

ECONOSCITECH INTEGRATION

ISSUE
7

INTERNATIONAL SCIENTIFIC
ELECTRONIC JOURNAL



**TASHKENT STATE
UNIVERSITY OF ECONOMICS**



**American University
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ISSN: 3060-5075



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THE SCIENTIFIC-POPULAR
ELECTRONIC JOURNAL
"ECONOSCITECH-INTEGRATION"
HAS BEEN REGISTERED UNDER
THE NUMBER C-5669651 BY THE
AGENCY FOR INFORMATION AND
MASS COMMUNICATIONS (AOKA)
OF THE REPUBLIC OF UZBEKISTAN,
EFFECTIVE FROM OCTOBER 9, 2024.

In accordance with Resolution No. 384/6 dated April 10, 2026, issued by the Presidium of the Supreme Attestation Commission under the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan, this journal is included in the list of recommended international scientific publications for publishing the primary research findings of doctoral dissertations in the field of Economic Sciences.

Partners: Tashkent State University of Economics / American University of Technology in Tashkent (AUT)

Electronic publication. Issue 7. 374 pages.
Approved for publication in July 2026.

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VISUALIZATION OF RISKS IN PUBLIC FINANCIAL CONTROL: RISK MAP, RISK REGISTER AND ANALYSIS OF INTERZONAL MIGRATION

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Abstract. This article proposes a methodology for developing and maintaining a risk map and a risk register to support the visualisation and prioritisation of risks in budget organisations and other control objects. Although risk maps are widely used in international risk management practice, including within the COSO ERM and ISO 31000 frameworks, the article proposes their integrated application to public financial control through probability–impact decomposition, a risk register that preserves institutional knowledge, and the analysis of objects’ interzonal migration. The integral risk score of each object is decomposed into probability (P) and impact (C) dimensions. Probability is derived from the compliance, operational, corruption and information technology groups, while impact is derived from the budget and scale groups; the resulting scores are displayed on a 3 × 3 risk map. The risk register provides a centralised record of assessments and related decisions for all objects and assessment periods and is maintained under the “four-eyes” principle. By preserving assessment histories, the register reduces the risk of losing information about objects not included in the audit plan. Historical data stored in the register enable interzonal migration analysis and support the transformation of planning from a static annual document into a continuously updated process. The principal methodological contribution of the study lies in integrating the risk register with interzonal migration analysis.

Keywords: public financial control, risk map, risk register, probability–impact decomposition, interzonal migration, risk visualisation, institutional knowledge, prioritisation, early warning.

Аннотация. В статье предложена методология разработки и ведения карты рисков и реестра рисков, направленная на визуализацию и приоритизацию рисков в деятельности бюджетных организаций и иных объектов контроля. Несмотря на широкое применение карт рисков в международной практике управления рисками, в том числе в рамках COSO ERM и ISO 31000, в статье предлагается их комплексное использование в системе государственного финансового контроля посредством декомпозиции риска по параметрам «вероятность — воздействие», ведения реестра рисков, обеспечивающего сохранение институциональных знаний, а также анализа межзональной миграции объектов. Интегральная оценка риска каждого объекта подразделяется на два измерения — вероятность (P) и воздействие (C). Вероятность формируется на основе групп показателей соответствия требованиям, операционных, коррупционных и информационно-технологических рисков, тогда как воздействие определяется на основе бюджетной группы и группы масштаба; полученные оценки отображаются на карте рисков формата 3 × 3. Реестр рисков представляет собой централизованную систему учёта оценок и связанных с ними решений по всем объектам и периодам оценки и ведётся в соответствии с принципом «четырёх глаз». Сохранение истории оценок позволяет снизить риск утраты информации об объектах, не включённых в план аудита. Исторические данные, содержащиеся в реестре, обеспечивают возможность анализа межзональной миграции и способствуют преобразованию планирования из статичного годового документа в непрерывно обновляемый процесс. Основным методологический вклад исследования заключается в интеграции реестра рисков с анализом межзональной миграции.

