# Internal Control of Financial and Economic Activities in the Military Unit

# Внутрішній контроль фінансово-господарської діяльності у військовій частині

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**Purpose.** To substantiate effective mechanisms for organizing internal control of financial and economic activities in military units through the integration of modern digital technologies and machine learning methods.

**Method:** The study employs a systems approach, comparative analysis, and generalization, complemented by elements of mathematical modeling. To enhance the robustness of managerial decision-making, decision tree analysis and the Random Forest machine learning algorithm are applied for risk assessment and forecasting of financial outcomes.

**Findings.** The study reveals that the existing internal control system in military units is characterized by formalism, insufficient automation, and limited use of a risk-based approach. A comprehensive internal control model is proposed, combining traditional procedures with digital data analysis tools. The results demonstrate that the application of the Random Forest algorithm significantly improves the accuracy of financial risk detection and enhances the effectiveness of management decisions.

**Theoretical implications.** The study contributes to the development of scientific approaches to internal control by integrating risk management concepts with machine learning techniques in the military domain.

**Practical implications.** The proposed approaches can be implemented in the activities of financial and economic services of military units to improve transparency, financial discipline, and the efficiency of budget resource utilization.

**Paper type.** Applied research.

**Мета дослідження.** Обґрунтування ефективних механізмів організації внутрішнього контролю фінансово-господарської діяльності у військових частинах на основі інтеграції сучасних цифрових технологій та методів машинного навчання.

**Метод дослідження.** Застосовано системний підхід, порівняльний аналіз, узагальнення та елементи математичного моделювання. Для підвищення обґрунтованості управлінських рішень використано метод дерева рішень і алгоритм Random Forest для оцінювання ризиків і прогнозування результатів фінансових операцій.

**Результати дослідження.** Встановлено, що існуюча система внутрішнього контролю у військових частинах характеризується формалізованістю, недостатньою автоматизацією та обмеженим застосуванням ризик-орієнтованого підходу. Запропоновано комплексну модель внутрішнього контролю, яка поєднує традиційні процедури з цифровими інструментами аналізу даних. Доведено, що використання Random Forest підвищує точність виявлення фінансових ризиків і ефективність прийняття управлінських рішень.

**Теоретична цінність дослідження.** Полягає у розвитку наукових підходів до внутрішнього контролю через інтеграцію концепцій ризик-менеджменту та машинного навчання у військовому секторі.

**Практична цінність дослідження.** апропоновані підходи можуть бути використані у діяльності фінансово-економічних служб військових частин для підвищення прозорості, фінансової дисципліни та ефективності використання бюджетних ресурсів.

**Тип статті.** Науково-прикладна.

***Key words:*** Internal Control; Financial Discipline; Budget Resources; Military Unit; Management; Comprehensive Approach; Transparency; Financial Security.

***Ключові слова:*** внутрішній контроль; фінансова дисципліна; бюджетні ресурси; військова частина; управління; комплексний підхід; прозорість; фінансова безпека.

## *Introduction*

In the context of martial law and rising government defense spending, improving the effectiveness of internal control over the financial and economic activities of military units has become particularly important. Existing problems—including the formalistic nature of control procedures, insufficient automation, and the lack of a risk-based approach—undermine financial discipline and the efficient use of budgetary resources.

An analysis of current scientific research indicates that internal control is viewed as a key instrument for ensuring transparency and managing risks. Foreign authors emphasize the role of ethical leadership, digitalization, and ESG factors in improving the quality of control (Zahari et al., 2023; Harasheh & Provasi, 2022; Boulhaga et al., 2022), as well as on the impact of digital transformation (Chen et al., 2023). Domestic research focuses on adapting international approaches to the conditions of Ukraine’s defense sector (Назаренко, 2023).

Nevertheless, the issue of integrating machine learning methods into the internal financial control system remains under-researched.

The purpose of this article is to justify effective mechanisms for organizing internal control of the financial and economic activities of military units using modern digital technologies.

The scientific novelty lies in the creation of a comprehensive model of internal control that integrates machine learning methods and adapts the Random Forest algorithm to the conditions of military units’ operations.

## *Literature review*

Under martial law and with the growth of budget expenditures on defense, the system of internal control over the financial and economic activities of military units remains less than fully effective. The main problems are the formal nature of control procedures, the lack of a clearly defined risk-oriented approach, weak automation of processes, and limited justification of management decisions, which increases the risks of misuse or inefficient use of budget funds and reduces the level of financial discipline.

The relevance of this issue is confirmed by the results of an analysis of scientific works by domestic and foreign authors, in which internal control of financial and economic activities is considered a key tool for ensuring financial discipline, transparency, and risk management (Zahari et al., 2023; Harasheh & Provasi, 2022). At the same time, foreign studies focus on the role of ethical leadership, digitalization, and a risk-oriented approach in the control system (Chen et al., 2023; Wang et al., 2024), while Ukrainian scientists focus on the peculiarities of internal control and audit in the defense sector, taking into account the current legislation.

Based on the scientific sources and regulatory acts studied, the article analyzes modern approaches to the organization of internal control in military units, which formed the theoretical and methodological basis of the study and made it possible to substantiate the relevant conclusions.

