

Application of Data Mining Technology in Accounting Information Systems of Government Institutions: Drivers and Scenarios

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Abstract: In the contemporary era, data mining, as an advanced tool for data analysis and the discovery of hidden patterns, plays an important role in enhancing information quality and improving financial processes. The present study aimed to conduct a foresight analysis of the use of data mining technology in the accounting information systems of Iranian government institutions using a scenario-planning approach. This study employed a mixed-methods (qualitative–quantitative) design. In the qualitative phase, a review of the literature and semi-structured interviews with 19 academic and professional experts identified 30 influential factors. Subsequently, using an expert assessment questionnaire, 22 statistically significant factors were selected. In the quantitative phase, a cross-impact analysis questionnaire was distributed among the experts, and the data were analyzed using MICMAC software, resulting in the identification of three key drivers. Subsequently, Scenario Wizard software was used to develop plausible scenarios for the future use of data mining, and appropriate implementation strategies were proposed for each scenario. Among the 22 significant factors, three key drivers with an influence score greater than 80 and a dependence score below 30 were identified: development of information technology infrastructure, availability of specialized human resources, and managers' inclination toward data-driven decision-making. The remaining factors were positioned in dependent, linkage, or autonomous zones, indicating their dependence on these three drivers. Ultimately, 21 plausible scenarios were developed. The findings can provide a basis for policymaking, planning, and enhancing financial transparency and accountability in the public sector.

Keywords: foresight, data mining technology, accounting information systems, government institutions, scenario planning.

1. Introduction

The increasing digitalization of public administration has transformed the nature of financial management, accounting, auditing, and managerial decision-making in government institutions. Public organizations currently operate in environments characterized by continuously expanding volumes of financial and administrative data, increasing demands for accountability, and growing pressure to improve the efficiency, transparency, and timeliness of public services. Within this environment, accounting information systems (AIS) have evolved from conventional transaction-processing mechanisms into integrated information infrastructures capable of supporting planning, control, performance evaluation, and managerial decision-making. Evidence from public-sector organizations indicates

that effective accounting information systems can contribute to improved managerial performance and strengthen the informational foundations of organizational control [1]. Furthermore, the progression of public-sector AIS toward emerging digital technologies has increasingly altered accountants' professional responsibilities and organizational information-processing requirements [2]. Consequently, the strategic value of accounting information systems is no longer determined solely by their ability to record and report transactions, but increasingly by their capacity to transform large and heterogeneous datasets into actionable managerial knowledge.

Digital transformation has further accelerated this transition by integrating advanced information technologies into public-sector accounting processes. Digitalization changes not only the technological architecture of governmental organizations but also organizational agency, governance mechanisms, workflows, and relationships among institutional actors [3]. In public-sector accounting specifically, the interaction between digital accounting systems and information technology infrastructure has become increasingly significant because the quality, integration, and accessibility of technological resources directly affect the functionality of accounting systems [4]. Recent evidence from developing-country contexts also suggests that digital transformation can substantially affect the quality of public-sector accounting information systems, particularly by improving data processing, information availability, reporting capabilities, and the timeliness of accounting outputs [5]. These developments have created favorable conditions for integrating analytical technologies such as data mining into accounting information systems and using financial data for purposes extending beyond conventional reporting.

Data mining refers to a collection of computational and analytical techniques used to discover meaningful relationships, recurring structures, associations, anomalies, and predictive patterns within large datasets. Its importance to accounting information systems has grown as accounting datasets have become larger, more complex, and increasingly multidimensional. The contemporary big-data environment has generated both substantial opportunities and significant methodological challenges for accounting, including the need to process high-volume information, integrate diverse data sources, and extract relevant patterns for decision support [6]. Similar transformations are evident in auditing, where large-scale digital data facilitate more extensive and continuous analysis while simultaneously increasing the need for advanced technological capabilities and appropriate analytical expertise [7]. Data mining therefore represents an important mechanism through which accounting information systems can move from retrospective financial reporting toward predictive, diagnostic, and prescriptive forms of analysis.

The value of data mining in accounting information systems is particularly evident in its contribution to intelligent decision-making. Data mining tools can support the automated identification of patterns within accounting information and provide managers with analytical evidence that would be difficult to derive through traditional accounting procedures [8]. Empirical research has also shown that the performance effects of data mining in accounting information systems are closely associated with the adequacy of information technology infrastructure, indicating that technological infrastructure can play an important mediating role in converting analytical capabilities into improved AIS performance [9]. More recent studies focused directly on public-sector environments have highlighted the potential of integrating data mining into AIS to improve information processing, managerial analysis, and organizational decision-making while also emphasizing implementation barriers relating to technology, human capabilities, institutional preparedness, and governance [10]. Thus, effective adoption of data mining depends on a broader sociotechnical configuration rather than merely the acquisition of analytical software.

One of the most important applications of data mining in governmental accounting is the improvement of financial monitoring and the detection of irregularities. Public institutions manage extensive financial flows and are responsible for safeguarding public resources, making fraud prevention and anomaly detection central components of sound financial governance. Advanced analytics and machine-learning techniques can increase the capacity of organizations to identify suspicious transactions, unusual financial behaviors, and hidden patterns that may indicate fraudulent activities [11]. Big-data analytics can similarly contribute to the detection and prevention of financial fraud in increasingly digitized transaction environments by enabling the analysis of large datasets at speeds and levels of complexity that exceed conventional manual procedures [12]. In the field of auditing, the integration of process mining and machine learning can strengthen internal control evaluation by identifying process deviations and control deficiencies and by providing more systematic evidence for audit judgments [13]. These capabilities are especially relevant to government institutions, where effective internal control constitutes a central mechanism for safeguarding public funds and strengthening institutional accountability.

The growing dependence of governmental accounting systems on digital infrastructures has, however, introduced new risks related to information security and internal control. Data-intensive accounting environments expose organizations to cybersecurity threats, unauthorized access, system vulnerabilities, and data breaches that may compromise the integrity and confidentiality of financial information. Research examining cybersecurity breaches and internal controls indicates that cybersecurity events can have significant implications for the effectiveness of organizational control structures and financial information environments [14]. Accordingly, adoption of data mining in governmental AIS must be accompanied by robust information-security arrangements, access controls, data-governance frameworks, and continuous monitoring mechanisms. The technological sophistication required for analytical accounting must therefore be evaluated alongside the institutional capacity to protect information assets and maintain reliable control systems.

Beyond control and fraud detection, data mining can strengthen the predictive capacity of public-sector financial management. Government institutions routinely make decisions concerning budgeting, resource allocation, expenditure control, public investment, and macroeconomic planning under conditions of uncertainty. Financial forecasting methods based on advanced analytical models can provide decision-makers with more informative assessments of future economic and financial conditions [15]. Contemporary financial forecasting is increasingly incorporating multimodal, causal, time-series, and macroeconomic-event information, further illustrating the potential of advanced data-oriented systems to improve forecasting accuracy and sensitivity to environmental changes [16]. At the broader policy level, complex data analysis can support public authorities in understanding structural economic relationships and identifying the potential consequences of policy interventions [17]. Consequently, integrating data mining into governmental accounting information systems may enhance not only organizational accounting functions but also higher-level financial policymaking and strategic planning.

