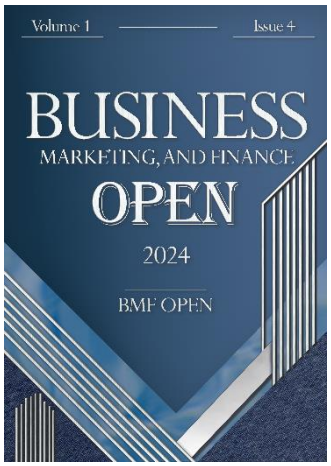
Identification and Screening of Foundational Factors of the Open Budget System in Enhancing the Audit Process: A Qualitative Study Using Content Analysis and the Delphi Method



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Abstract: The implementation of an open budgeting system in the public sector has brought significant opportunities and challenges for improving oversight processes. This study, employing a qualitative approach based on content analysis and the Delphi method, seeks to identify and prioritize the critical components that facilitate the effective establishment of an open budgeting system within the auditing processes of the Supreme Audit Court. In the first phase, 25 semi-structured interviews were conducted with senior managers, audit experts, and information technology specialists in the Supreme Audit Court and its affiliated organizations. Thematic content analysis led to the identification of 15 key components, categorized into five main thematic areas: technological infrastructure, organizational readiness, stakeholder integration, knowledge transfer, and regulatory compliance. These components were subsequently evaluated through three rounds of Delphi analysis by 15 experienced experts to achieve consensus on their relevance and importance. The findings indicate that elements such as data transparency, open access to information, financial traceability, digital governance, change management capacity, and public accountability play a central role in the successful implementation of the open budgeting system. The results emphasize that merely establishing an open budgeting system does not guarantee improved audit performance unless it is supported by appropriate technical infrastructure, organizational readiness, and a culture of transparency. This study provides a conceptual framework for policymakers and decision-makers seeking to implement open budgeting systems in the public sector. By outlining the components that must be aligned for the effective and sustainable establishment of open budgeting systems in oversight institutions, this study contributes to both academic literature and managerial practice in the field of financial governance.

Keywords: Open budgeting system, public auditing, Delphi method, content analysis, Supreme Audit Court, organizational readiness, financial transparency

1. Introduction

Budgeting has long been recognized as one of the most critical tools of public financial management, providing a framework for allocating limited resources, achieving policy goals, and maintaining accountability within governmental institutions. In both developed and developing economies, budgeting plays a dual role—serving as

a planning instrument and as a control mechanism that ensures fiscal discipline and performance evaluation [1]. The evolution of budgeting systems reflects not only the growing complexity of socio-economic structures but also the increasing need for transparency, efficiency, and citizen engagement in public finance. Within the context of Iran and similar emerging economies, the modernization of budgeting systems has been tightly linked to reforms in governance, audit practices, and institutional oversight [2].

Public budgeting has undergone several transformations—from traditional line-item budgeting, which emphasized expenditure control, to more sophisticated performance-based and results-oriented models [3]. The emergence of performance-based budgeting and open budget systems has been a response to global calls for improved accountability, data transparency, and public trust in state institutions [4]. These shifts align with the international movement toward fiscal openness, which promotes accessibility of financial data, stakeholder participation, and auditability of expenditures [5]. The open budgeting paradigm encourages governments to disclose budget information proactively, thereby allowing citizens, civil society, and oversight bodies to scrutinize fiscal performance and contribute to decision-making processes [6].

In the Iranian context, the national budgeting system has traditionally faced challenges related to opacity, inefficiency, and inadequate synchronization with strategic development objectives [7]. While efforts have been made to align the budgeting framework with economic growth and regional competitiveness through system dynamics approaches [7], the operationalization of open budgeting principles remains at an early stage. The Supreme Audit Court, as the central body for fiscal oversight, plays a pivotal role in ensuring that budget allocations translate into measurable outcomes. However, the integration of open budgeting systems into audit processes requires institutional readiness, advanced technological infrastructure, and cultural acceptance of transparency [8].

The conceptualization of budgeting as a strategic management tool has gained prominence in recent years, emphasizing the connection between financial planning and organizational objectives [9]. In this regard, strategic budgeting serves as a mechanism to align resource allocation with performance goals, risk management, and long-term sustainability [10]. As governments move toward digital transformation and evidence-based policy-making, the demand for integrated financial information systems has intensified [1]. These systems enhance coordination among departments, facilitate real-time data analysis, and improve audit trails, which are essential for ensuring accountability and reducing opportunities for corruption [11].

One of the major developments in public sector budgeting has been the adoption of performance-based budgeting models that tie expenditures directly to measurable results [4]. This approach shifts attention from inputs and processes to outputs and outcomes, thereby enhancing both efficiency and effectiveness. However, the successful implementation of performance-based and open budgeting frameworks depends heavily on managerial competence, technological capacity, and the presence of robust monitoring mechanisms [12]. The complexity of integrating such systems in developing contexts underscores the need for strong leadership, inter-organizational collaboration, and supportive regulatory environments [2].

From an auditing perspective, budgeting reforms have profound implications for accountability and oversight. Studies have shown that auditors' judgments and audit quality are significantly affected by time budget pressures, competence, and ethical reasoning [13, 14]. When budget constraints are tight, auditors may experience reduced independence or may prioritize efficiency over depth, thereby compromising audit quality [15]. Moreover, the design and structure of audit budgets themselves can act as surrogates for perceived audit risk [16]. Therefore, the integration of open budgeting principles—emphasizing transparency, traceability, and accountability—can

enhance audit credibility and reduce informational asymmetries between auditors, policymakers, and the public [17].