## *Materials and Methods*

An analysis was conducted during the course of the study in order to examine the regulatory and legal documentation that governs internal control within the Armed Forces of Ukraine. A comparative method was employed to review the experience of foreign countries and determine the possibility of adapting it to Ukrainian conditions (Ong et al., 2024; Koeswayo et al., 2024). A generalisation method was employed to systematise the information obtained and identify the main areas for improving control (Zhang & Su, 2023). Furthermore, graphical modelling was employed to construct a decision tree, illustrating the sequence of actions to be undertaken by the financial and economic service in the event of risks.

In the context of the study, one of the objectives is to enhance the system of internal control of financial operations in a military unit by employing contemporary decision-making algorithms. In the initial phase of the empirical work, it is recommended to devise a decision tree that facilitates the formalisation of pivotal options for management actions under diverse scenarios of combat operations. Concurrently, the second empirical element involves integrating the first with the Random Forest machine learning method (Wang et al., 2024; Moffitt et al., n.d.), thereby enhancing the stability, accuracy, and generalizability of the model, and ensuring its capacity to adapt to the specific requirements of the military unit.

In order to create a hierarchical decision tree model (where tree nodes correspond to critical control points in financial processes), it is necessary to allocate budget appropriations, assess risks (based on preliminary probability calculations), and identify deviations. For each event, the consequences of the decisions made are determined, as are the alternatives. In order to structure and calculate alternatives, simulated data from the military unit is used. This includes the size of the general fund under program classification code of expenditures (hereinafter–PCCE) 2101150 ECCE (hereinafter–economic classification code of expenditures) 2260, as well as the modelling of operational performance indicators.

Conversely, the utilisation of Random Forest facilitates the analysis of numerous decision trees based on disparate characteristics and data, thereby preventing model overfitting and enhancing the reliability of predictive reporting. In the context of financial internal control, Random Forest employs a probabilistic approach to simulate various scenarios for the distribution of budget allocations. It then undertakes a thorough examination of alternatives and identifies hidden patterns both within each decision tree and at the aggregate level. This facilitates a more comprehensive evaluation of risks and anomalies in budget operations related to planning, requesting, receiving, and spending appropriations.

The modelling stages are as follows:

1. The present study will entail the collation of data pertaining to budgetary allocations designated for military unit A4398.

2. The development of an integrated decision tree is presented herein, with said tree being based on the processes of reallocating appropriations in the military unit, in addition to typical scenarios of risky operations.

3. The creation, training, and testing of a Random Forest is based on input variables selected in the decision tree structure. It is imperative that significant features are given full consideration in the following domains: budget programmes (subprogrammes), funding volumes, operational frequency, the function of the internal control manager, chief accountant, head of the initiative service, and authorised procurement officer.

4. The evaluation of the model is conducted on both real and synthetic cases. This is achieved by analysing the accuracy of detecting violations, as well as forecasting risks and providing recommendations for the optimisation of financial planning processes. It is imperative to take into account risks in terms of internal financial control.

5. The validation of results and the comparison thereof with traditional decision-making methods is the subject of this study.

## *Results*

The internal control of financial and economic activities within military units constitutes a pivotal component of the budget resource management system. This system is designed to ensure the legality, appropriate utilisation, and effective distribution of financial flows within the defence sector of the country . In accordance with Ukrainian legislation, specifically Orders No. 475 of the Ministry of Defence of Ukraine dated 15 December 2021 and No. 145 of the Ministry of Defence of Ukraine dated 2 April 2019, the primary objective of internal control is to attain the institution's objectives by establishing a mechanism to prevent financial risks and ensure the transparency and accountability of the financial and economic activities of military units.

The study concluded that the current internal control system requires substantial enhancement in terms of a risk-based approach, automation of control mechanisms, and planning of methodological approaches. A thorough examination of the practical aspects revealed that the issue of budget funds utilisation is primarily attributable to two key factors. Firstly, there is a conspicuous absence of effective interaction between the financial service departments. Secondly, there is a paucity of clearly defined decision-making systems.

Following the identification of the relevant patterns, a risk management plan was formulated, with the primary objectives of the plan as follows:

The necessity of ensuring the sustainability of financial discipline is paramount.

The objective is to minimise the probability of financial violations and the improper use of funds.

The development of a unified algorithm for the actions of the financial service department when identifying risks is imperative.

It is imperative to enhance the transparency of financial and economic operations.

It is imperative to implement measures that guarantee the efficacy of preventative controls.

