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Digital Transformation in Public Sector Organization: Examine Machine Learning Adoption in Accounting and Auditing Practices with Moderating effect of Regulatory Framework in Khyber Pakhtunkhwa

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	Abstract
<p>Asghar Khan Musazai^{*1} Ph. D Scholar Abasyn University Peshawar Email: asgharmusazai@gmail.com</p> <p>Dr. Mahfooz Khan² Abasyn University Peshawar Email: mahfooz.khan1@abasyn.edu.pk</p>	<p>Digital transformation has become a critical priority for public sector organizations, aiming to improve efficiency, transparency, and accountability in financial management. Among emerging technologies, machine learning a key tool of artificial intelligence has the potential to transform accounting and auditing practices by enabling automated data analysis, pattern recognition, predictive forecasting, and anomaly detection. This study examines the adoption of machine learning in accounting and auditing practices within public sector organizations of Khyber Pakhtunkhwa, with a focus on the moderating effect of the regulatory framework. Grounded in the Technology Acceptance Model and Institutional Theory, the study investigates how machine learning enhances financial accuracy, audit quality, and decision making, and how regulatory structures influence its effective implementation. A quantitative research design was employed, collecting primary data from 562 accounting and audit personnel across diverse public sector organizations using a structured questionnaire. Data analysis involved descriptive statistics, correlation analysis, structural equation modeling, and multiple regression analysis. The findings indicate that machine learning adoption significantly improves accounting and auditing practices, while a strong regulatory framework strengthens this positive relationship. The study highlights the critical role of regulatory oversight in ensuring ethical, transparent, and accountable use of machine learning in public financial management. These results provide empirical evidence to guide policymakers, regulators, and public sector administrators in promoting digital transformation initiatives. The study concludes that integrating machine learning with robust regulatory governance can significantly enhance financial management, operational efficiency, and institutional accountability in public sector organizations of Khyber Pakhtunkhwa. Recommendations for effective implementation, capacity building, and employee training are provided, while noting limitations such as the focus on a single province and cross sectional data; future research could extend to other regions and explore additional artificial intelligence technologies in both public and private sectors.</p>
<p>Keywords:</p>	<p>Machine Learning, Accounting Practices, Auditing Practices, Regulatory Framework, Public Sector Organizations, Khyber Pakhtunkhwa.</p>



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Introduction

Digital transformation has become a central strategic priority for public sector organizations globally as they modernize administration and improve service delivery through digital technologies (OECD, 2025). These technologies enhance operational efficiency, transparency, accountability, and the quality of public financial management systems. Within this broader transformation, artificial intelligence has emerged as a core driver of data driven governance, enabling the analysis of large financial datasets and supporting evidence based decision-making (Aldemir & Uçma Uysal, 2025; OECD, 2025). Artificial intelligence facilitates a shift from traditional manual processes toward automation, improving predictability, reducing errors, and strengthening institutional performance. Among artificial intelligence applications, machine learning is especially significant due to its ability to learn from data, recognize patterns, and generate predictions without explicit programming (Russell & Norvig, 2021). In public sector accounting and auditing practice, machine learning has the potential to improve accuracy, automate routine tasks, and support timely decision making. Machine learning enhances predictive budgeting, risk based audit planning, transaction classification, and fraud detection, thereby improving financial control and audit quality (OECD, 2025; Preprints.org, 2026). Machine learning also aid in real time anomaly detection and classification of unusual transactions, which strengthens financial oversight and accountability. However, successful machine learning adoption in public accounting and auditing practices depends not only on technological capability but also on the regulatory framework that governs its use. Effective regulatory framework provides guidelines for ethical machine learning use, data protection, institutional transparency, and public accountability (Sulistyantoro et al., 2024; Abbas, Chesterman, & Taeihagh, 2025). Strong governance mitigates risks such as algorithmic bias and data misuse and promotes public trust, whereas weak or unclear regulations may hinder implementation and reduce institutional readiness (OECD, 2025). Research shows that artificial intelligence governance frameworks in public organizations are essential to ensure that artificial intelligence systems are used responsibly and in accordance with ethical principles, legal requirements, and accountability standards (ScienceDirect, 2024). In the context of Khyber Pakhtunkhwa, public sector organizations are gradually progressing toward digital transformation, but the integration of machine learning into accounting and auditing practices remains at an early stage. Limited empirical evidence exists on how machine learning adoption affects public financial management in this regional context, especially considering the moderating influence of the regulatory framework. Therefore, this study examines machine learning adoption in accounting and auditing practices within public sector organizations of Khyber Pakhtunkhwa and analyzes the moderating role of the regulatory framework. The findings aim to contribute to the literature on artificial intelligence enabled public financial management and provide policy insights for strengthening transparency, efficiency, and accountability.