The relationship between budgeting and auditing is reciprocal. While budgets set the framework for financial planning, audits ensure that the budgeting process adheres to legal, procedural, and ethical standards [18]. The quality of public audit systems is often viewed as a proxy for fiscal discipline and governance integrity. Empirical evidence from Iran indicates that effective audit court interventions can improve financial oversight and promote the efficiency of public expenditures [8, 18]. However, the Audit Court's traditional supervision mechanisms are often constrained by rigid budgetary systems that lack adaptability to changing fiscal environments. This underscores the importance of developing dynamic and transparent budgeting systems that integrate modern audit requirements and digital reporting tools [2].

Global experiences further highlight how open and participatory budgeting enhances public accountability and trust. In Malaysia, for instance, research has demonstrated that participatory budgeting improves organizational responsiveness and stakeholder satisfaction [6]. Similarly, in developed economies, the introduction of open data and fiscal disclosure practices has led to significant improvements in both budget efficiency and tax revenue systems [5]. The principles underlying open budgeting—transparency, participation, and collaboration—mirror broader trends in governance that prioritize inclusivity, evidence-based decision-making, and public engagement [19].

At the same time, the shift toward open budgeting requires overcoming institutional inertia and cultural resistance to transparency. Organizational readiness and learning play decisive roles in enabling this transition [9]. Institutions that foster continuous learning, innovation, and adaptability are better equipped to implement open budget systems and integrate them with audit processes. This adaptability is especially critical in contexts where bureaucratic structures are hierarchical and resistant to change [12]. Furthermore, open budgeting calls for collaboration across different organizational layers—including ministries, audit bodies, and local governments—to ensure alignment of goals and operational coherence [10].

Technological innovation also underpins the success of open budgeting initiatives. Information systems capable of processing large datasets, ensuring data accuracy, and providing real-time financial information are vital for the implementation of open fiscal systems [20]. Digital transformation allows for enhanced traceability, greater efficiency in audit operations, and improved citizen access to fiscal information. The use of advanced analytics, blockchain, and artificial intelligence tools is increasingly viewed as essential for achieving fiscal transparency and preventing financial irregularities [17]. Nevertheless, technological infrastructure alone cannot ensure success without complementary institutional reforms and ethical leadership [14].

Open budgeting also aligns with global sustainable development goals, particularly those focusing on strong institutions, transparency, and responsible governance [2]. In Iran, the challenges of achieving sustainable fiscal governance are compounded by political, administrative, and socio-economic constraints. A sustainable governance-oriented budgeting framework requires systemic integration of environmental, social, and governance (ESG) principles, which promote not only economic efficiency but also social justice and environmental responsibility. This approach underscores the need for an integrated model that connects financial management with the broader goals of national development and institutional accountability [7].

Furthermore, the application of system dynamics and modeling techniques in budgeting and auditing research has gained attention for its potential to simulate complex interrelationships between fiscal variables [20]. By applying these techniques, researchers and policymakers can better understand how changes in policy, governance,

and institutional capacity affect audit performance and fiscal sustainability. For instance, studies using system dynamics have shown that effective feedback loops between budgeting and auditing processes can enhance the responsiveness of public institutions and improve the quality of financial reporting [4, 7].

In addition to structural and technological considerations, the human dimension of budgeting remains critical. Psychological factors, leadership commitment, and ethical culture influence how budgeting reforms are perceived and implemented [9]. A culture that values openness and accountability facilitates innovation and fosters trust among stakeholders. Conversely, when budgeting is treated merely as a bureaucratic exercise, it loses its strategic value and may even foster inefficiency and corruption [12].

The contemporary literature also recognizes that budgeting processes are not purely technical; they are deeply embedded in social, political, and institutional contexts [11]. Budgetary decisions reflect competing interests, power dynamics, and policy priorities. In this sense, open budgeting represents not only a managerial reform but also a democratic instrument that enhances citizen oversight and strengthens public participation in governance [19].

Therefore, implementing an open budgeting system in Iran's Supreme Audit Court context entails rethinking how budgeting and auditing are interlinked. It requires aligning institutional structures, improving technological readiness, fostering inter-organizational collaboration, and cultivating a culture of transparency and continuous learning. The integration of open budget principles can significantly contribute to improving audit efficiency, strengthening financial accountability, and enhancing public trust in governmental oversight institutions [2, 10, 18].

In summary, this study aims to identify and validate the foundational factors of the open budgeting system that enhance the audit process within the Supreme Audit Court of Iran.

2. Methodology

To achieve a deep understanding of the subject, a qualitative approach was selected, incorporating content analysis and the Delphi technique. The statistical population of the study consisted of senior managers, supervisors, and expert specialists with more than 15 years of professional experience in the fields of public auditing, government budgeting, and information technology within the Supreme Audit Court and its affiliated organizations across the country. According to available statistics, this population comprised 650 individuals.

Using purposive sampling, between 10 and 15 senior experts were selected who possessed extensive knowledge and experience in performance auditing, public budgeting, and integrated financial systems. Data were collected through semi-structured interviews to obtain professional insights on the factors influencing the implementation of the open budgeting system and its role in improving auditing processes. The collected information was analyzed using the content analysis technique to identify key themes and validate initial conceptual constructs. To enhance the reliability and validity of the findings, the Delphi method was also employed, involving multiple iterative rounds of anonymous feedback among selected experts. The Delphi panel included experts from both auditing and academic backgrounds, chosen based on their expertise in budgeting systems and auditing processes. This approach effectively contributed to validating and refining the conceptual model. The combination of qualitative content analysis and Delphi-based validation allowed for a comprehensive and in-depth examination of the relationships between the effects of open budgeting, process improvement, and audit performance within the specific organizational context of the Supreme Audit Court.