A table was created for the risk management stages:

**Table 1:** Risk management stages

| Stage | Contents of the stage | Responsible persons/structures | Expected result |
|---|---|---|---|
| **Risk identification** | Identify all potential threats to the financial activities of the unit | Financial and economic service, commander, accountant, persons responsible for material assets | Established list of risks by area of activity |
| **Risk classification** | Risk distribution by type | Internal Control Department/ Responsible for internal control | Priority risk categories identified |
| **Risk assessment** | Determining the probability of risk occurrence and the extent of its impact on financial stability | Commission, Financial and Economic Service | Risk card |
| **Development of response measures** | Formulation of specific actions to prevent or minimize risks | Unit command, head of financial and economic service | Action plan for risk minimization |
| **Monitoring and control** | Regular monitoring of risk situations, verification of measures implementation, updating of data in the risk register | Financial and economic service, auditors, commander | Current risk status, control report |
| **Reporting and analysis of results** | Preparation of monthly or quarterly reports on control effectiveness, incident recording, development analysis | Financial and economic service, accounting department | Reporting for the purpose of improving the control system |
| **System adjustment** | Improvement of control methods, updating of the risk management plan | Command, Internal Control Manager of a Military Unit | Flexibility and stability of the control system |

***Source:*** Created by the authors.

In light of the identified issues and the necessity to enhance the efficacy of internal control over financial and economic operations, it is imperative to establish a comprehensive system of management decisions. This system should facilitate a prompt response to potential risks and optimise the control procedures of the financial and economic service. In order to achieve this objective, it is imperative to not only identify the primary domains of financial risk, but also to ensure a logical sequence of actions by all designated individuals involved in the process of overcoming them.

In order to model this process and illustrate the relationship between the stages of risk management, a decision tree was developed that reflects the algorithm of actions of the financial and economic service and the unit command in the event of threats or violations in the use of budget funds.

The process of decision-making within a military unit has been shown to frequently entail a certain degree of risk. The issue of management decision-making in conditions (states) of risk is becoming increasingly relevant. In light of these considerations, military units are devising risk monitoring and management strategies with the objective of mitigating the adverse impact of high-risk operations on their performance indicators to the greatest extent possible.

It is recommended that the decision tree (henceforth referred to as DT) be given due consideration. DT facilitates the reflection of the decision-making process. This problem is constituted by a series of management decisions made from the first stage, the initiated process, to the final stage, which encompasses all potential consequences.

The DT comprises patterns, which in turn are expressed in (1) decisions (alternatives) and (2) events (States of Natures) that may occur and affect the military unit. The following case study will model a situation in which the commander of a military unit must make a management decision on the purchase of unmanned aerial vehicles to perform the combat tasks assigned to the military unit.

In accordance with the approved and communicated to the military unit limit of expenditures under PCCE 2101150 ECCE 2260 for the next year, funding in the amount of UAH 100,000,000.00 is provided for the purchase of UAVs. Preliminary price monitoring has identified four organisations that manufacture and supply UAVs that meet the tactical and technical characteristics required for combat missions. The following assumption is made: UAV_1, UAV_2, UAV_3, UAV_4...UAV_n. Therefore, at the initial stage, the commander of the military unit has the opportunity to select one of four alternatives for the purpose of making a purchase decision.

Concurrently, the commander of the military unit is apprised of potential occurrences that may transpire during the utilisation of UAVs in combat conditions. Consequently, three potential outcomes must be considered:

1. The situation on the battlefield will remain unchanged (henceforth referred to as Event_1).

2. The signing of the peace agreement is expected to result in a gradual easing of tensions (hereinafter referred to as Event_2).

3. It is anticipated that there will be an accumulation of military capabilities on both sides, which will in turn necessitate a series of additional offensive and defensive operations (hereinafter referred to as Event_3).

Therefore, in consideration of the four potential decisions regarding the procurement of UAVs, in conjunction with the outcomes of forecasting the probability of events, it is recommended to formulate a decision-making matrix for the commander of the military unit, which constitutes a component of the internal control system within the military unit. The matrix is presented in Table 2.

**Table 2:** Decision making matrix

| x | State of Nature_1 | State of Nature_2 | State of Nature_3 |
|---|---|---|---|
| $P(\theta_j)$ | **0,35** | **0,40** | **0,25** |
| **UAV _1** | 38616 | 22593 | 27171 |
| **UAV _2** | 207268 | 121267 | 145839 |
| **UAV _3** | 175458 | 102656 | 123457 |
| **UAV _4** | 304083 | 177911 | 213960 |
| **…** | … | … | … |
| **UAV _10** | v | v | v |

***Source:*** Created by the authors.

*Note: the cost of UAVs is calculated in UAH.*

As demonstrated in the above table, it is important to emphasise the formula for calculating probability:

$$P(\theta_j) = \frac{number\ of\ events\ j}{number\ of\ all\ events} \quad [1]$$

In the probability table, the probabilities are given as $P(\theta_1) = 0{,}35$, $P(\theta_2) = 0{,}40$, $P(\theta_3) = 0{,}25$, and the values correspond to the simulated probabilities of each alternative event. At the same time, they can be represented as a generalized formula for each event:

$$\sum_{j=1}^{n} P(\theta_j) = 1 \qquad [2]$$

It is also noticeable that the purchase of UAVs leads to the receipt or loss of budget allocations. Such losses are nominal, and the following input data are taken into account when calculating them: (1) the initial cost of the procurement item; (2) the depreciation accrued during the first year of use; (3) the indicator of the procurement item's compliance with the tasks set for the military unit; (4) the innovation index of the purchased item; (5) the useful life of the purchased item.

