of significant savings if modern software is introduced to automate key financial processes.

It should be noted, however, that the calculations presented are only approximate expectations based on preliminary analytical estimates and expert judgements. Their accuracy depends to a large extent on the full development and implementation of the software that will take into account all parameters of financial support, including the specifics of the work of budget holders at various levels.

Thus, these results should be viewed as predictive, which highlights the need for further refinement of the assessment models. The development and implementation of the V1 software is an important step in confirming these results in real life, which will not only optimise costs but also ensure greater transparency and control over the use of budget funds in the system of the Ministry of Defence of Ukraine.

CONCLUSIONS

The results of the paper show that the majority of representatives of budget holders in the system of the Ministry of Defence of Ukraine assess the possible implementation positively, emphasising the importance of the legislative framework and regulations that would regulate the responsibilities of the heads of certain units and services regarding the use of such applications.

Based on the reasearch, it can be concluded that the implementation of the above-mentioned measures to optimise key risk factors in the financial support system of the Armed Forces of Ukraine is a promising and relevant solution. According to the survey results, the vast majority of experts positively assessed the possibility of integrating the software in the form of a mobile application, which underlines its potential as an effective tool for automating processes and reducing the workload on staff.

The key aspects of the software functionality that received support among the experts are

a mobile reference book of regulatory and legal acts for the financial support system of the Armed Forces of Ukraine;

Implementation of multi-criteria optimisation methods for financial planning and cost-effectiveness assessment, as well as evaluation and ranking of suppliers' proposals in public and defence procurement.

The obtained indicators indicate a significant potential for optimising financial resource management processes.

Thus, the results of the paper confirm the importance of implementing the proposed optimisation measures, which will help to improve the efficiency of the financial support system in the context of budget programmes.

In general, the implementation of the software, according to the respondents, is a significant step towards the modernisation of the financial support system of the Armed Forces of Ukraine. This solution will increase the level of adaptability to modern challenges, reduce the risk of loss of financial resources, and ensure transparency and efficiency in financial transactions.

In our paper, the basis for calculations is the TOPSIS method, which takes into account the relative importance of the criteria determined by experts and assesses the degree to which alternatives meet the optimal conditions. According to Ayeley P. Tchangani, any real decision analysis problem is characterised by at least one of the following features: multiple attributes or criteria, alternatives to be ranked, multiple objectives, multiple participants (stakeholders), to increase the accuracy and validity of the results, in further research it is advisable to calculate the share of economic efficiency using the BOCR (Benefits, Opportunities, Costs, and Risks) methodology [20]. This methodology allows to comprehensively take into account not only the benefits and costs, but also the opportunities and risks associated with the implementation of each of the directions. Such an approach will allow for a deeper assessment of the economic impact of the selected solutions, as well as balancing financial efficiency with potential challenges and risks, which will increase the overall reliability and credibility of the results.

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