Table 1. Panel of Experts Participating in This Study

Expert ID	Professional Position	Years of Experience	Academic Degree
1	Director General of Auditing	25	Ph.D. in Accounting
2	Performance Audit Supervisor	22	M.A. in Economics
3	Expert in Integrated Financial Systems	23	M.A. in Information Technology
4	Senior Budget Oversight Manager	28	Ph.D. in Public Management
5	Specialist in Internal Control and Auditing	21	M.A. in Accounting
6	Budget Unit Supervisor	20	M.A. in Financial Management
7	Director General of Information Technology	30	M.A. in Software Engineering
8	Expert in Financial Transparency	24	Ph.D. in Finance
9	Operational Audit Supervisor	22	M.A. in Auditing
10	Senior Planning Manager	26	Ph.D. in Strategic Management
11	Expert in Financial Governance	23	M.A. in Economics
12	Information Security Supervisor	21	M.A. in Cybersecurity
13	Senior Systems Development Manager	27	M.A. in Information Technology
14	Specialist in Financial Data Analysis	24	M.A. in Data Science
15	Supervision Unit Supervisor	20	M.A. in Public Management

Implementation of the Delphi Process

Initial Evaluation of the Questionnaire for the First Delphi Round

To ensure the clarity, relevance, and conceptual alignment of the initial questionnaire with the research domain, a preliminary assessment was conducted with the participation of two independent experts who were not part of the main Delphi panel. One of these experts had professional experience in public sector auditing, while the other had an academic background in financial and budgeting systems. Their feedback highlighted several points for improvement—particularly concerning the clarity of measurement items and their consistency with terminology commonly used in the public auditing sector. The proposed revisions were discussed in meetings with the research team and, following final approval, incorporated into the main research instrument.

Preparation of the Final Questionnaire Version

The revised items were incorporated into the final version of the questionnaire. This final version was designed to ensure full consistency in terminology, structure, and content with the context of public auditing and the implementation of the open budgeting system within the Supreme Audit Court.

Exploratory Phase: Delphi Rounds

This phase included two consecutive consultation rounds with experts, aimed at validating and updating the questionnaire and measurement scales through consensus.

First Round:

The finalized questionnaire was distributed to 15 selected experts from the Supreme Audit Court. These individuals were chosen for their deep expertise in auditing, government budgeting, and financial systems, each having more than 15 years of professional experience in their respective specialties. The questionnaire was divided into three main sections, each addressing one of the key dimensions related to the implementation of the open budgeting system in the audit process. Experts were asked to evaluate the relevance, clarity, and effectiveness of each item in measuring the intended construct. They were also invited to propose revisions, alternative formulations, or overlooked dimensions based on their field experience. This first Delphi round was conducted from May 7 to May 13, 2025.

Second Round:

After collecting and analyzing the first-round data, a summary report of areas of agreement and disagreement was prepared, incorporating the proposed suggestions concerning terminology and measurement logic. The updated version of the questionnaire was then redistributed to the same panel from May 14 to May 20, 2025. In this round, panel members were asked to review the revised items in light of other experts' feedback and update their evaluations if necessary. The goal of this round was to reach a final consensus on each item. An agreement threshold of 80% was set as the criterion for final item approval.

Final Phase

After completing the second round, responses were subjected to final analysis, and a comprehensive review of all expert feedback was carried out. Ultimately, full consensus was achieved on all questionnaire items and related measurement scales. Accordingly, a validated and contextually appropriate instrument was developed for assessing the factors influencing the implementation of the open budgeting system in improving the audit process within the Supreme Audit Court.

Composition of the Delphi Expert Panel

The expert panel of this study consisted of a diverse mix of specialists:

- Nine senior managers and professional experts from various departments of the Supreme Audit Court (including performance auditing, budget oversight, IT, and internal control);
- Six university professors specializing in public accounting, public sector economics, financial management, and information technology.

All members possessed proven expertise in budgeting systems and practical experience in auditing processes. This balanced composition ensured that the final instrument was both theoretically rigorous and practically relevant.

Table 2. Research Questions and Brief Descriptions

Research Question	Brief Description
What are the key factors influencing the successful implementation of the open budgeting system in the audit process?	Identifying and categorizing technical, organizational, human, and legal factors that support the implementation of the open budgeting system.
How does the open budgeting system affect the efficiency and effectiveness of the auditing process?	Examining the perceived and actual impacts of open budgeting on auditing processes, reduction of review time, increased accuracy, and improved report quality.
What are the barriers and challenges to implementing the open budgeting system in the auditing process?	Identifying obstacles such as cultural resistance, technical limitations, legal challenges, and implementation complexities.
What are the solutions to overcome barriers to implementing the open budgeting system in the auditing process?	Exploring practical strategies for managing challenges and facilitating the successful implementation of the open budgeting system.
What is the role of leadership and management in the success of implementing the open budgeting system?	Analyzing leadership roles, decision-making, and the strategic alignment of managers in auditing process innovation.
What institutional and structural requirements affect the implementation of the open budgeting system?	Identifying national, regulatory, and organizational conditions influencing the adoption of the open budgeting system within the Supreme Audit Court.

Selection of the Expert Panel and Demographic Profile

In the Supreme Audit Court, experts were selected based on the following criteria:

1. Senior managers, supervisors, or senior specialists with more than 15 years of professional experience in auditing and budgeting within the Supreme Audit Court.
2. Direct experience in projects related to integrated financial systems or audit process management.

3. In the academic sector, participants were selected based on their research experience in public accounting, budgeting systems, public auditing, and financial governance.