Thus, the formula for calculating the expected value of the purchased item during the first year of its use is as follows:

$$EPV_i = (C_{in} - A_{1y}) \times I_{comp} \times I_{inn} \times I_{UL} \qquad (3)$$

where:
$EPV_i$ – expected preliminary value of the *i*-th procurement item;
$C_{in}$ – initial cost of the procurement item;
$A_{1y}$ – depreciation accrued during the first year of use;
$I_{comp}$ – compliance index with the tasks of the military unit;
$I_{inn}$ – innovation index of the procurement item;
$I_{UL}$ – useful life index.

It is important to note that the expected value of the procurement item may be negative, as illustrated in the table. A negative result may indicate the inefficiency or economic inexpediency of the procurement — for example, the item may lose its value due to wear and tear, low compliance with the task, low innovation, or a short actual service life. In the context of decision-making theory, it is recommended that the expected value of the procurement item be conceptualised as a payoff.

The decision tree presented in Figure 1 is thus derived from the aforementioned data.

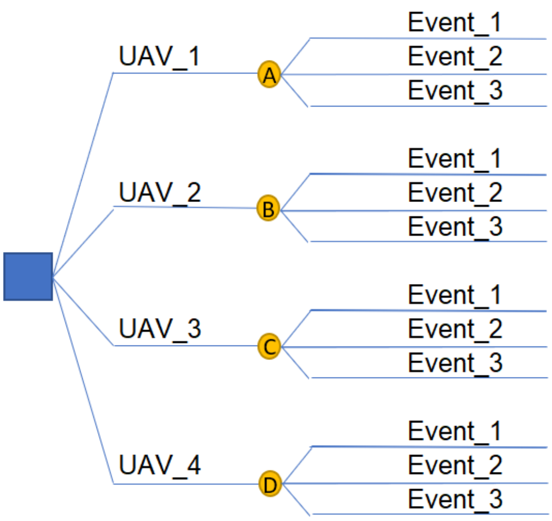


**Figure 1:** Step 1: Building a decision tree
***Source:*** Created by the authors.
*Note: blue square — decision node; yellow circle — event node (natural state)*

A decision tree is developed by arranging decisions and events in chronological order. The subsequent stage of the process is to assign probabilities to events and rewards (see Figure 2).

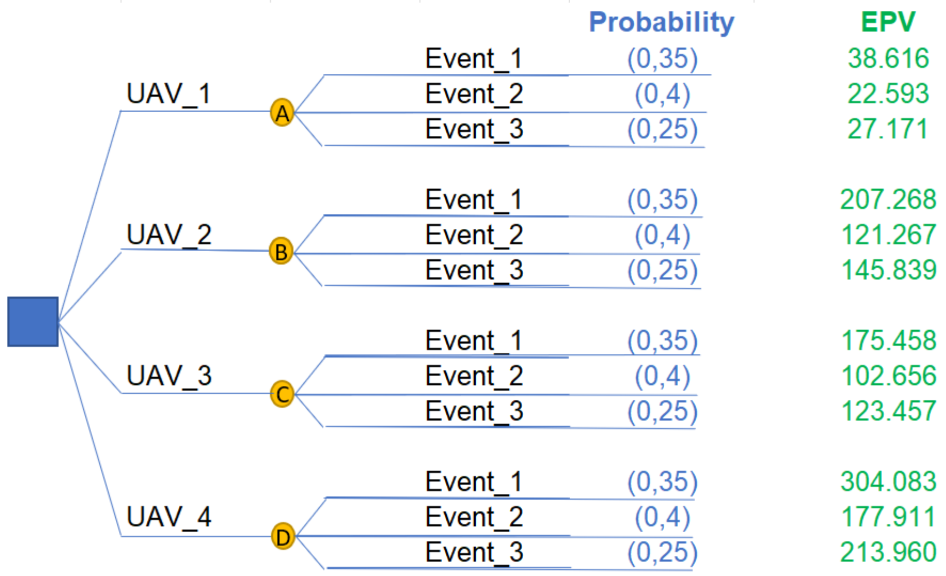


**Figure 2:** Step 2: Assigning probabilities and rewards to events
***Source:*** Created by the authors.

The next step is to continue building the decision tree and calculate the expected values for each decision.