The effectiveness of such analytical systems is closely related to the quality of public-resource management. Government institutions face persistent pressure to improve efficiency while simultaneously maintaining service quality and meeting societal expectations. Comparative evidence suggests that public-sector efficiency is strongly associated with governance quality and the institutional capacity to manage resources effectively [18]. Effective monitoring and evaluation mechanisms similarly contribute to good governance by facilitating systematic assessment of organizational performance, resource utilization, and public-program outcomes [19]. The development of relevant key performance indicators can further strengthen performance management in public administration by transforming organizational data into measurable indicators that support control and managerial

assessment [20]. Data mining can extend these approaches by identifying multidimensional patterns across financial and operational indicators and thereby enabling more precise evaluation of resource allocation and organizational performance.

Another important dimension of data-driven public management is the growing use of management dashboards. Dashboards translate complex and frequently updated datasets into structured visual information that managers can use for monitoring organizational conditions and identifying emerging problems. Comprehensive data dashboards have been associated with improved service delivery by providing managers with timely, consolidated, and operationally relevant information [21]. Research on management-dashboard design likewise demonstrates the importance of tailoring indicators and visual information structures to users' managerial and decision-making requirements [22]. In governmental accounting environments, the integration of data mining with dashboards can strengthen real-time monitoring by enabling the identification of trends and exceptions before the information is presented to decision-makers. This integration can therefore shift accounting information systems from static reporting platforms toward dynamic managerial intelligence systems.

Transparency and accountability provide an additional rationale for the adoption of advanced analytical technologies in the public sector. Public-sector accounting is expected to support stewardship of public resources and provide transparent information to oversight bodies, policymakers, and citizens. Systematic evidence emphasizes the close relationship between public-sector accounting practices, accountability, and transparency [23]. Greater budget transparency can also generate important governance benefits by improving the visibility of public financial activities and enabling more effective external scrutiny [24]. Accordingly, improving budget transparency is regarded as an important component of effective and sustainable governance [25]. In the Iranian context, assessments of governmental financial transparency have similarly identified deficiencies and highlighted the need for institutional and procedural reforms to improve financial disclosure and accountability [26]. By facilitating detailed analysis of public financial data, data mining may contribute to identifying inconsistencies, improving the traceability of transactions, and strengthening the informational basis for financial oversight.

Nevertheless, technological capacity alone does not guarantee the successful adoption of data mining. Human-resource competencies constitute a central determinant of whether organizations can effectively implement and sustain advanced analytical systems. The increasing complexity of digital accounting environments requires personnel who possess competencies in accounting, information systems, data analytics, and emerging technologies. Human-resource auditing and performance evaluation frameworks emphasize the strategic importance of aligning workforce competencies with organizational requirements and technological change [27]. Continuous education is similarly necessary because technological developments require accountants and other organizational personnel to acquire new analytical and digital capabilities [28]. In the context of Iranian government organizations, the development of integrated accounting information systems has also been associated with the need to enhance organizational performance and reduce administrative violations, highlighting the importance of appropriate institutional and human capacities [29]. Therefore, the availability and retention of specialized personnel can be considered a major driver of data mining adoption.

Employees' responses to technological change represent another significant organizational consideration. Digital transformation frequently alters established routines, responsibilities, power relationships, and perceptions of professional identity. Employees may accept new technologies when they perceive them as useful and manageable, but they may also exhibit resistance when digital tools are associated with uncertainty, workload, diminished autonomy, or insufficient organizational support [30]. Contemporary research on resistance to digital

transformation argues that resistance should not be interpreted merely as individual opposition; rather, it may emerge from interactions among organizational structures, technology design, institutional practices, and employee experiences [31]. Consequently, implementation of data mining in government institutions requires change-management mechanisms, employee participation, training, and communication strategies that address both technical and behavioral dimensions of technological transition.

Organizational culture also shapes the extent to which analytical technologies become embedded in routine decision-making. Public organizations with cultures oriented toward innovation and continuous improvement may be more capable of experimenting with digital tools, learning from implementation processes, and institutionalizing new analytical practices [32]. At the same time, effective data mining requires a decision-making culture that recognizes the value of empirical evidence. Organizational strategies designed to institutionalize evidence-informed decision-making emphasize leadership support, access to high-quality evidence, technical competence, and routines that integrate analytical findings into management processes [33]. Research on evidence-based management further suggests that decision-making styles, cultural characteristics, and managerial competencies influence managers' adoption of evidence sources [34]. These findings demonstrate that the future of data mining in governmental AIS depends not only on whether data and analytical tools exist but also on whether organizational decision-makers are willing and able to use them systematically.

This managerial dimension has become particularly salient as artificial intelligence and advanced analytics are increasingly introduced into the public sector. AI-driven decision-making can enhance the capacity of public organizations to process complex information, but successful application requires appropriate methodological tools, institutional safeguards, and managerial understanding of how analytical outputs should be interpreted [35]. Data-driven decision-making should therefore be considered an organizational capability involving technology, human expertise, institutional routines, leadership, and governance rather than a purely computational process. Where managers continue to rely primarily on intuition or conventional reporting despite the availability of advanced analytics, the organizational value of data mining may remain unrealized.

The foregoing considerations indicate that the adoption of data mining within governmental accounting information systems is influenced by a complex network of mutually reinforcing technological, organizational, managerial, regulatory, and human-resource factors. Existing studies provide valuable evidence regarding the contribution of information technology infrastructure, advanced analytics, financial forecasting, internal control, transparency, human competencies, organizational culture, employee acceptance, and evidence-based management. However, these determinants are frequently examined independently or through conventional explanatory models, whereas the future development of data mining in public-sector accounting is inherently characterized by uncertainty, interaction among drivers, and multiple possible development pathways. This problem is particularly important in environments in which technological infrastructure, access to analytical software, workforce capabilities, regulatory expectations, and managerial attitudes may develop at different rates.

Foresight and scenario planning provide an appropriate framework for addressing this complexity because they do not assume that the future will follow a single predetermined trajectory. Instead, scenario-based approaches identify critical drivers, examine interactions among uncertain variables, and construct internally coherent alternative futures that can support strategic preparedness. For government institutions, such an approach is particularly useful because decisions concerning information infrastructure, workforce development, accounting-system modernization, and digital governance involve long-term investments whose effectiveness depends on the future configuration of multiple interdependent factors. Identifying the variables with the strongest driving power

can therefore help policymakers distinguish between factors that fundamentally shape system development and those whose behavior is primarily dependent on broader structural changes.

Accordingly, the aim of this study is to identify the key drivers affecting the future application of data mining technology in the accounting information systems of Iranian government institutions and to develop plausible future scenarios using a foresight and scenario-planning approach.

2. Methods and Materials

This study was conducted using a mixed-methods (qualitative–quantitative) approach in three principal stages: a systematic literature review, semi-structured interviews, and three rounds of questionnaires. The statistical population consisted of academic experts (holders of a doctoral degree with at least 20 years of experience and two relevant publications) and professional experts (individuals occupying key financial positions with at least 25 years of experience) in government institutions. Purposive sampling combined with snowball sampling was continued until theoretical saturation was achieved, resulting in a final sample of 19 experts, including eight academic and 11 professional experts. The content validity of the questionnaires was confirmed using the Content Validity Ratio (CVR) and Content Validity Index (CVI), while reliability was confirmed using Cronbach’s alpha (0.96) and test–retest coefficients (0.82–0.85). In the qualitative phase, the trustworthiness of the interviews was ensured through participant feedback and data-source triangulation. The expert selection process was validated through peer evaluation by referring the selection criteria to two independent specialists. In the quantitative phase, questionnaire data were analyzed using SPSS, MICMAC, and Scenario Wizard software. The demographic and professional characteristics of the experts are presented in Table 1.