In total, 15 experts participated in the Delphi process, including:

- Nine professional specialists from the public auditing sector.
- Six academic faculty members and researchers.

Table 3. Demographic Characteristics of Expert Panel Members

Variable	Category	Frequency (n)	Response Rate (%)
Gender	Male	11	73.3%
	Female	4	26.7%
Age Group	45–55 years	7	46.7%
	56–65 years	8	53.3%
Professional Role	Public Auditing Experts	9	60.0%
	Academic Researchers	6	40.0%
Years of Experience	More than 20 years	15	100%

Development and Delphi-Based Validation of the Research Instrument

In this study, expert participants were exclusively selected from the Supreme Audit Court, focusing on individuals with deep experience in performance auditing, public budgeting, and organizational transformation. The aim was to examine how implementing the open budgeting system influences audit performance, considering the facilitating role of organizational factors.

In total, 15 experts were purposively selected based on the following criteria:

• A minimum of 15 years of professional experience in auditing or public budgeting.

• Proven expertise in implementing financial systems, strategic planning, or organizational innovation.

To validate the research constructs and ensure contextual alignment, the Delphi technique was employed. The Delphi process consisted of three key stages:

Preliminary Assessment

The initial draft of the interview framework and questionnaire was reviewed by two independent experts—one from the auditing industry and the other from academia. Based on their feedback, terminology and scale formulations were revised to ensure conceptual clarity and relevance to the public auditing domain.

First Delphi Round

The revised version was distributed to the 15-member expert panel. The finalized instrument covered three key constructs:

• Dimensions of the open budgeting system (transparency, data accessibility, cost reduction, efficiency improvement, regulatory compliance);

• Organizational factors (technological adaptability, innovation orientation, strategic agility);

• Audit performance indicators (operational efficiency, report quality, stakeholder satisfaction, oversight effectiveness).

Experts evaluated the conceptual relevance, clarity, and adequacy of each item and were allowed to provide suggestions for revisions, additions, or deletions. Qualitative feedback was also collected through open-ended responses.

Second Delphi Round

After analyzing the first-round data, the questionnaire was revised and re-sent to the same panel along with a summary of results and rationale for the proposed changes. At this stage, experts reviewed their initial opinions

considering other members' views. An agreement threshold of 80% was used as the acceptance criterion for each item.

Finalization of the Research Instrument

The final version consisted of 30 open and semi-structured items categorized into four sections:

1. Background information and demographic characteristics;
2. Understanding and implementation of the open budgeting system within the Supreme Audit Court;
3. The role of organizational factors in the success of the open budgeting system;
4. Observed effects of implementing the open budgeting system on audit performance.

All qualitative responses were analyzed through thematic content analysis, allowing for systematic coding of themes, identification of relationships among constructs, and verification of findings with prior literature. Conceptual dimensions and item structures were derived from validated prior studies on innovation and technology and then adapted through the Delphi process to align with the cultural and operational context of the Supreme Audit Court.

3. Findings and Results

Given the use of qualitative content analysis alongside the Delphi technique, data analysis focused on thematic validation and expert consensus, and quantitative statistical procedures were not employed.

The data collected through semi-structured interviews with senior managers, supervisors, and audit specialists at the Supreme Audit Court were examined using thematic analysis. This analysis led to the identification of 17 main categories, each comprising subcategories and defined professional indicators. These themes represented strategic, operational, technological, and regulatory aspects of implementing the open budgeting system and improving auditing processes. The key dimensions included:

- Features of the open budgeting system (such as transparency, accessibility, and data integrity)
- Audit process improvement factors (such as efficiency, effectiveness, and quality)
- Audit performance indicators (such as stakeholder satisfaction and improved reports)
- Technological infrastructure, information security, human capital, innovation, and others.

Coding was performed by two coders, and analysis using Cohen's Kappa (Cohen's Kappa > 0.75) confirmed high validity of the conceptual categorization.

The Delphi study was conducted with 15 experienced experts, including auditing specialists, IT managers, and academic researchers. They were selected based on practical experience in improving auditing processes. Across two consecutive rounds, the experts assessed the indicators in terms of clarity, relevance, and necessity. The consensus criterion was defined as ≥80%. In the first round, revisions were proposed to eliminate overlapping subcategories (such as internal control and risk management). In the second round, based on the implemented revisions, complete consensus was achieved on the 17 final categories.

Content validity was confirmed through the Delphi process and by examining the alignment of indicators with the realities of Iran's auditing system. Reliability was ensured through:

- Stability of responses across Delphi rounds,
- High inter-coder agreement in the qualitative analysis,
- Consistency in experts' interpretation of indicators.

Discriminant validity of the constructs was also ensured by maintaining conceptual boundaries between themes; for example, a precise distinction between "integration of information systems" and "development of technological capabilities."

The final analytical framework—comprising 17 main categories, comprehensive subcategories, and qualitative/quantitative indicators—forms the basis of the measurement model. This integration ensures that:

The findings reflect the actual priorities of the auditing industry;

The study structure supports strategic planning and the assessment of open budgeting system implementation;

The model is adapted to the conditions of the Supreme Audit Court and balances global standards with domestic institutional realities.