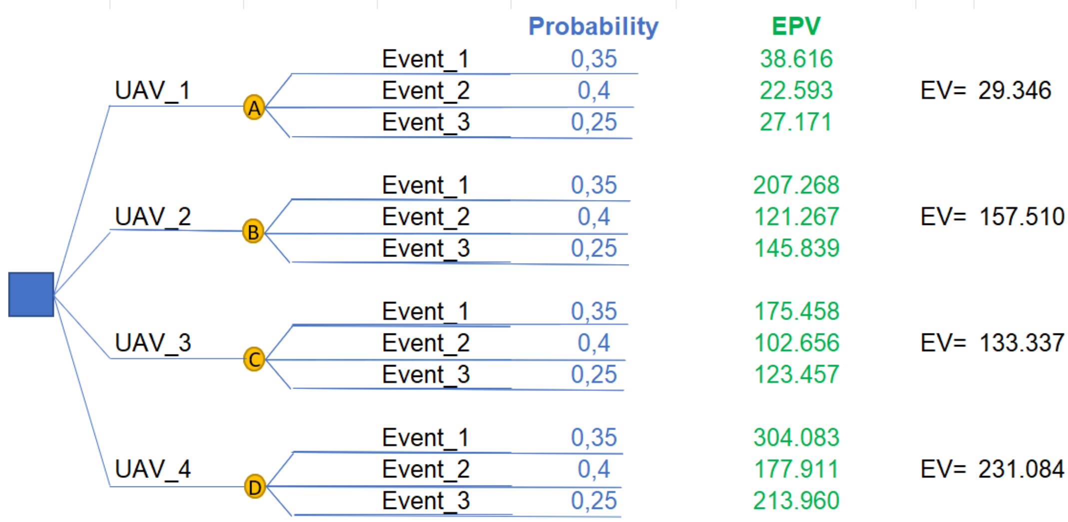


**Figure 3:** Step 3: Calculate expected values for each decision
***Source:*** Created by the authors.

The figure above shows that we calculate the expected value for each decision (hereinafter referred to as EV). The formula for calculating EV in a decision tree is as follows:

$$EV = \sum_{j=1}^{n} P(\theta_j) \times V_j \qquad [4]$$

where: $EV$ – expected value for a specific decision;
$P(\theta_j)$ – probability of occurrence of the j-th event;
$V_j$ – the value of the reward upon the occurrence of this event;
$n$ – number of alternative scenarios (events).

In each instance depicted in the above figure, the EV is calculated as the sum of the products of the probabilities and the corresponding rewards or losses (negative values).

In order to reach a decision that is commensurate with the situation, it is necessary to select the event node that contains the highest expected value. This is the process of purchasing UAV_1.

The subsequent decision-making method involves the implementation of Random Forest, which is essentially a machine learning algorithm that employs multiple decision trees to enhance prediction accuracy. Consequently, each tree analyses different random parts of the data, and their results are combined through classification or averaging for regression. This process renders the algorithm a self-learning technique. This approach has been shown to enhance accuracy and reduce errors.

It is important to note that Python is utilised in the implementation of the Random Forest algorithm. The general scheme of operation is illustrated in Figure 4. Simultaneously, it is acknowledged that the UAV features derived in the formula can also be utilised [2].

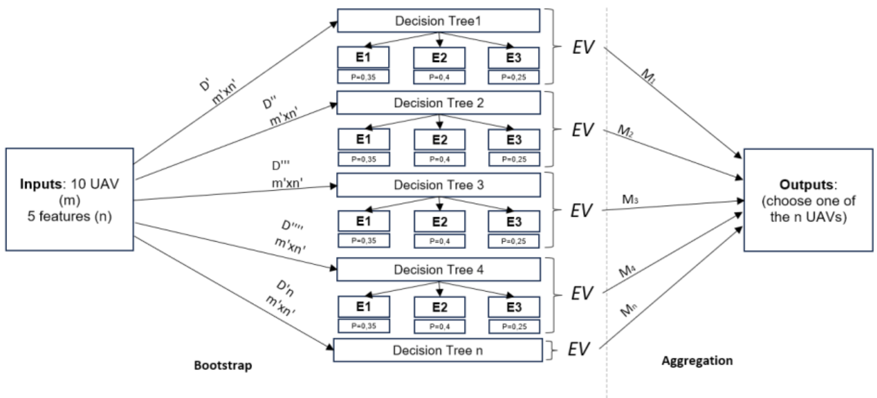


**Figure 4:** Scheme of application of the Random Forest algorithm
***Source:*** Created by the authors.

The efficacy of the aforementioned algorithm is predicated on its ability to circumvent the variability and overfitting that is often observed in individual decision trees, particularly in scenarios where additional features are present. Concurrently, the utilisation of multiple decision trees in Random Forest leads to a reduction in variability, thereby enhancing the accuracy and stability of predictions. Consequently, this approach facilitates improved model generalisation.

A detailed examination of the diagram's constituent elements is warranted.

D (mxn) is the complete input dataset (shown earlier in Table 1), where m is the number of objects (10 UAVs), and n is the number of features (5 features: (1) initial cost, (2) depreciation, (3) compliance, (4) innovation, (5) useful life) for each object;

Decision tree — a separate tree based on a subset of data and/or features; we noted above that in Random Forest there can be several such trees ($DPR_1$, $DPR_2$,..., $DPR_n$);

M — a forecast model from each DTR, which is included in the final aggregated decision;

E — an event;

P — the probability of an event occurring;

EV — expected value;

Bootstrap is a random selection of a subset of the initial data for training each DPM (i.e., in $DPM_1$, $DPM_2$, ..., not all data is taken from the input, but only random samples).

Aggregation is the process of combining (averaging or voting) the results of all DPs for a final decision/forecast: the input data shows the final value — which UAV to choose based on all scenarios and features.

The key steps for selecting a UAV are described as follows: the data goes through Bootstrap sampling, several decision trees, and then their predictions are aggregated for the final selection of one object. To work in Python, we import the numpy, pandas, matplotlib, seaborn, and scikit learn libraries. At the same time, we use:

RandomForestRegressor as a regression model based on the Random Forest model;
LabelEncoder for encoding categorical data into numerical values;
KNNImputer to fill in missing values in the dataset using the k-nearest neighbors approach;
train_test_split as a function to split the dataset into training and test sets;
StandardScaler for standardizing features by removing the mean and scaling to unit variance;
f1_score for evaluating model performance using the F1 score in machine learning;
cross_val_score for performing k-fold cross-validation to evaluate model performance.