Table 1. Demographic Characteristics of the Experts

Field	Gender	Highest Academic Degree	Number	Mean Age (Years)	Mean Work Experience (Years)	Selection Criterion
Academic	Male	PhD	5	45	25	Research and teaching in accounting
Academic	Female	PhD	3	41	21	Research and teaching in accounting
Professional	Male	PhD	3	49	23	Professional activity in the accounting departments of government institutions
Professional	Male	Master’s degree	8	53	29	Professional activity in the accounting departments of government institutions

The research was conducted through the following stages:

Step 1: To identify the influential factors, a systematic review of the literature was first conducted, together with semi-structured interviews with 19 experts, resulting in the extraction of 30 initial factors. For the systematic literature review and identification of influential factors, reputable domestic databases, including SID, Noormags, Magiran, and Elmnet, as well as international databases such as ScienceDirect, Scopus, Emerald, Google Scholar, and Web of Science, were searched. Following the initial search, the articles were screened according to the inclusion criteria, including relevance to the research topic, publication in peer-reviewed scientific journals, publication period, and availability of the full text. Ultimately, 62 articles were selected for in-depth analysis. In addition to database searches, semi-structured interviews with 19 academic and professional experts were used as a complementary source for identifying context-specific factors relevant to conditions in Iran.

Step 2: These factors were presented to the same group of experts through an expert assessment questionnaire using a five-point Likert scale. After the responses were collected, the data were analyzed using the binomial test

in SPSS. Factors with a significance level below 0.05 were considered significant and influential, whereas eight factors that lacked statistical significance (8 of the 30 factors) were eliminated. Accordingly, the number of factors was reduced from 30 to 22 significant factors.

Step 3: After identifying the 22 significant factors, they were presented to the experts in the form of a cross-impact analysis matrix using a scale from 0 to 3, and the data were analyzed using MICMAC software. For each factor, the software calculates two indicators—driving power and dependence—and accordingly classifies the variables into driving, linkage, dependent, autonomous, and regulatory categories.

Among the 22 factors, only three were positioned in the driving zone, exhibiting the highest driving power (above 80 out of 100) and the lowest dependence (below 30 out of 100). These three factors were the advancement of information technology infrastructure, availability of specialized human resources, and managers' inclination toward data-driven decision-making. The remaining 19 factors were classified into dependent, linkage, or autonomous zones, indicating that their effects were contingent upon the three key drivers and that changes in these factors alone could not produce a fundamental transformation in the system. These three drivers, as the driving forces of the system and the principal dimensions of scenario development, were carried forward to the next stage of the research.

Step 4: Experts were consulted regarding the possible states of each driver, and three states—optimistic, intermediate, and pessimistic—were specified for each driver.

Step 5: An uncertainty questionnaire was designed based on Cross-Impact Balance (CIB) analysis and administered to the experts. In this method, each state is evaluated on a scale ranging from -3 to +3, representing the degree to which the occurrence of one state influences the other states (Zali, 2011). The resulting data were analyzed using Scenario Wizard software, and three plausible scenarios with consistency scores of 0.87, 0.82, and 0.75 were identified.

Step 6: The plausible scenarios—optimistic, intermediate, and pessimistic—were explained, and implementation strategies appropriate to each scenario were proposed. The research horizon was defined as the next 5–15 years, and the validity and reliability of all three questionnaires were confirmed using CVR, CVI, Cronbach's alpha, and test-retest measures.

3. Findings and Results

Initially, 30 influential factors were identified through a review of the research literature and interviews with experts. Subsequently, using a Likert-scale questionnaire and based on the experts' assessments, the importance of each factor was evaluated. After completion and collection of the 19 questionnaires, the relevant data were entered into SPSS. Based on the analyses, 22 factors with statistical significance were identified as key factors. Details of these factors are presented in Table 2.

Table 2. Factors and Drivers Influencing the Adoption of Data Mining Technology in the Accounting Information Systems of Government Institutions, Derived from Previous Research and Expert Interviews

Thematic Category	Driver	Sources
Productivity and resource allocation	Necessity of increasing efficiency in the allocation of national resources	Interview; Mahmoudi et al. (2019)
Productivity and resource allocation	Pressure to reduce costs and increase productivity in government organizations	Interview; Molaei et al. (2025)
Productivity and resource allocation	Need for more effective control and monitoring of public resources	Interview; Fioretto et al. (2024); Negri and Dincă (2023); Mohamed and Kulmie (2023)

Data mining and financial analysis	Need to enhance financial information security and big-data-based auditing	Interview; Zhou and Huang (2024); Sun et al. (2024)
Data mining and financial analysis	Managers' inclination toward data-driven decision-making	Fischer-Abaigar et al. (2024)
Data mining and financial analysis	Increasing volume and complexity of financial data, necessitating advanced analytics	Theodorakopoulos et al. (2024); Babajani et al. (2023); Aziznejad (2019)
Data mining and financial analysis	Need to detect fraud, deviations, and anomalous patterns in financial data	Interview; Udeh et al. (2024); Bello et al. (2023); Theodorakopoulos et al. (2024); Babajani et al. (2023); Aziznejad (2019)
Data mining and financial analysis	Support for financial forecasting, intelligent budgeting, and cost-benefit analysis	Interview; Allahverdi et al. (2023)
Data mining and financial analysis	Increasing demand for management dashboards based on real-time and up-to-date data	Adekugbe and Ibeh (2024); Ghanatjoo et al. (2024)
Polymaking and macro-level decision-making	Government macro-level policies concerning digital transformation and e-government	Babajani et al. (2023); Aziznejad (2019)
Polymaking and macro-level decision-making	Support provided by data mining technology for policy analysis and macroeconomic decision-making	Hidalgo (2023); Mehrzad (2019)
Polymaking and macro-level decision-making	Ability to forecast the financial impacts of government policies and projects	Zhang et al. (2025); Rafiei et al. (2024)
Transparency, oversight, and internal controls	Regulatory requirements and budget transparency requirements imposed by supervisory institutions	Interview; Prijaković (2022); Stanimirovic (2022); Babajani et al. (2023)
Transparency, oversight, and internal controls	Use of data mining for preventive monitoring and automation of internal controls	Duan et al. (2025); Babajani et al. (2023)
Transparency, oversight, and internal controls	Pressure to improve financial transparency and public accountability	Interview; Sari and Muslim (2023); Delashoub (2024)
Technology and information infrastructure	Advancement of information technology infrastructure in government organizations	Interview; Alsharari and Ikem (2023); Di Giulio and Vecchi (2021); Kheirandish et al. (2016)
Technology and information infrastructure	Access to analytical software and data mining tools suitable for and adaptable to accounting data	Interview; Jia and Wang (2024); Amani and Fadlalla (2017)
Human resources and skills	Availability of specialized human resources in data analytics and emerging technologies	Interview; Adllaleh et al. (2024); Chu and Yong (2021)
Human resources and skills	Organizational culture based on innovation and continuous improvement	Sena et al. (2024)
Human resources and skills	Employees' acceptance of emerging technologies and low resistance to change	Interview; Alabi (2025); Cieslak and Valor (2024)
Human resources and skills	Organizational culture supporting evidence-based and analytical decision-making	Kassar et al. (2024); Clark et al. (2024)
Human resources and skills	Continuous training in data mining and analytical accounting	Interview; Amalia (2023); Gilani-Nia et al. (2023)

The status and role of each key factor are illustrated in Figure 1.