Table 4. Themes and Key Criteria Derived from Content Analysis of Interviews and Literature Review

Main Category Code	Main Category	Subcategory Code	Subcategory	Indicator Type	Indicator
T1	Open Budgeting System	T1.1	Transparency and Accessibility	Quantitative	Percentage of accessible budget data; rate of information updates; completeness of published reports
				Qualitative	Stakeholder perceptions of transparency; feedback on compliance with standards
		T1.2	Data Integrity and Accuracy	Quantitative	Data error rate; percentage of verified information; completeness of the audit trail
				Qualitative	Expert assessment of data quality; user trust in information
		T1.3	Traceability and Tracking	Quantitative	Percentage of traceable budget items; response time to inquiries
				Qualitative	User satisfaction with traceability
		T1.4	Scalability and Performance	Quantitative	Average data-processing capacity; update latency; system downtime hours
				Qualitative	Expert assessment of scalability solutions
T2	Audit Process Improvement	T2.1	Operational Efficiency	Qualitative	Reduced time for document collection; increased speed of testing; reduced operational costs
				Quantitative	Auditor productivity assessment
		T2.2	Supervisory Effectiveness	Quantitative	Increased accuracy of findings; improved report quality; better detection of violations
				Qualitative	Analysis of stakeholder feedback; organizational credibility index
		T2.3	Innovation in Auditing Methods	Qualitative	Development of novel supervisory methods; process reengineering initiatives
				Quantitative	Investment rate in process change, learning, and development
T3	Organizational Performance	T3.1	Financial Performance	Quantitative	Cost savings in auditing; return on investment in technology
		T3.2	Service Quality	Quantitative	Stakeholder complaint rate; response time to requests
				Qualitative	Stakeholder satisfaction scores
		T3.3	Organizational Trust and Legitimacy	Quantitative	Public trust score; stakeholder trust retention rate

				Qualitative	Community feedback analysis; organizational credibility index
T4	Regulatory Environment and Compliance	T4.1	Regulatory Adherence	Quantitative	Percentage compliance with regulatory requirements; number of non-compliance events
				Qualitative	Expert assessments of regulatory risk management
		T4.2	Legal Risk Management	Quantitative	Number of legal incidents; time required to resolve legal issues
				Qualitative	Effectiveness of risk-mitigation strategy
T5	Organizational Culture and Change Management	T5.1	Readiness for Change	Qualitative	Employee surveys on change readiness; effectiveness of change communications
				Quantitative	Percentage of employees participating in change initiatives
		T5.2	Learning Culture	Quantitative	Average training hours per employee; number of knowledge-sharing sessions
				Qualitative	Perception of the learning environment; encouragement of innovation
T6	Technological Infrastructure and Support	T6.1	Robustness of IT Infrastructure	Quantitative	System uptime percentage; mean time to recovery (MTTR); network capacity utilization
				Qualitative	User satisfaction with IT systems
		T6.2	Quality of Technical Support	Qualitative	Support response time; resolution rate; user feedback on support
T7	User Adoption and Behavior	T7.1	System Utilization Rate	Quantitative	Percentage of users employing the open budget system; usage frequency
				Qualitative	Users' willingness to adopt new technologies
		T7.2	Users' Digital Literacy	Qualitative	Survey scores on digital skills; training completion rate
T8	Innovation and Strategic Alignment	T8.1	Innovation Rate	Quantitative	Number of newly developed auditing methods; percentage of R&D expenditure
				Qualitative	Leadership commitment to innovation
		T8.2	Strategy–Technology Alignment	Qualitative	Strategic alignment via managerial surveys
				Quantitative	Percentage of projects aligned with organizational strategy
T9	Risk Management and Information Security	T9.1	Security Threat Detection	Quantitative	Number of detected cyberattacks; incident response time
				Qualitative	Cybersecurity maturity assessment
		T9.2	Risk Mitigation	Quantitative	Frequency of risk assessments; success rate of risk reduction
				Qualitative	Expert judgments on risk culture
T10	Data Management and Analytics	T10.1	Data Quality	Quantitative	Data accuracy rate; data completeness; error rate
				Qualitative	Data governance maturity assessment
		T10.2	Advanced Analytics Application	Qualitative	Extent of analytics use in decision-making; adoption of AI and machine-learning tools

				Quantitative	Number of analytics projects; analytics return on investment
T11	Human Capital and Expertise	T11.1	Staff Expertise	Qualitative	Professional certification rate; years of relevant experience
				Quantitative	Employee retention rate; skills gap analysis
		T11.2	Training and Development	Quantitative	Average training hours per employee; training effectiveness score
				Qualitative	Employee feedback on training programs
T12	Ecosystem Development and Partnerships	T12.1	Strategic Partnerships	Qualitative	Number and quality of partnerships; partner satisfaction surveys
				Quantitative	Contribution to process improvement
		T12.2	Ecosystem Collaboration	Qualitative	Joint innovation projects; knowledge-sharing initiatives
T13	Financial Inclusion and Social Impact	T13.1	Access to Information	Quantitative	Percentage of new system users; number of new information requests
				Qualitative	Social impact assessment
		T13.2	Social Responsibility	Qualitative	Scope of corporate social responsibility projects; social investment
T14	Stakeholder Services and Communications Management	T14.1	Service Quality	Qualitative	Stakeholder complaint rate; service resolution time
				Quantitative	Stakeholder satisfaction scores
		T14.2	Relationship Management	Qualitative	Levels of stakeholder engagement; participation in improvement programs
T15	Operational Excellence and Process Optimization	T15.1	Process Efficiency	Quantitative	Average process cycle time; error rate
				Qualitative	Staff feedback on process improvements
		T15.2	Cost Optimization	Quantitative	Operational cost savings; return on investment of technology initiatives
T16	Communication Strategy and Awareness-Raising	T16.1	Effectiveness of Awareness Campaigns	Qualitative	Campaign reach; engagement rate
				Quantitative	Organizational perception surveys
		T16.2	Stakeholder Communication	Qualitative	Satisfaction with communication; response time
T17	Sustainability and Organizational Responsibility	T17.1	Reduction of Paper Use	Quantitative	Reduction in paper consumption; percentage reduction in physical documents
				Qualitative	Employee participation in sustainability
		T17.2	Sustainability Initiatives	Qualitative	Number and impact of green projects