Ключевые слова: государственный финансовый контроль, карта рисков, реестр рисков, декомпозиция «вероятность — воздействие», межзональная миграция, визуализация рисков, институциональные знания, приоритизация, раннее предупреждение.

INTRODUCTION

The assessment and selection model assigns an integral risk score to each control object. However, a linear ranking and an integral score alone do not fully address two important requirements: risk visualisation, which enables the concise and clear presentation of results to management and relevant stakeholders, and the preservation of institutional knowledge through the systematic retention of assessment histories. In practice, risk information concerning objects not included in the audit plan may not be systematically retained and may be lost over time, thereby limiting opportunities for trend analysis and model calibration.

Risk maps and risk registers are widely used in international risk management practice, including within the COSO ERM and ISO 31000 frameworks (COSO, 2017; ISO 31000, 2018). Supreme audit institutions in selected countries also use these tools for planning and management reporting (GAO, 2016; NAO, 2011). Nevertheless, their integrated application to public financial control—combining probability–impact decomposition, a register that preserves institutional knowledge, and the analysis of objects' interzonal migration—remains insufficiently developed.

The main purpose of this article is to develop a methodology for managing a risk map and a risk register that supports the visualisation and prioritisation of risks associated with budget organisations and other control objects. The proposed methodology incorporates probability–impact decomposition and interzonal migration analysis within the public financial control system.

LITERATURE REVIEW

A risk map is defined in international risk management frameworks as a visual tool for presenting risks according to their probability and impact (COSO, 2017; ISO 31000, 2018). A risk register, in turn, is widely used as a structured instrument for recording, reviewing and monitoring risks in accordance with the principles of ISO 31000:2018. Supreme audit institutions in selected countries, including the United States Government Accountability Office and the United Kingdom National Audit Office, apply risk-based tools in planning and management reporting (GAO, 2016; NAO, 2011). ISSAI standards also emphasise the need to substantiate risk analysis during audit planning (ISSAI 100, 2019; ISSAI 300, 2019). Uzbek scholars R. D. Dusmuratov, N. K. Rizaev and X. H. Nazarov have examined issues related to adapting international financial reporting and auditing standards to national practice (Dusmuratov et al., 2020).

In the available sources, risk maps and registers are described as general risk management tools. However, a comprehensive methodology for state financial control that decomposes the integral score into probability and impact dimensions, manages the register as institutional memory and an evidence base, and analyses the interzonal migration of objects has not been developed. This scientific gap determines the direction of the present research.

RESEARCH METHODOLOGY

The methodology is based on international risk management concepts (COSO ERM, ISO 31000 and ISSAI) and a multi-criteria object assessment model. The integral score is divided into two dimensions using weights renormalised from group scores, while a 3×3 risk map on a probability–impact plane is applied as a visualisation tool. The structure and management procedures of the risk register were developed based on the “four-eyes” principle and qualitative indicators. Interzonal migration analysis was carried out using the history of assessments stored in the register. The proposed developments are consistent with the general principles and objectives of the national system of public financial control.

ANALYSIS AND RESULTS

Probability–Impact Decomposition

The integral score is sufficient to arrange objects linearly, but it compresses two independent aspects of risk — the probability of occurrence and the scale of the consequences — into a single number. To build a risk map, these two aspects are separated: the compliance, operational, corruption and information technology groups essentially characterise the probability of a violation, while the budget and scale groups characterise its financial and social impact. Accordingly, the probability (P) and impact (C) scores are calculated using weights renormalised from the group scores:

$$P = \sum (w'_j \times G_j), j \in \{M, O, K, A\}, \quad (1)$$

$$C = \sum (w'_j \times G_j), j \in \{B, S\}, \quad (2)$$

where w_j represents the renormalised weights within the corresponding set (the sum of each set is equal to one); G_j is the score of the j -th group. Under the current weights, the shares of the probability set are 0.333 (compliance), 0.250 (operations), 0.250 (corruption) and 0.167 (information technology); the shares of the impact set are 0.625 (budget) and 0.375 (scale). The internal consistency of the decomposition is controlled by a simple check: when the probability and impact scores are recombined using their weights ($0.60 \times P + 0.40 \times C$), the exact integral score R must result. Thus, the map and the rating are derived from a single calculation source and cannot produce contradictory results.