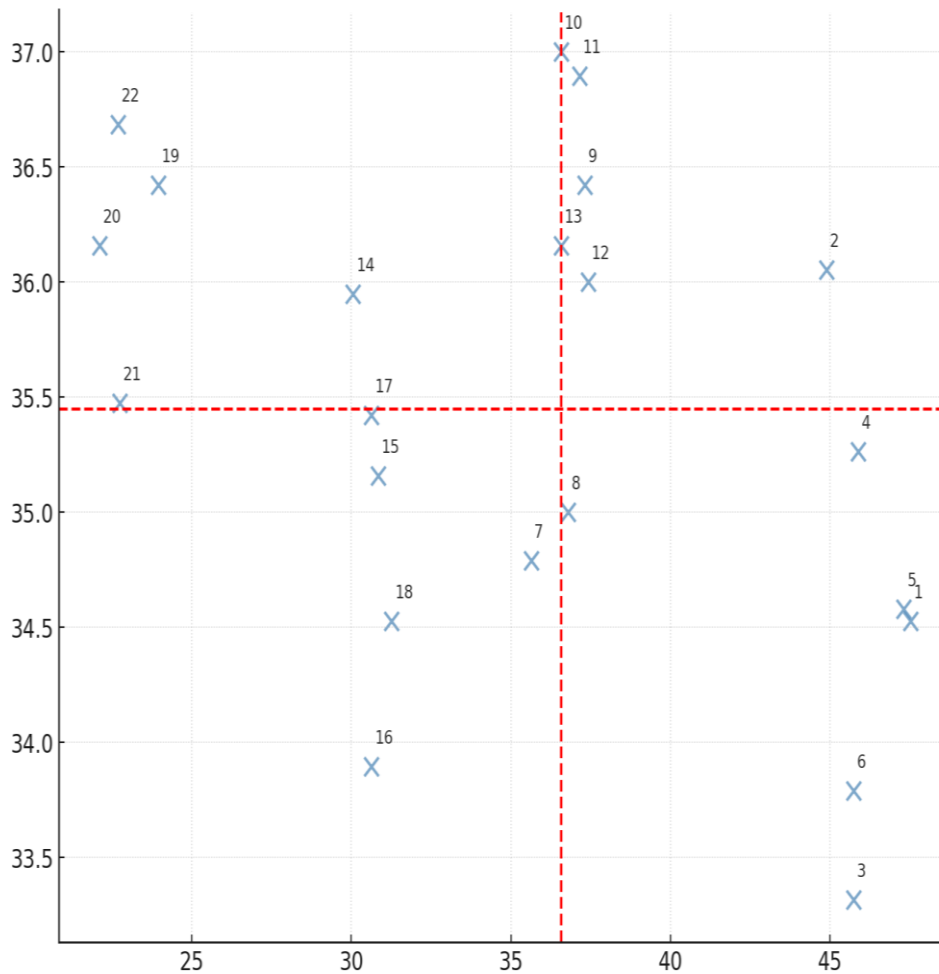


Figure 1. Scatter Plot of Drivers Based on Simulated MICMAC Analysis

As shown in Figure 1, the levels of influence and dependence of the key variables can be determined.

According to the MICMAC analysis, the driving factors include advancement of information technology infrastructure, government macro-level policies in the field of digital transformation, regulatory requirements, and pressure for financial transparency. These factors exhibit the highest driving power and the lowest dependence. They are located in the southeastern region of the scatter plot and are identified as the most critical components because the future adoption of data mining in government institutions largely depends on them. Nevertheless, these variables are predominantly external to the system and cannot be controlled through the system itself. Details concerning the status of each factor influencing the use of data mining technology in the accounting information systems of government institutions are presented in Table 3.

Table 3. Influence and Dependence Status of Factors Affecting the Adoption of Data Mining Technology in the Accounting Information Systems of Government Institutions

No.	Driver	MICMAC Classification	Mapping ID
1	Use of data mining for preventive monitoring and automation of internal controls	Dependent	10
2	Support for financial forecasting, intelligent budgeting, and cost-benefit analysis	Dependent	14
3	Employees' acceptance of emerging technologies and low resistance to change	Dependent	19
4	Organizational culture supporting evidence-based and analytical decision-making	Dependent	20
5	Increasing demand for management dashboards based on real-time and up-to-date data	Dependent	21
6	Continuous training in data mining and analytical accounting	Dependent	22

7	Advancement of information technology infrastructure	Driving/Strategic	1
8	Availability of specialized human resources in data analytics and emerging technologies	Driving/Strategic	3
9	Access to analytical software and data mining tools suitable for and adaptable to accounting data	Driving/Strategic	4
10	Regulatory requirements and budget transparency requirements imposed by supervisory institutions	Driving/Strategic	5
11	Managers' inclination toward data-driven decision-making	Driving/Strategic	6
12	Government macro-level policies concerning digital transformation and e-government	Driving/Strategic	8
13	Increasing volume and complexity of financial data, necessitating advanced analytics	Autonomous	7
14	Ability to forecast the financial impacts of government policies and projects	Autonomous	15
15	Pressure to reduce costs and increase productivity in government organizations	Autonomous	16
16	Need for more effective control and monitoring of public resources	Autonomous	17
17	Organizational culture based on innovation and continuous improvement	Autonomous	18
18	Need to enhance financial information security and big-data-based auditing	Linkage/Key	2
19	Need to detect fraud, deviations, and anomalous patterns in financial data	Linkage/Key	9
20	Support provided by data mining technology for policy analysis and macroeconomic decision-making	Linkage/Key	11
21	Necessity of increasing efficiency in the allocation of national resources	Linkage/Key	12
22	Pressure to improve financial transparency and public accountability	Linkage/Key	13

As shown in Figure 1, three principal factors were identified:

- (a) availability of specialized human resources in data analytics and emerging technologies;
- (b) managers' inclination toward data-driven decision-making; and
- (c) advancement of information technology infrastructure.

These factors were identified as the most important and influential determinants of the adoption of data mining technology in the accounting information systems of Iranian government institutions. The other factors are directly or indirectly influenced by these three factors. In the next stage, the scenario development process was conducted by focusing on these three key factors. For this purpose, the experts described the different states that each of these key factors might assume in the future. Details of the possible states of the key variables are presented in Table 4.

Table 4. Possible States of Key Drivers Affecting the Future Adoption of Data Mining Technology in the Accounting Information Systems of Government Institutions

No.	Driver	State 1: Optimistic	State 2: Intermediate	State 3: Pessimistic
1	Advancement of information technology infrastructure in government organizations	Full and sustainable infrastructure development	Moderate and gradual development	Stagnation or weak development
2	Availability of specialized human resources in data analytics and emerging technologies	Abundant specialized workforce with effective recruitment and retention	Relative shortage of specialists and limited reliance on outsourcing	Severe shortage and loss of key personnel
3	Managers' inclination toward data-driven decision-making	Fully data-driven managerial decision-making	Combined approach based on data and experience	Dominance of managerial discretion and resistance

After defining the different states of the factors and drivers, these states were incorporated into the uncertainty questionnaire, and the experts were asked to assess, using a scale from -3 to +3, the extent to which the occurrence of one state would influence the occurrence of another state. Following collection of the questionnaire data, the information was entered into Scenario Wizard software. At this stage, after identifying the key factors, each factor was divided into a set of possible states, and all states were presented to the experts in the form of a matrix. The scenarios were then quantitatively developed by considering different combinations and permutations of the

possible real-world states of each of the three key factors. Scenario Wizard compares all states with one another and generates various scenarios that can be used by practitioners in the relevant field. Part of the final software output is presented in Tables 4 and 5.