Table 5. Final Delphi Validation of Thematic Indicators

Main Theme	Subtheme	Indicator	Delphi Round	Consensus Level (%)	Summary of Expert Feedback	Final Action Taken
Strategic Management	Strategic Vision	Alignment with Open Budgeting Goals	Round 1	80%	Clear but requires department-specific phrasing	Minor revision

	Strategic Alignment	Compatibility with National Financial Strategy	Round 1	86%	Well-formulated	Accepted
	Risk Management	Risk Policies Related to Open Budgeting	Round 2	93%	Critical item; a stronger tone is recommended	Finalized
Technological Capability	IT Infrastructure	Infrastructure Readiness	Round 1	76%	Needs clarification of the term "readiness"	Rewritten in Round 2
	Integration Capability	Integration with Legacy Systems	Round 2	100%	Clear and important	Accepted
	Technological Agility	Flexibility of Open Budget Platforms	Round 1	80%	Relevant; consider similar examples	Accepted
Organizational Capability	Human Capital	Skills in Open Budgeting	Round 2	87%	Suggested splitting technical vs. managerial skills	Divided into two sub-items
	Leadership Support	Management Commitment	Round 1	93%	Clear and validated	Accepted
	Organizational Learning	Culture of Acceptance and Learning	Round 2	86%	Define "learning" as formal/informal	Revised
User-Centered Innovation	User Trust	Perceived Data Security	Round 1	80%	Needs real-world examples	Rewritten in Round 2
	User Experience	Ease of Use of Open Budgeting Services	Round 2	100%	Well-articulated and simple	Accepted
	Customization	Personalization of Open Budgeting Services	Round 1	73%	Ambiguity in the term "customization"	Revised and validated in Round 2
Environmental Readiness	Legal and Regulatory	Regulatory Transparency	Round 2	93%	Essential; reflects current Iranian context	Finalized
	Ecosystem Support	Open Budget Developer Ecosystem	Round 1	67%	Lacked clarity; ambiguous scope	Removed due to low consensus
	Market Dynamics	Competitive Pressure	Round 2	86%	Precise and relevant	Accepted
Performance Orientation	Financial Results	Cost Savings and ROI	Round 1	100%	High agreement	Accepted
	Operational Efficiency	Speed, Transparency, Automation	Round 2	93%	Critical indicator; no revision needed	Accepted
	Innovation Performance	Innovation in Products/Services	Round 1	87%	Rewrite to distinguish from technological innovation	Adjusted

Table 6. Final Indicators for Foundational Factors of the Open Budgeting System in Improving the Audit Process

Main Theme (Dimension)	Subtheme	Indicator Type	Final Indicator (Code)
Strategic Readiness	Organizational Readiness	Qualitative	Integration of Open Budgeting into Strategic Goals
Strategic Readiness	Vision Alignment	Qualitative	Senior Management Commitment to Open Budget Transformation
Technological Infrastructure	System Compatibility	Quantitative	Availability of IT Systems Compatible with Open Budgeting
Technological Infrastructure	Infrastructure Agility	Qualitative	Flexibility of Digital Infrastructure for Adaptation
Organizational Learning	Knowledge Development	Qualitative	Open Budget-Related Training and Internal Knowledge Sharing
Organizational Learning	Innovation Culture	Qualitative	Encouragement of Experimentation with Open Budgeting
Process Reconfiguration	Workflow Digitalization	Quantitative	Degree of Process Automation through Open Budgeting
Process Reconfiguration	Integration Flexibility	Qualitative	Ability to Redesign Processes Around Open Budgeting Systems

User-Centricity	User Experience Enhancement	Quantitative	Transparency and Personalization of Open Budget-Based Services
User-Centricity	Trust and Security	Quantitative	Use of Open Budgeting to Enhance User Trust
Risk Management	Compliance Monitoring	Quantitative	Real-Time Audit Capability through Open Budgeting
Risk Management	Fraud Reduction	Quantitative	Use of Open Budgeting to Prevent Manipulation or Misconduct
Operational Efficiency	Cost Reduction	Quantitative	Role of Open Budgeting in Reducing Auditing Costs
Operational Efficiency	Time Optimization	Quantitative	Reduction in Service Delivery Time Using Open Budgeting
Inter-Organizational Connectivity	Ecosystem Integration	Qualitative	Integration with Other Organizations via Open Budgeting
Inter-Organizational Connectivity	Collaborative Synergy	Qualitative	Increased Collaboration through Integrated Systems
Regulatory Alignment	Legal Compatibility	Qualitative	Flexibility to Align Open Budget Initiatives with Regulations

To ensure the robustness and practical applicability of the thematically identified indicators, the Delphi method was employed with the participation of 15 experts in open budgeting systems, audit innovation, and organizational capabilities. This method enabled the structured and iterative validation of the thematic codes extracted from qualitative content analysis and literature review.

First Round Analysis: Exploratory Evaluation

In the first Delphi round, an initial list of 17 indicators within seven main thematic domains was presented to the experts. Their task was to assess the clarity, relevance, and comprehensiveness of each indicator using a structured feedback matrix and a five-point Likert scale. Open-ended qualitative comments were also collected. The mean consensus rate at this stage was 73.4%, below the predefined structural validity threshold of 80%.