So, during the first stage, we need to make sure that the features for each State of Nature are grouped separately, and that each UAV variant has all the necessary attributes. We also note the probabilities.

**Table 3: Probabilities and signs for each State of Nature**

| State of Nature | Probability | Feature 1 | Feature 2 | Feature 3 | Feature 4 | Feature 5 |
|---|---|---|---|---|---|---|
| **features_1SN** | 0.35 | Cin | A1y_1SN | Icomp_1SN | Iinn_1SN | IUL_1SN |
| **features_2SN** | 0.40 | Cin | A1y_2SN | Icomp_2SN | Iinn_2SN | IUL_2SN |
| **features_3SN** | 0.25 | Cin | A1y_3SN | Icomp_3SN | Iinn_3SN | IUL_3SN |

***Source:*** Created by the authors.

The subsequent stage of the process is to form a decision-making matrix using formula [formula 2], which involves multiplying the initial value and features. Subsequent to this, when forming a multidimensional matrix and target variable, we select features and a target for each State of Nature, since it is necessary to train Random Forest on each State of Nature separately.

*X = pd.concat([X_1SN, X_2SN, X_3SN], axis*=1*)*
*Y = df[['DM_1SN','DM_2SN','DM_3SN']]*

Random Forest training involves several key points:

• Define separate target variables “y_1SN”, ‘y_2SN’, “y_3SN” for three scenarios;

• using the corresponding set of features “X_1SN”, ‘X_2SN’, “X_3SN” and corresponding target values for each model;

• saving the predictions of each model “predictions_1”, ‘predictions_2’, “predictions_3” separately, which can then be combined taking into account probabilities.

Thus, we will obtain three trained models and their predictions for each of the three States of Nature with target variables.

**Table 4:** Training the Random Forest model

| Defining target variables for each State of Nature | Training the model (using States of Nature 1 as an example) |
|---|---|
| **y_1SN = df['DM_1SN'].values**<br>**y_2SN = df['DM_2SN'].values**<br>**y_3SN = df['DM_3SN'].values** | rf_1 = RandomForestRegressor(n_estimators=100, random_state=42)<br>rf_1.fit(X_1SN, y_1SN)<br>predictions_1 = rf_1.predict(X_1SN) |

***Source:*** Created by the authors.

Performing model aggregation with probabilities allows us to obtain a forecast for each State of Nature and calculate the expected value with probabilities. After that, we determine the best option.

*best_uav = df.loc[df['ExpectedValue'].idxmax()]['Unnamed: 0']*
*print("The best option UAV:", best_uav)*
*The best option UAV: UAV_9*

So, after completing the Random Forest modeling and determining the best purchase option, it is necessary to assess the adequacy of the model. To do this, we calculate the Mean Squared Error and R-squared for each State of Nature.

**Table 5:** Calculation of model adequacy

| | Mean Squared Error | R-squared |
|---|---|---|
| **State of Nature 1** | 4359890928.476374 | 0.9249317371310476 |
| **State of Nature 2** | 1787349625.8498044 | 0.9088230455278048 |
| **State of Nature 3** | 2173717423.3703337 | 0.9233311430092417 |

***Source:*** Created by the authors.

The findings suggest that Random Forest models demonstrate high quality for each of the States of Nature. It is evident that, in general, all models demonstrate high R-squared values, which is indicative of exceptional prediction quality. With regard to the Mean Squared Error, the value is deemed suitable for practical tasks involving the selection of the most optimal UAV, with the probabilities of one of three events occurring being taken into account.

The following visualisation depicts the values obtained for each of the three States of Nature.