Table 5. Cross-Impact Matrix of the Main Variables

Description	1	2	3	4	5	6	7	8	9
IT Infrastructure – Optimistic	0	0	0	3	0	0	2	0	0
IT Infrastructure – Intermediate	0	0	0	0	2	0	0	1	0
IT Infrastructure – Pessimistic	0	0	0	0	0	-2	0	0	-1
Access to Data Mining Software – Optimistic	2	0	0	0	0	0	3	0	0
Access to Data Mining Software – Intermediate	0	1	0	0	0	0	0	2	0
Access to Data Mining Software – Pessimistic	0	0	-1	0	0	0	0	0	-2
Managers' Inclination Toward Data-Driven Decision-Making – Optimistic	1	0	0	2	0	0	0	0	0
Managers' Inclination Toward Data-Driven Decision-Making – Intermediate	0	1	0	0	1	0	0	0	0
Managers' Inclination Toward Data-Driven Decision-Making – Pessimistic	0	0	-1	0	0	-1	0	0	0

For example, if the optimistic state of information technology infrastructure occurs, the likelihood of increased access to data mining software will rise by three units, indicating a strong relationship between the probabilities of occurrence of these two states. Subsequently, Scenario Wizard generates future scenarios for the use of data mining technology in the accounting information systems of government institutions.

Scenario 1: An Intelligent and Integrated Future

This scenario depicts the most desirable future for the adoption of data mining technology in the accounting information systems of government institutions. In this situation, information technology infrastructure, access to data mining tools, and managers' inclination toward data-driven decision-making are simultaneously at favorable and mutually consistent levels and, according to the Scenario Wizard results, demonstrate the highest levels of consistency and stability. Under such conditions, data mining is effectively integrated into accounting and financial reporting processes, thereby improving decision-making quality, increasing transparency and accountability, enhancing fraud detection, and accelerating digital transformation in the public sector. Realization of this scenario requires the simultaneous development of technological infrastructure, enhancement of human-resource capabilities, and institutionalization of a data-driven decision-making culture.

Scenario 2: An Intermediate and Stable Future

This scenario depicts a balanced and relatively stable future for the adoption of data mining technology in the accounting information systems of government institutions. Under this condition, information technology infrastructure, access to data mining tools, and managers' inclination toward data-driven decision-making are all positioned at moderate and mutually consistent levels. Scenario Wizard results indicate that this combination exhibits a high degree of coherence and represents one of the plausible and attainable futures. Under such circumstances, organizations can use data mining capabilities to gradually improve decision-making quality, enhance financial transparency, and advance digital transformation. Nevertheless, achievement of the desirable scenario requires further infrastructure development, enhancement of specialized skills, and reinforcement of a data-driven decision-making culture.

Scenario 3: Progressive Management, Incomplete Infrastructure

This scenario represents a future in which managers support data-driven decision-making and data mining software is available, but information technology infrastructure has not developed proportionately with these advances. Scenario Wizard results indicate that the mismatch between technological infrastructure and the other

two drivers is the principal weakness of this scenario. Under such circumstances, despite managerial readiness and access to analytical tools, infrastructure limitations prevent full utilization of data mining capabilities. This scenario emphasizes the necessity of developing information technology infrastructure concurrently with analytical tools and a data-driven decision-making culture and identifies such development as a prerequisite for successful digital transformation in government institutions.

Scenario 4: Intelligent Leadership, Obsolete Infrastructure

This scenario depicts a future in which managers are inclined toward data-driven decision-making and data mining software is available; however, weak information technology infrastructure prevents effective utilization of these capabilities. Scenario Wizard results indicate that the principal inconsistency in this scenario arises from the relatively low level of information technology infrastructure compared with the other two drivers. Under such circumstances, technical constraints, including the absence of integrated systems, limited processing capacity, and information security problems, reduce the effectiveness of data mining and slow the digital transformation process. This scenario demonstrates that the development of information technology infrastructure is the primary prerequisite for effectively utilizing data mining tools and achieving intelligent decision-making in government institutions.

Scenario 5: Ready Infrastructure, Inadequate Tools

This scenario depicts a future in which information technology infrastructure has been developed and managers support data-driven decision-making, but limited access to specialized data mining software prevents full utilization of these capabilities. Scenario Wizard results similarly indicate that the driver of access to data mining software represents the primary source of inconsistency in this scenario. Under such circumstances, although financial data are generated and stored on a large scale, the absence of appropriate analytical tools limits the application of data mining capabilities, and managerial decision-making remains largely dependent on traditional reports. This scenario emphasizes the necessity of developing and localizing data mining software and facilitating government organizations' access to analytical technologies as complements to infrastructure development and a data-driven decision-making culture.

Scenario 6: Future-Oriented Management, Partially Prepared Capacities

This scenario depicts a future in which managers support data-driven decision-making, but information technology infrastructure and access to data mining software remain at moderate levels. Scenario Wizard results indicate that high managerial readiness is not fully aligned with the available technical capacities; therefore, this scenario lacks sufficient coherence. Under such circumstances, although there is willingness to use data in decision-making, infrastructure and software limitations prevent full utilization of data mining capabilities. This scenario indicates that achieving digital transformation requires development of a data-driven decision-making culture concurrently with improvements in information technology infrastructure and analytical tools.

Scenario 7: Managerial Maturity Without Technological Support

This scenario depicts a future in which managers have a strong inclination toward data-driven decision-making, but weak information technology infrastructure and limited access to data mining software prevent implementation of this approach. Scenario Wizard results indicate insufficient alignment among the three drivers and a mismatch between managerial readiness and organizational technological capacities. Under such circumstances, despite managers' willingness to use data analytics, technical and software limitations mean that decisions continue to rely on traditional methods and digital transformation progresses slowly. This scenario emphasizes the necessity of simultaneously developing information technology infrastructure, data mining tools,

and a data-driven decision-making culture to achieve the effective application of data mining technology in accounting information systems.

Scenario 8: Advanced Infrastructure, Shortage of Intelligent Tools

This scenario depicts a future in which information technology infrastructure has been developed and managers support data-driven decision-making, but limited access to specialized data mining software prevents full utilization of these capacities. Scenario Wizard results indicate that access to data mining software constitutes the principal source of inconsistency in this scenario. Under such circumstances, despite integrated data and managerial readiness, the shortage of analytical tools reduces the effectiveness of technological investments and perpetuates organizational reliance on traditional reporting. This scenario emphasizes the necessity of developing domestically produced software, facilitating access to analytical technologies, and removing barriers to their implementation as conditions for completing the digital transformation process in the accounting information systems of government institutions.

Scenario 9: Unbalanced and Unsustainable Transformation

This scenario depicts a future in which managers support data-driven decision-making, but information technology infrastructure remains at an intermediate level and access to specialized data mining software is unfavorable. Scenario Wizard results indicate that this combination exhibits the lowest degree of consistency and that misalignment among all three drivers prevents the effective implementation of data mining in accounting information systems. Under such circumstances, infrastructure constraints and the shortage of analytical tools reduce the effectiveness of data-driven decision-making and slow digital transformation. This scenario emphasizes the necessity of simultaneously developing information technology infrastructure, improving access to data mining software, and strengthening a data-driven decision-making culture as prerequisites for the successful implementation of data mining technology in government institutions.