Key expert suggestions included:

- Simplifying certain technical terms (such as “infrastructure agility” and “collaborative synergy”);
- Merging two similar indicators within the “user-centricity” domain;
- More clearly differentiating between “legal adaptability” and “compliance monitoring”;
- Adding more operational indicators related to audit process improvement.

Based on this feedback, the indicators were rewritten and simplified, duplicates were removed, and overlapping items were delineated with greater precision.

Second Round Analysis: Refinement and Consolidation

In the second round, the revised indicators—along with a summary of first-round results and anonymized feedback from other experts—were provided to the same panel. This transparency allowed for reflection and greater alignment among experts. Results at this stage were more promising: the mean consensus rate rose to 87.2%, and 13 out of 17 indicators achieved consensus levels of 80% or higher. However, four indicators—“collaborative synergy,” “legal adaptability,” “vision alignment,” and “knowledge development”—remained within the 76%–79% range.

Third Round Analysis: Final Consensus

In the third and final round, the revised indicators were presented with updated definitions and practical examples tailored to the context of the Supreme Audit Court. At this stage, full consensus was achieved: nine indicators reached 100% agreement, and the remaining indicators attained at least 80%, meeting the convergence criterion of the Delphi method.

Experts particularly confirmed the practical alignment of the indicators with the realities of Iran's auditing system, especially in the areas of regulatory constraints, inter-organizational collaboration, and operational efficiency. Furthermore, some experts suggested classifying the indicators into three functional layers: (1) Strategy and Governance Layer, (2) Technology and Infrastructure Layer, and (3) Operations and Performance Layer. This was considered a complementary perspective rather than a structural reorganization.

The Delphi method successfully validated the indicators derived from thematic analysis. Through a rigorous, consensus-driven three-round process, a final set of 17 theoretically and practically validated indicators was established, specifically adapted to Iran's auditing environment—particularly within the Supreme Audit Court. The integration of qualitative depth and expert consensus ensures the robustness of the research model for analyzing audit process improvement based on the open budgeting system.

4. Discussion and Conclusion

The results of this study, obtained through a combination of qualitative content analysis and the Delphi method, revealed a comprehensive framework of 17 validated indicators that collectively define the foundational factors influencing the successful implementation of the open budgeting system in improving the audit process of the Supreme Audit Court of Iran. These indicators were categorized into major thematic dimensions such as strategic readiness, technological infrastructure, organizational learning, process reconfiguration, user-centricity, risk management, operational efficiency, inter-organizational connectivity, and regulatory alignment. The findings underscore that the transition toward open budgeting is a multidimensional transformation that extends beyond financial reforms—it represents an integrated process of strategic, organizational, technological, and cultural change [2].

The results suggest that strategic readiness and managerial commitment play a pivotal role in facilitating the adoption of open budgeting practices. The experts reached consensus that aligning open budgeting initiatives with organizational vision and strategic goals strengthens coherence between financial management and institutional missions. This finding aligns with the argument that effective budget management is inseparable from strategic planning and long-term policy objectives [9]. Prior research confirms that when senior leadership commits to budget transparency, it fosters trust and accountability across institutional layers [11]. This is especially significant in public institutions like the Supreme Audit Court, where managerial vision determines how budgeting reform translates into practical governance mechanisms. The inclusion of "management commitment" as one of the highest-rated indicators resonates with previous studies that emphasize leadership's role in ensuring the success of fiscal reforms [1].

Moreover, the findings highlight technological infrastructure and agility as essential components in implementing open budgeting. Experts agreed that the presence of integrated and adaptable digital platforms enables better data management, real-time monitoring, and seamless auditing. This outcome mirrors global experiences showing that the digitization of financial systems can reduce operational inefficiencies and enhance transparency [5]. In the context of Iran, where technological fragmentation and bureaucratic silos often hinder reform efforts, the establishment of interoperable systems for fiscal reporting is a precondition for institutional modernization [20]. Similar to the work of [4], the present findings reinforce that digital readiness acts as a catalyst for performance-based and open budgeting by allowing timely access to financial information and supporting performance evaluation processes. The consensus achieved on "infrastructure readiness" and "system

compatibility" also corresponds with previous research emphasizing that information technology maturity directly influences audit efficiency and the traceability of public funds [8].

The results further demonstrated that organizational learning and innovation culture are central to sustaining open budgeting initiatives. Experts agreed that training programs, knowledge sharing, and an open learning environment significantly contribute to the institutionalization of budgeting reforms. This finding resonates with [12], who emphasized that public sector budgeting reforms succeed only when supported by a culture of adaptability and learning. The acknowledgment of "innovation culture" as a critical dimension is consistent with [9], who identified organizational innovation and psychological readiness as antecedents of budgetary effectiveness. Additionally, [11] found that open budgeting in universities promoted not only transparency but also collaborative learning between departments, strengthening overall fiscal governance. In this study, experts viewed organizational learning as a mechanism for bridging knowledge gaps between technology adoption and practical auditing applications—a factor often overlooked in traditional budgeting reforms.

The dimension of process reconfiguration and workflow digitalization was also validated as a transformative factor. According to the experts, digitalizing audit workflows through open budgeting systems enhances efficiency, reduces human error, and minimizes duplication in reporting. This finding supports the assertion that automation and process redesign are vital for operational excellence in audit systems [4]. Furthermore, such digital integration allows for real-time financial tracking and continuous control, fostering proactive oversight rather than reactive reporting [17]. As [3] and [7] also argue, optimal resource allocation and audit accuracy improve when budgeting systems are dynamic and supported by intelligent feedback mechanisms. In the present study, the experts confirmed that workflow automation not only streamlines audit operations but also reinforces the credibility of financial reports by eliminating manual bias and enhancing consistency.