RISK MAP

A risk map is a visual tool that places objects on a probability–impact plane. It is based on a 3×3 matrix: each axis is divided into three ranges using the zone boundaries of the assessment model (40 and 70 points), the cells are coloured according to the level of risk, and a control response strategy is assigned to each cell. High-probability and high-impact cells require priority consideration for inclusion in the audit plan and in-depth audits; high-impact but low- or medium-probability cells require mitigation measures and enhanced monitoring; and high-probability but low-impact cells require systematic but lighter monitoring. The estimated probability and impact scores for the ten conditional objects and their positions on the map are presented in Table 1.

Table 1
Probability and impact assessments of conditional objects

Object	Probability (P)	Impact (C)	Location on the map
Sh-1	73.5	86.9	High P – high C: priority inclusion in the audit plan
Sh-2	43.3	43.8	Medium P – medium C: selective control
Sh-3	82.0	84.4	High P – high C: priority inclusion in the audit plan
Sh-4	52.9	58.8	Medium P – medium C: selective control
Sh-5	29.6	33.8	Low P – low C: routine monitoring
Sh-6	70.9	72.4	High P – high C: priority inclusion in the audit plan
Sh-7	50.4	44.4	Medium P – medium C: remote monitoring
Sh-8	25.8	23.8	Low P – low C: periodic monitoring
Sh-9	56.9	66.9	Medium P – medium C (close to the upper limit)
Sh-10	34.3	31.3	Low P – low C: routine monitoring

Source: developed by the author.

The map provides additional information compared to the linear rating. For example, although Sh-9 ($P = 56.9$; $C = 66.9$) and Sh-4 ($P = 52.9$; $C = 58.8$) occupy neighbouring positions in the integral ranking, the map shows that Sh-9 is closer to the upper limit on the impact axis—in this case, the probability of a violation is medium, but if it occurs, the potential consequences may be comparatively significant; this justifies increased monitoring. Sh-7, on the contrary, has a relatively high probability, but its impact is limited. The map therefore helps answer two related questions: “How significant is the risk?” and “Which dimension primarily drives it?” The map can be created at different levels of aggregation: in addition to the main map by object, generalised maps by sector (ministerial system) and region provide a strategic overview for management; all levels are automatically generated from the same register. However, one rule remains unchanged: the map is never the sole basis for decision-making—it is a generalised reflection of the complete information contained in the register.

RISK REGISTER

The risk register is a centralised, systematically maintained record of risk assessments and related decisions for all control objects. In international practice, a risk register is widely used as a structured tool for recording, reviewing and monitoring risks in accordance with the principles of ISO 31000:2018, and it provides a systematic solution to the problem of institutional memory—the loss of risk information on objects

not included in the plan. The recommended structure of the register is provided in Table 2. The relationship between the register and the assessment sheet creates two levels of document flow: the sheet is a complete primary document for one object and one assessment period, while the register is a summary record that combines the main results for all objects and periods. If any doubt arises, it is possible to move consistently from the register entry to the assessment sheet and from the sheet to the source documents—this ensures the continuity of the chain of evidence.

Table 2
Structure of the risk register

Register section	Field content
Identification	Object code and name, segment, responsible department, evaluation date
Indicator values	Raw and normalised values of 22 indicators, data sources
Evaluation results	Group scores (G_1 – G_6), integral risk score (R), probability (P), impact (C)
Stratification	Risk zone, map cell, ranking position, veto-rule status
Decisions	Inclusion in the audit plan, type and duration of the control measure, monitoring mode
History and migration	Assessments from previous periods, interzonal movements, control measures and their outcomes
Administrative information	Recorded by, Approved by, Version number, Change log

Source: developed by the author.