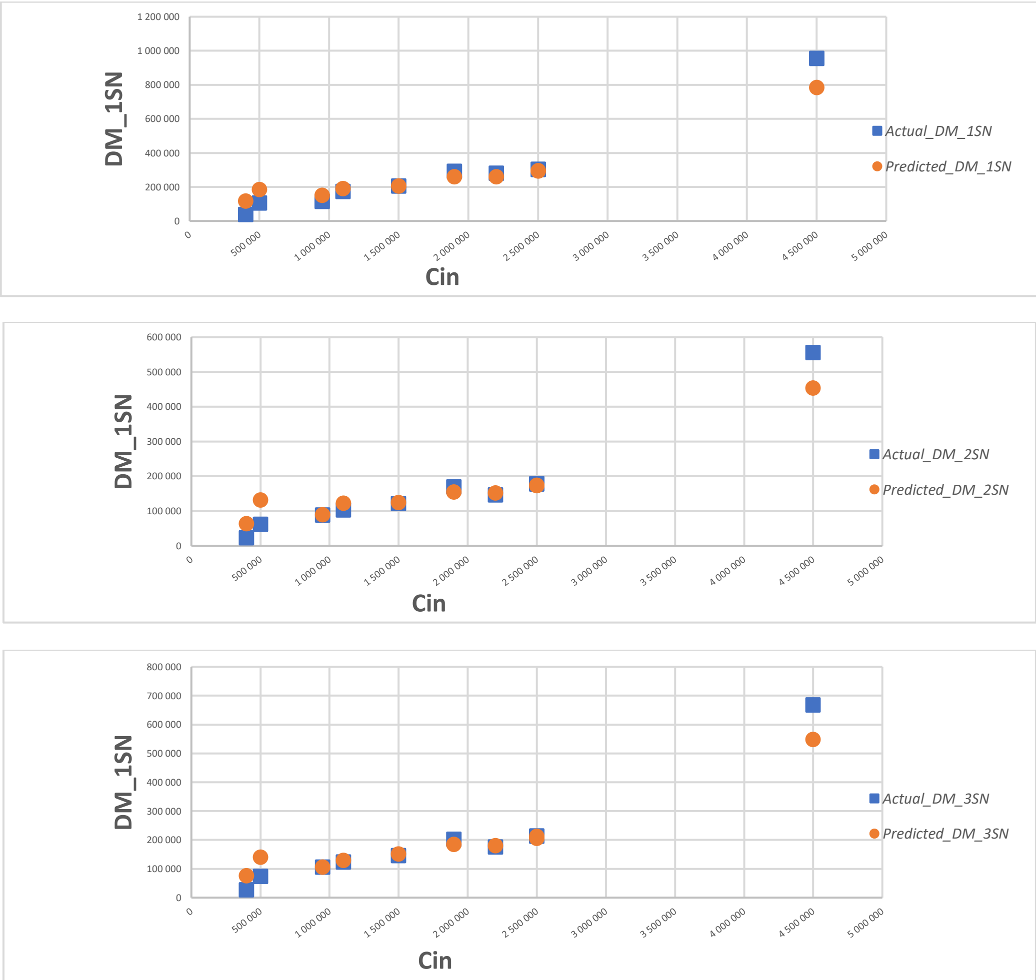


**Figure 5:** Visualization of current and forecast data for each State of Nature

***Source:*** Created by the authors.

In the scatter plots, the orange dots indicate the extent to which the Random Forest model can approximate the actual calculated values for each UAV for a specific State of Nature at a given initial cost and other characteristics. Furthermore, to schematically represent the Random Forest algorithm using the example of one of the decision trees, a Plot Tree for State of Nature 1 is provided.

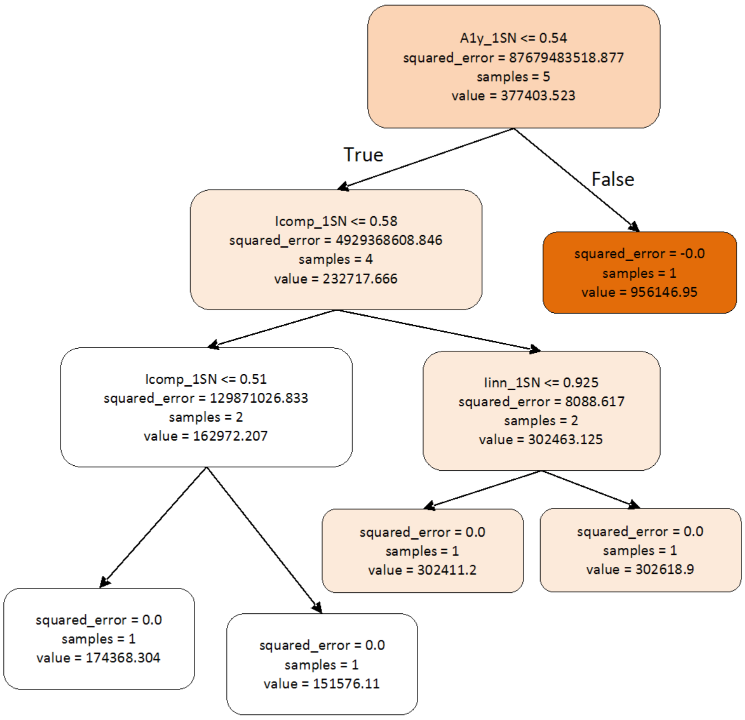


**Figure 6:** Decision Tree from Random Forest (State of Nature 1)
***Source:*** Created by the authors.

The visualised plot tree illustrates the structure of a single decision tree from the overall Random Forest for State of Nature 1. This tree demonstrates how specific features influence the distribution of decisions regarding the DM_1SN indicator for each subject (UAV). The primary branch is designated "A1y_1SN", signifying that the initial division is predicated on its value. Subsequent decisions are delineated by 'Icomp_1SN' and 'Iinn_1SN', which constitute additional branches. It is evident that each node contains the following: (1) a feature for branching (x < = threshold); (2) "squared_error", which functions as an indicator of variation in the group; (3) "samples", which denotes the number of UAVs in the group; and (4) "value", which is the average "DM_1SN" indicator for this subgroup.

Upon thorough examination of the diagram, it becomes evident that all terminal nodes exhibit a 'zero squared error'. Consequently, the group consists of a single sample (UAV). Concurrently, the depth of the tree does not exceed three levels, which is characteristic of a limited sample size. The final "value" is the actual estimate of "DM_1SN" for each UAV under the corresponding conditions of the features.