Scenario 10: Technological Advancement Without Organizational Maturity

This scenario depicts a future in which access to data mining software is favorable, whereas information technology infrastructure and managers' inclination toward data-driven decision-making remain only at moderate levels. Scenario Wizard results indicate that this combination lacks sufficient coherence because effective utilization of advanced software requires appropriate infrastructure and a data-driven managerial culture. Under such circumstances, a substantial proportion of data mining software capacity remains unused, reducing the return on technological investment. This scenario emphasizes the necessity of simultaneously developing information technology infrastructure, enhancing a data-driven decision-making culture, and improving data quality alongside the development of analytical tools to facilitate successful implementation of data mining in the accounting information systems of government institutions.

Scenario 11: Islands of Technology in a Sea of Stagnation

This scenario depicts a future in which access to data mining software is favorable, but weak information technology infrastructure and limited managerial support for data-driven decision-making prevent effective utilization of these tools. Scenario Wizard results indicate that this combination lacks sufficient coherence and that misalignment exists among the three key drivers. Under such circumstances, analytical software is used only to a limited extent, and a large proportion of its potential to improve decision-making and enhance financial transparency remains untapped. This scenario emphasizes the necessity of simultaneously developing information technology infrastructure, integrating information systems, and strengthening a data-driven decision-making culture to ensure that investments in data mining technology generate the expected outcomes.

Scenario 12: Advanced Technology, Hesitant Management

This scenario depicts a future in which information technology infrastructure and access to data mining software are favorable, but managers' inclination toward data-driven decision-making remains only at an intermediate level. Scenario Wizard results indicate that the principal weakness of this scenario is the mismatch between technological readiness and managerial maturity. Under such circumstances, despite the availability of infrastructure and analytical tools, utilization of data mining capabilities in managerial decision-making remains limited, and some of the benefits associated with technological investments are not realized. This scenario emphasizes the necessity of strengthening a data-driven decision-making culture, training managers, and increasing confidence in intelligent analytics alongside technological development to fully realize digital transformation in the accounting information systems of government institutions.

Scenario 13: Incomplete Transition Toward Intelligent Systems

This scenario represents a condition in which information technology infrastructure is favorable and managers' inclination toward data-driven decision-making is at an intermediate level, while access to specialized data mining software remains limited. Scenario Wizard results indicate that the mismatch between infrastructure development and access to analytical tools represents the principal weakness of this scenario. Under such circumstances, although financial data can be collected and processed, the full capabilities of data mining and intelligent decision-making cannot be realized. This scenario emphasizes the necessity of developing data mining software and completing the analytical infrastructure alongside information technology development to achieve sustainable digital transformation in accounting information systems.

Scenario 14: Balanced and Gradual Development

This scenario depicts a balanced and stable future in which information technology infrastructure, access to data mining software, and managers' inclination toward data-driven decision-making are all at moderate and mutually consistent levels. Scenario Wizard results indicate that this combination exhibits the highest degree of coherence, with no incompatibility among the drivers. Under such circumstances, government organizations can gradually develop infrastructure, analytical tools, and a data-driven decision-making culture, thereby establishing the conditions necessary for successful implementation of data mining in accounting information systems. This scenario represents a realistic future and a bridge from the current situation toward the desirable scenario.

Scenario 15: Advanced Infrastructure, Maturing Management

This scenario depicts a future in which information technology infrastructure and access to data mining software are favorable, while managers' inclination toward data-driven decision-making is at an intermediate level but remains compatible with the other drivers. Scenario Wizard results indicate that this combination has a high degree of coherence and feasibility and provides an appropriate foundation for implementing data mining technology in accounting information systems. Under such circumstances, continued managerial training and reinforcement of a data-driven decision-making culture can enable full utilization of data mining capabilities and facilitate gradual progress toward the desirable future scenario.

Scenario 16: Progressive Management, Technology Awaiting Development

This scenario depicts a future in which managers support data-driven decision-making, but information technology infrastructure and access to data mining software remain at moderate levels. Scenario Wizard results indicate that the mismatch between managerial readiness and technological capacities is the principal weakness of this scenario. Under such circumstances, although there is an inclination to use data analytics, infrastructure and software limitations prevent full utilization of data mining capabilities. This scenario emphasizes the necessity of

simultaneously developing information technology infrastructure, analytical tools, and a data-driven decision-making culture to achieve successful digital transformation in accounting information systems.

Scenario 17: Advanced Tools, Evolving Infrastructure

This scenario depicts a future in which organizations have access to advanced data mining software and tools, but information technology infrastructure has not yet been sufficiently developed, while managers only partially support data-driven decision-making. Consequently, although analytical tools are available, infrastructure and managerial limitations prevent their capabilities from being fully utilized. According to Scenario Wizard results, the lack of balance among infrastructure development, analytical tools, and managerial attitudes is the principal weakness of this scenario. Under such circumstances, some data mining capabilities remain unused, thereby reducing the return on technological investment. Overall, this scenario indicates that merely providing advanced software does not guarantee successful digital transformation and that effective implementation of data mining requires the simultaneous development of information technology infrastructure and reinforcement of a data-driven decision-making culture.

Scenario 18: Progressive Management and Tools, Infrastructure Lagging Behind

This scenario depicts a future in which managers demonstrate a strong inclination toward using data in decision-making and advanced data mining tools are available to the organization, but information technology infrastructure has not yet reached a level capable of fully supporting these capacities. Consequently, some analytical capabilities remain unused, and the expected efficiency of accounting information systems is not achieved. According to Scenario Wizard results, the principal weakness of this scenario is the mismatch between information technology infrastructure development and the other drivers. Therefore, the primary priority for moving toward the desirable scenario is to strengthen hardware, network, and database infrastructure so that the capacities developed in management and data mining tools can be converted into actual organizational value.

Scenario 19: Advanced Infrastructure, Limited Utilization

This scenario depicts a future in which substantial investment has been made in developing information technology infrastructure and the technical foundations required to implement emerging technologies are available; however, access to specialized data mining software and managers' use of data analytics remain at moderate levels. Under such circumstances, organizations fail to utilize the full capacity of the infrastructure that has been developed, and part of the investment fails to generate the desired returns. According to Scenario Wizard results, the principal weakness of this scenario is the asynchronous development of the three key drivers. Therefore, in addition to infrastructure development, access to data mining tools must be expanded and a data-driven decision-making culture must be strengthened among managers so that information technology capabilities contribute to improved performance of accounting information systems and enhanced decision-making in government institutions.

Scenario 20: Advanced Technology, Resistant Management

This scenario depicts a future in which information technology infrastructure has been developed, but access to data mining software remains at an intermediate level and, more importantly, managers continue to exhibit a low inclination toward data-driven decision-making. Under such circumstances, despite the availability of a substantial proportion of the required technical capacity, managerial resistance prevents effective use of analytical technologies in accounting information systems. According to the Scenario Wizard analysis, the weakness of this scenario results from a mismatch between technological maturity and managerial culture. In practice, infrastructure development will produce desirable outcomes only when managers simultaneously adopt the use of data analytics in decision-

making and access to data mining tools is strengthened. Otherwise, a substantial proportion of technological investment will fail to achieve its intended objectives.