Another key finding relates to user-centricity, particularly the subdimensions of "user experience improvement" and "trust and security." Experts unanimously agreed that the usability and perceived reliability of open budget systems directly affect stakeholder engagement and acceptance. This corresponds with [6], who found that users' perceptions of budgeting systems as useful and transparent determine their practical relevance in organizational settings. Similarly, [14] emphasized that auditor experience and competence significantly influence their confidence in using budgeting and auditing technologies. In the Iranian context, where financial information is often viewed as sensitive, ensuring data security and user confidence becomes essential for the success of open budget systems [17]. Therefore, improving the interface, accessibility, and reliability of fiscal platforms enhances participation among both internal auditors and external stakeholders.

The results also revealed that risk management and compliance monitoring are indispensable for strengthening fiscal oversight in open budgeting systems. The experts achieved strong consensus on indicators related to "real-time audit capability" and "fraud prevention." These outcomes are in line with [15], who demonstrated that budget constraints often shape the auditor selection process and influence risk management policies. Likewise, [16] showed that audit budgets can act as proxies for managing perceived audit risks. The current study confirms that incorporating risk analytics into open budget systems improves the predictive capacity of audits and minimizes opportunities for manipulation. In this sense, open budgeting enhances not only transparency but also accountability through continuous monitoring, as suggested by [18]. This transformation ensures that audit institutions move from traditional, post-facto evaluations to ongoing, real-time verification mechanisms that improve governance integrity.

The study's Delphi results also identified operational efficiency—specifically cost reduction and time optimization—as crucial outcomes of open budgeting implementation. According to the panel, open budgeting systems streamline financial management, reduce administrative burdens, and expedite auditing processes. This aligns with the system dynamics-based findings of [7], which demonstrated that integrated budget models enhance efficiency and fiscal discipline. Moreover, [4] established that performance-based budgeting using fuzzy programming significantly reduces operational costs in public organizations. These efficiencies directly affect the Supreme Audit Court's ability to deliver timely, high-quality audit reports, contributing to the overall effectiveness of government financial supervision [8]. In line with [3], the study reinforces that process optimization through open budgeting not only improves organizational productivity but also strengthens fiscal accountability mechanisms.

The finding regarding inter-organizational connectivity and collaborative synergy emphasizes that open budgeting systems function effectively only when financial data can flow seamlessly across institutional boundaries. Experts agreed that collaboration between auditing, budgeting, and policy-making entities is vital to avoid data silos and duplication. This perspective is supported by [10], who demonstrated that inter-organizational collaboration and legislative oversight enhance the accountability of budgeting processes. Similarly, [20] found that university–society budget integration through system dynamics fosters mutual learning and efficiency in resource utilization. The present study supports these conclusions, confirming that open budgeting must be embedded within a cooperative ecosystem involving multiple stakeholders to ensure system-level coherence and transparency.

Finally, regulatory alignment emerged as a cross-cutting factor that determines the success or failure of open budgeting initiatives. Experts emphasized that flexibility in aligning open budgeting reforms with existing laws and governance frameworks ensures sustainability. This outcome is consistent with [2], who argued that sustainable development-based governance in Iran's budgeting system requires adaptive regulatory structures. Likewise, [10] highlighted that the success of parliamentary supervision depends on the congruence between budgeting policies and legislative frameworks. The current findings confirm that without regulatory synchronization, even technologically advanced systems remain vulnerable to institutional fragmentation and resistance.

Overall, the study's integrated results confirm that open budgeting enhances the transparency–accountability–efficiency triad in public auditing. The validated indicators form a cohesive model in which strategic commitment, digital infrastructure, organizational learning, and inter-institutional collaboration converge to promote fiscal openness. The empirical evidence supports the theoretical proposition that open budgeting not only strengthens the efficiency of audit institutions but also builds public trust and democratic legitimacy in financial governance [5, 11]. This holistic framework demonstrates that the Supreme Audit Court's transformation toward open budgeting is feasible, provided that it is supported by cultural readiness, cross-sector coordination, and sustained leadership commitment.

Despite its methodological rigor, this study faced several limitations. First, the qualitative and Delphi approaches rely heavily on expert judgment, which may introduce subjectivity, especially in interpreting complex fiscal concepts. Although triangulation was used to minimize bias, future quantitative validation would strengthen the generalizability of the findings. Second, the study was context-specific to Iran's Supreme Audit Court, limiting the applicability of its conclusions to other countries with different governance structures. Third, access to some participants was constrained by confidentiality restrictions within governmental bodies, which may have reduced

the diversity of viewpoints. Lastly, rapid technological changes could outpace the stability of the identified indicators, requiring periodic updates to maintain relevance in dynamic fiscal environments.

Future studies should expand the model using quantitative methods such as structural equation modeling or system dynamics simulation to test causal relationships among the identified indicators. Cross-country comparative research could also explore how institutional, legal, and cultural differences affect the implementation of open budgeting systems. Moreover, longitudinal studies could assess how the introduction of open budgeting impacts audit efficiency, transparency, and corruption control over time. Integrating behavioral perspectives—such as auditor decision-making and citizen trust—would further enrich understanding of the human dimension in budgeting reforms.

Practically, policymakers and managers should prioritize building technological and organizational readiness before implementing open budgeting systems. Continuous training and capacity-building programs should be established to enhance staff competence in data analytics, digital auditing, and fiscal transparency. It is also recommended that public institutions develop clear guidelines for inter-agency collaboration and ensure regulatory flexibility to support innovation. Finally, embedding transparency and accountability as cultural norms, rather than merely administrative requirements, will be key to sustaining the long-term effectiveness of open budgeting reforms in improving public audit processes.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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