The register is maintained through clearly defined responsibilities: the analytical unit enters and updates records; sectoral departments provide qualitative assessments and the results of control measures; and management approves changes in risk zones and related planning decisions. Each record is formalised under the “four-eyes” principle, meaning that it is entered and approved by different persons, while all amendments are documented in the change log. This process enables the register to serve as an evidence base for calculations and subsequent external assessment.

The quality of the register is monitored using criteria such as completeness, relevance, consistency and adequate documentation. Records are retained for at least five years, thereby providing sufficient historical depth for migration analysis and model calibration. Risk assessments of control objects are treated as restricted internal information. Uncontrolled disclosure may affect the objectivity of the information submitted by assessed entities; therefore, appropriate access controls should be applied.

ANALYSIS OF INTERZONAL MIGRATION

Since the history of assessments is stored in the register, migration analysis—tracking the movement of objects between zones over time—becomes possible. Migration signals provide the basis for three types of management conclusions. A rise is an early warning: control attention is increased before the object enters the high-risk zone, which is a practical expression of the preventive approach. Remaining at a consistently low level is the basis for applying a less resource-intensive control approach and freeing up resources. A decrease following an intervention may indicate an improvement in the object’s risk profile and may be considered when assessing the effectiveness of risk-based control. Thus, planning changes from a static one-year document into a continuously updated process—this is fully consistent with the planning requirements of international standards (ISSAI 300, 2019).

Migration analysis is enriched with quantitative indicators: the number and share of objects that have risen and fallen during the period, the degree of stability in the composition of the zones, and the change in the average score in the subsequent period for objects where measures were taken. These indicators perform two functions: first, they diagnose the system itself (excessive instability may indicate random variation or insufficient reliability of the indicators, while the absence of any change may indicate that the indicators are insufficiently responsive to changes in risk conditions); second, they provide direct input into the system of indicators for assessing the effectiveness of risk-based control. It should be emphasised that the system of indicators, the integrated methodology, the map and the register are not a set of separate tools, but a single integrated information framework: the indicator is described in the passport, measured in the sheet, summarised in the register, reflected on the map and incorporated into the planning decision.

CONCLUSIONS AND SUGGESTIONS

A risk map and a risk register were developed to visualise and prioritise risks in state financial control. Although the risk map is known in international practice (COSO ERM, ISO 31000), it was applied to state financial control in an integrated manner, together with probability–impact decomposition, a register providing institutional memory and interzonal migration analysis.

A decomposition method was proposed that separates the integral risk score into probability (P) and impact (C) measures (Formulas 1 and 2): probability is derived from the compliance, operational, corruption and IT groups, while impact is derived from the budget and scale groups. The consistency of the decomposition is ensured by the arithmetic identity ($0.60 \times P + 0.40 \times C = R$), which guarantees that the map and the rating are generated from a single calculation source.

The risk map, which positions objects within a 3×3 probability–impact matrix, helps determine both the overall significance of a risk and the dimension that primarily drives it. The map can be developed at different levels of aggregation, including the object, sectoral and regional levels.

A risk register—a centralised, “four-eyes” record of assessments and decisions across all control objects and time periods—helps address the problem of preserving institutional knowledge and creates an evidence base for calculations prior to external evaluation. The register is monitored through quality indicators, and records are kept for at least five years.

The history of assessments in the register makes interzonal migration analysis possible: a rise is an early warning, while a decline following an intervention may indicate an improvement in the risk profile and can be considered when assessing control effectiveness. As a recommendation, it is advisable to approve the risk map and register as components of the risk analysis standards and maintain them as a dedicated module of the unified information system “State Audit.”

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Proofreader: Xondamir Ismoilov
Layout and Designer: Hasan Maqsudov

2026. № 7

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