Scenario 21: Ready Infrastructure, Resistant Management

This scenario describes a future in which information technology infrastructure and access to data mining software are at acceptable levels, but managers continue to exhibit limited willingness to use data in managerial decision-making. Consequently, the existing technical capacities are not fully utilized, and accounting information systems continue to perform predominantly traditional roles. According to the Scenario Wizard analysis, the principal weakness of this scenario is the incompatibility of the driver “managers’ inclination toward data-driven decision-making” with the other two drivers. The software report indicates that if managerial attitudes improve from the pessimistic state to the intermediate level, the coherence of this scenario will increase substantially. Therefore, in addition to technological development, successful digital transformation in government institutions requires changes in managerial attitudes, analytical skills training, and reinforcement of an evidence-based decision-making culture.

4. Discussion and Conclusion

The present study examined the future application of data mining technology in the accounting information systems of Iranian government institutions using a foresight and scenario-planning approach. The findings first identified 30 potential factors through the systematic literature review and expert interviews, of which 22 factors were retained as statistically significant. MICMAC analysis subsequently demonstrated that the future development of data mining in governmental accounting information systems is shaped by a set of interdependent technological, organizational, managerial, regulatory, and human-resource variables. Among these variables, three factors emerged as the most critical drivers for scenario development: advancement of information technology infrastructure, availability of specialized human resources in data analytics and emerging technologies, and managers’ inclination toward data-driven decision-making. The remaining variables were primarily classified as dependent, linkage, or autonomous factors, indicating that their future behavior is strongly influenced by these central drivers. The scenario analysis further generated 21 plausible configurations representing different combinations of technological readiness, analytical capabilities, and managerial orientation. Collectively, these findings demonstrate that successful adoption of data mining in public-sector accounting information systems requires synchronized development across technological, human, and managerial dimensions rather than isolated investment in a single domain.

The identification of information technology infrastructure as one of the principal driving forces is consistent with previous research emphasizing the foundational role of digital infrastructure in the effective operation of advanced accounting technologies. Qatawneh found that information technology infrastructure plays a substantial role in the relationship between data mining and accounting information system performance, suggesting that sophisticated analytical techniques cannot yield their full benefits in the absence of an adequate technological foundation [9]. Similarly, Alsharari and Ikem demonstrated that digital accounting systems and information technology in the public sector are mutually reinforcing, with the functionality of digital accounting being highly dependent on technological readiness and system integration [4]. Hamdy et al. likewise reported that digital transformation improves the quality of accounting information systems in the public sector when technological infrastructure supports timely processing, information integration, and reliable reporting [5]. These findings

support the present result that information technology infrastructure functions as a structural prerequisite for the future application of data mining in government institutions.

This result is also aligned with the broader literature on public-sector digitalization. Di Giulio and Vecchi argued that implementation of digital technologies in government depends not merely on the acquisition of technical tools, but also on the capacity of public organizations to embed these technologies in governance structures, administrative processes, and institutional arrangements [3]. The present findings extend this argument by showing that inadequate infrastructure can undermine even relatively favorable managerial and software conditions. Several of the developed scenarios illustrate this situation: when managers demonstrate a high willingness to use data and analytical software is available but infrastructure remains weak, overall scenario coherence declines. Therefore, infrastructure development appears to be a necessary enabling condition for converting managerial intent and analytical capacity into actual organizational performance.

The second major driver identified in this study was the availability of specialized human resources in data analysis and emerging technologies. This finding reflects the increasingly interdisciplinary character of contemporary accounting information systems. Data mining requires capabilities that extend beyond conventional financial accounting, including data management, statistical analysis, information systems knowledge, algorithmic thinking, and interpretation of complex analytical outputs. Adllaleh et al. emphasized that human-resource capabilities must be systematically aligned with changing organizational and technological requirements, especially where performance improvement depends on specialized competencies [27]. Amalia similarly emphasized the importance of human capabilities and professional development in strengthening accountability and transparency through modern public-sector accounting practices [28]. In the Iranian context, Gilaniniay Soumehsaraei et al. showed that the development of integrated accounting information systems in governmental organizations depends on organizational capacities that support improved performance and the reduction of administrative violations [29]. These studies reinforce the present conclusion that the presence of technically competent and analytically skilled personnel is indispensable for the effective institutionalization of data mining.

The significance of specialized human resources is further explained by the fact that data mining is not a fully autonomous technological process. Although algorithms can identify patterns and generate predictions, accounting and managerial interpretation remains necessary to determine whether those patterns are meaningful, actionable, and institutionally appropriate. The increasing use of big data in accounting and auditing has expanded the volume and complexity of available information, thereby intensifying the need for personnel capable of understanding advanced analytical methods [6]. Sun et al. similarly highlighted that the big-data environment is reshaping accounting and auditing by requiring professionals to acquire advanced technological and analytical competencies [7]. Accordingly, the present finding suggests that government organizations that invest in software without developing specialized human capital are likely to face underutilization of technological capabilities.

The third central driver was managers' inclination toward data-driven decision-making. This result is particularly important because technological and analytical resources generate organizational value only when decision-makers are willing to incorporate analytical evidence into managerial processes. Fischer-Abaigar et al. emphasized that AI-driven and data-intensive decision-making in the public sector requires institutional and managerial readiness in addition to technical capacity [35]. Clark et al. also showed that organizational implementation of evidence-informed decision-making depends on leadership support, appropriate structures, access to evidence, and systematic incorporation of analytical findings into decision processes [33]. Cassar et al. further demonstrated that managerial culture, competence, and decision-making style influence the adoption of

evidence-based management sources [34]. These findings strongly support the present result that managerial orientation is a principal determinant of whether data mining becomes embedded in governmental accounting practice.

The importance of managerial willingness is also visible across the scenario configurations. Scenarios characterized by developed infrastructure and adequate analytical tools but weak managerial commitment were less coherent and produced limited utilization of available capacities. This indicates that technological readiness does not automatically lead to analytical decision-making. Where managers continue to rely predominantly on personal judgment, convention, or experience, the informational advantages of data mining may remain underused. This conclusion is also consistent with research on technology acceptance and resistance. Alabi noted that employees' and organizational actors' responses to digital technologies are influenced by perceived usefulness, readiness, and contextual factors [30]. Cieslak and Valor further argued that resistance to digital transformation should be understood as an organizational phenomenon shaped by structures, processes, and experiences rather than as simple individual opposition [31]. Therefore, cultivating a data-oriented management culture is essential not only for technological adoption but also for overcoming institutional inertia.

The findings also revealed that several variables, including the use of data mining for preventive monitoring, intelligent budgeting, management dashboards, and evidence-based organizational culture, occupied dependent positions. This implies that these outcomes are likely to improve when the key drivers develop favorably. For example, the use of advanced analytics for fraud detection depends on access to appropriate systems, qualified personnel, and managerial support for continuous analytical monitoring. Previous studies support this interpretation. Bello et al. demonstrated that advanced analytics and machine learning can substantially strengthen fraud detection by identifying complex and unusual transactional patterns [11], while Udeh et al. emphasized the value of big-data techniques in detecting and preventing financial fraud in digital environments [12]. Duan et al. similarly showed that integrating process mining and machine learning can enhance internal control evaluation and auditing processes [13]. Hence, the present classification of fraud detection and automated control as dependent outcomes is theoretically reasonable because their implementation requires supportive technological and organizational conditions.