In view of the aforementioned information and the identified issues with the functioning of internal financial control mechanisms in military units, there is a necessity for an in-depth analysis of theoretical approaches and the study of international experience. Contemporary scientific works demonstrate that the effectiveness of a control system is contingent not only on the regulatory framework, but also on organisational culture, ethical leadership, the level of digitisation of processes, and the integration of modern management concepts.

In this case, in order to develop a comprehensive model of internal control in the military sphere, it is necessary to analyse and take into account the results of some foreign studies on this topic. An international approach, grounded in the COSO concept and dynamic organisational capabilities, facilitates the identification of factors that ensure transparency, sustainability, and accountability in the public sector.

A further review of the literature makes it possible to systematize global experience, identify key patterns, and determine the mechanisms that can be adapted to the conditions of military units in Ukraine.

**Table 6:** Advantages and disadvantages of internal control in international practic

| Country | Advantages of internal control | Problematic aspects |
|---|---|---|
| **Malaysia** | • The influence of ethical leadership on the formation of a control environment.<br>• Well-developed mechanisms of government accountability.<br>• Employees respond positively to a moral leadership style. | • Control systems are overly dependent on the personal qualities of the manager.<br>• Low standardization of control procedures in the public sector. |
| **Italy** | • High level of ESG integration into internal control.<br>• Significant investments in control systems.<br>• Existence of EU legislative requirements that enhance transparency. | • Complex corporate governance structure, which slows down the implementation of reforms.<br>• High cost of implementing controls. |
| **China** | • Development of internal control in response to modern challenges.<br>• High level of digitization of control processes.<br>• Increased control under the influence of foreign investors. | • Significant difference in the quality of control between the public sector and private business.<br>• Need for transparency.<br>• Control is often only formal. |
| **France** | • High level of CSR integration and control.<br>• Management system focused on long-term stability.<br>• Effective control – financial stability. | • Control systems and CSR create bureaucratic burdens.<br>• Some companies have difficulty harmonizing standards. |
| **EU countries** | • High standards of internal control regulation (COSO, EU Directives).<br>• Integration of sustainable development principles | • Expensive implementation of controls and audits.<br>• EU requirements are overly complex for small organizations. |
| **International context** | • Universal standards that ensure the integrity of the control system.<br>• Global application of management practices. | • Differences in staff training levels in different countries.<br>• COSO is sometimes applied without real effectiveness. |

***Source:*** Created by the authors.

## *Discussion*

The study's findings indicate that combining traditional internal control methods with digital tools—specifically decision trees and the Random Forest algorithm—improves the accuracy of risk assessments and the soundness of management decisions in military units.

These findings are consistent with the research by Zahari et al. (2023), which emphasizes the role of managerial factors in the effectiveness of internal control. At the same time, Harasheh and Provasi (2022) and Boulhaga et al. (2022) emphasize the importance of integrating ESG factors, whereas this study additionally incorporates analytical risk assessment models.

The findings of Chen et al. (2023) regarding the impact of digitalization on control quality are confirmed in this study, though they are supplemented by the practical application of machine learning methods. Ong et al. (2024) and Koeswayo et al. (2024) examine organizational aspects of management, which are combined with quantitative analysis methods in the proposed model.

Thus, unlike previous studies, the proposed model combines classical approaches to internal control with machine learning methods, thereby enhancing the effectiveness of financial resource management in military units.

## *Conclusion*

Notwithstanding the paucity of research conducted thus far, a number of models for predicting the results of legal proceedings have been constructed, based on the analysis of a series of standard financial transactions. The employment of a classical theory of decision-making on the basis of a decision-making process, as well as a more advanced algorithm for decision-making, namely Random Forest, has been utilised.

It is possible to interpret this as an indication that the Random Forest model is being used to predict the outcome of the decision-making process at the micro-level. It is evident that the most significant impact is observed in relation to the characteristics designated "A1y_1SN", hereafter referred to as "Icomp_1SN" and "Iinn_1SN". The visualisation is a valuable tool for understanding the model or report, as it can demonstrate the significance of specific features and the pathway to identifying the optimum solution for the problem.

It is imperative to emphasise that Plot Tree is a highly effective tool for the purpose of modelling the "ensemble" mechanism in "State of Nature", thereby ensuring the transparency of modelling complex problems related to defence.

In summary, the present study aims to assess the current status and future prospects of the financial management audit within the military sector in the context of the prevailing conditions. It is evident that the establishment of a regulatory framework, the conduction of empirical trials by the financial and economic departments, and the identification of external factors have contributed to the enhancement of the financial discipline within the defence sector. This, in turn, has facilitated the optimisation of financial resources within the sector.

A synthesis of the findings reveals that the proposed model for enhancing internal control of financial and economic activities in military units serves as a foundation for bolstering the financial security of military units, mitigating the occurrence of risky situations, enhancing the precision of management decisions, and optimising the utilisation of budget resources. The practical significance of the study lies in the possibility of implementing the developed approaches in the activities of financial and economic service units. This will increase the stability of the control system and ensure an adequate level of financial discipline in conditions of prolonged military aggression.

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## *Competing interests*

The authors declare that they have no competing interests.

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