The study also identified financial forecasting, intelligent budgeting, and cost-benefit analysis as important consequences of data mining adoption. This result is compatible with previous work demonstrating the value of advanced analytical models for financial and economic forecasting. Alahverdi et al. showed that advanced forecasting approaches can improve understanding of macroeconomic trends under changing financial conditions [15]. Zhang et al. similarly demonstrated the growing potential of data-intensive forecasting models that integrate time-series patterns and macroeconomic information [16]. Hidalgo emphasized that complex economic information can contribute to improved policy understanding and public-sector decision-making [17]. These findings suggest that the analytical capacity created by data mining can extend the role of accounting information systems beyond historical reporting toward forward-looking financial planning and policy analysis.

Transparency and accountability were also prominent among the identified factors. The importance of these variables is understandable in the context of government institutions, where the legitimacy of financial management depends heavily on the visibility, traceability, and reliability of public financial information. Sari and Muslim identified transparency and accountability as central objectives of public-sector accounting systems [23]. Prijaković reported that budget transparency can influence both economic and political outcomes by strengthening oversight and improving access to fiscal information [24], while Stanimirovic emphasized that greater budget

transparency contributes to effective and sustainable governance [25]. In Iran, Babajani et al. identified limitations in governmental financial transparency and proposed reforms for strengthening disclosure and accountability [26]. The present findings imply that data mining can contribute to this agenda by enabling systematic analysis of transactions, rapid detection of irregularities, and more comprehensive monitoring of financial operations.

At the same time, the finding that cybersecurity and financial information security occupy an important position within the system reflects the risks accompanying digital transformation. As governmental accounting increasingly depends on interconnected databases and advanced analytical tools, threats related to unauthorized access, data manipulation, privacy, and system disruption become more consequential. Zhou and Huang demonstrated a significant relationship between cybersecurity breaches and internal control, indicating that digital security should be integrated into broader control and governance structures [14]. This result reinforces the view that data mining strategies in governmental accounting should not focus exclusively on analytical functionality but should also incorporate information security, access management, data governance, and control mechanisms.

The findings concerning dashboards and continuous information monitoring also correspond with prior studies. Adekugbe and Ibeh showed that comprehensive dashboards can improve service delivery by consolidating complex organizational information and providing managers with timely insights [21]. Ghanaatjoo et al. similarly demonstrated that management dashboards can facilitate monitoring and decision support when they are appropriately designed around managerial information needs [22]. The present results suggest that data mining can strengthen such dashboards by moving them from descriptive visualization toward predictive and diagnostic analysis. However, because dashboard effectiveness depends on data quality, technological integration, skilled users, and managerial utilization, its classification as a dependent outcome is consistent with the broader structure identified in the MICMAC analysis.

The scenario analysis provides an additional contribution by illustrating how different combinations of the key drivers may produce markedly different futures. The most favorable scenarios were those characterized by simultaneous progress in technological infrastructure, analytical capabilities, and data-driven managerial orientation. Conversely, scenarios in which one or more of these dimensions lagged behind exhibited lower coherence and reduced capacity for effective data mining adoption. This pattern supports the concept of complementarity among organizational resources. Public-sector digital transformation is inherently systemic; developing only hardware, only software, or only managerial willingness is insufficient. The findings of Sena et al., who emphasized the role of innovation culture in public organizations [32], and Negri and Dincă, who connected public-sector efficiency to governance quality [18], provide additional support for this systemic interpretation. Effective digital transformation requires mutually reinforcing technological, institutional, cultural, and governance capacities.

The findings also have implications for public-resource monitoring and performance management. Mohamed and Kulmie emphasized that effective monitoring and evaluation contribute substantially to good governance in public institutions [19], whereas Fioretto et al. highlighted the value of performance indicators in public administration [20]. Data mining can strengthen these mechanisms by revealing relationships among financial, operational, and performance variables that cannot easily be detected using conventional reporting systems. Consequently, its value lies not simply in technological modernization but also in enabling a transition toward continuous, evidence-based public management.

Overall, the findings demonstrate that the future use of data mining in governmental accounting information systems should be understood as a sociotechnical transformation rather than a software implementation project.

Infrastructure provides the technical foundation, specialized human resources enable analytical operation and interpretation, and managerial willingness determines whether analytical outputs become incorporated into actual decisions. Other advantages—including fraud detection, predictive budgeting, internal-control automation, transparency, dashboards, and improved resource monitoring—are largely contingent upon the coordinated development of these fundamental drivers. This interpretation is consistent with the emerging literature on intelligent accounting systems and public-sector digital transformation and highlights the necessity of integrated long-term planning rather than fragmented technology adoption.

This study has several limitations that should be considered when interpreting its findings. First, the expert panel consisted of 19 academic and professional specialists, and although sampling continued until theoretical saturation was achieved, the relatively limited sample may not represent the full diversity of perspectives across all Iranian government institutions. Second, expert judgments were central to the identification, evaluation, and cross-impact assessment of the variables; therefore, the results may be affected by subjective perceptions, professional experiences, and expectations regarding technological development. Third, the scenarios were developed on the basis of the factors identified at the time of the study, whereas rapid changes in artificial intelligence, cloud computing, cybersecurity, public-sector regulations, and analytical software may introduce new drivers in the future. Fourth, the study focused specifically on government institutions in Iran, which limits the direct generalizability of the results to private organizations or public sectors operating under substantially different institutional, technological, and regulatory environments. Finally, scenario analysis does not predict which future will actually occur; rather, it presents internally plausible alternative configurations based on the interactions among the selected drivers.

Future studies can extend these findings in several directions. Larger and more diverse expert panels could be employed to compare perceptions across different ministries, municipalities, public enterprises, regulatory agencies, and other governmental institutions. Longitudinal studies would be particularly useful for examining whether the driving power and dependence of the identified factors change as digital transformation advances. Future research could also combine scenario planning with structural equation modeling, fuzzy cognitive mapping, DEMATEL, or system dynamics to provide additional evidence regarding causal relationships among technological, organizational, and managerial variables. Comparative studies across countries could identify how institutional arrangements, regulatory systems, digital maturity, and public-sector governance affect the adoption of data mining in accounting information systems. Researchers may also investigate emerging variables such as generative artificial intelligence, cloud-based accounting, blockchain, explainable AI, data sovereignty, privacy regulation, and algorithmic accountability. Finally, future empirical studies could test the proposed scenarios against actual organizational outcomes and develop measurable indicators for assessing the readiness of government institutions for data-mining implementation.

Government institutions should adopt a coordinated implementation strategy that simultaneously addresses technological infrastructure, human-resource capability, and managerial culture. Investment priorities should include modernizing information technology infrastructure, integrating fragmented financial databases, improving processing and storage capacity, strengthening cybersecurity, and ensuring interoperability among accounting and administrative systems. At the human-resource level, organizations should establish continuous training programs in data analytics, data mining, digital accounting, and interpretation of analytical outputs while developing recruitment and retention mechanisms for specialized personnel. At the managerial level, senior executives should institutionalize evidence-based and data-driven decision-making through performance systems, reporting

protocols, and explicit requirements for the use of analytical evidence in major financial decisions. Government institutions should also gradually deploy analytical dashboards, automated internal-control tools, fraud-detection systems, and predictive budgeting applications through pilot projects before organization-wide implementation. Finally, implementation should be governed by clear data-quality standards, security policies, accountability mechanisms, and periodic readiness assessments so that technological investment produces measurable improvements in financial transparency, efficiency, control, and public accountability.

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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