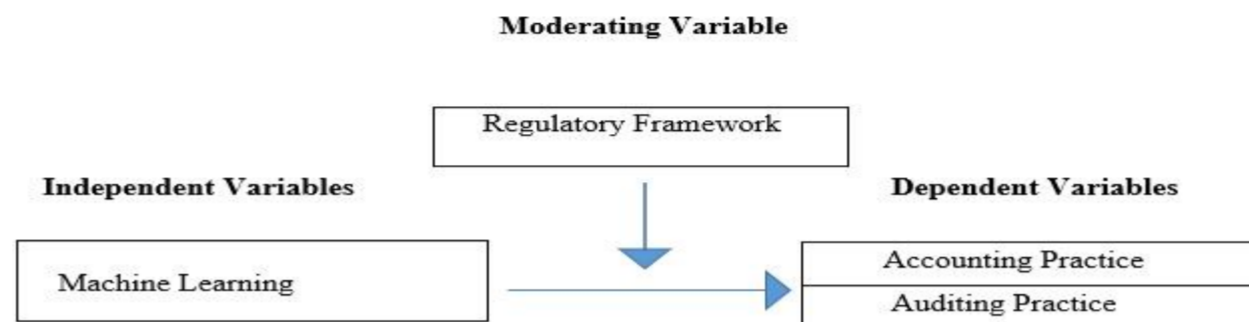
Recent research shows that digital transformation is reshaping accounting and auditing practices through the adoption of artificial intelligence tools, particularly machine learning. Research shows that machine learning improves efficiency, accuracy, transparency, and decision making in both public and private sector organizations. Lu and Wu (2025) investigated that successful artificial intelligence tools adoption in accounting depends on important factors such as strong IT infrastructure, high quality data, regulatory compliance, and skilled human resources. Their study shows that machine learning applications including invoice processing, anomaly detection, financial forecasting, and compliance monitoring significantly enhance operational performance and financial accuracy. Further Rewashed et al. (2025) and Zhu et al. (2025) examined through systematic reviews, conclude that machine learning automates routine accounting tasks, reduces administrative burden, and supports real time financial reporting, which strengthens public sector financial management. In auditing practices, machine learning demonstrates strong potential to enhance audit quality and risk assessment. ISACA (2024) reported that machine learning techniques such as clustering, neural networks, and predictive analytics can analyze large volumes of financial data more efficiently than traditional manual methods. Machine learning improve risk identification, anomaly detection, and audit planning. However, the study also highlights challenges related to data quality and algorithmic bias. Saad (2022) investigated that predictive analytics and neural network models improve the ability of auditors to detect material misstatements and fraud, while emphasizing that bias management is essential to maintain audit reliability and credibility. Phuangthuean and Nuansang (2024) explained that integration of artificial intelligence in the public sector accounting and auditing practices enhances financial accountability by identifying irregularities and misuse of public funds. However, without proper regulatory oversight, ethical concerns and algorithmic bias may reduce public trust in artificial intelligence based systems. Ibra et al. (2024) further examined that strong IT governance aligns machine learning implementation with organizational objectives, ensures data quality, manages risks, and enhances transparency in accounting and auditing practices. Phuangthuean & Nuansang, 2024; Rawashdeh et al., 2025 conducted study that machine learning supports evidence based budgeting, automates repetitive financial processes, and strengthens accountability mechanisms in public sector organizations. Despite these developments, an important research gap remains. Most prior studies examine either the technical benefits of machine learning or general governance issues separately. Limited empirical research investigates how the regulatory framework moderates the

relationship between machine learning adoption and accounting and auditing practices in the public sector. Based on these existing literature and theoretical foundations the following hypotheses are proposed.

H_1 : Machine Learning positively and significantly influences accounting and auditing practices in public sector organizations of Khyber Pakhtunkhwa.

H_2 : The regulatory framework strengthens the relationship between machine learning and accounting and auditing practices in public sector organizations of Khyber Pakhtunkhwa.

Conceptual Model



Source: (Owonifari, et al. 2023; Reda, and Ibrahim, 2023; Al Wael, et al. 2024).

Materials and Methods

1. Population of the Study

The population of this study comprises employees working in accounting, finance, and auditing related positions in public sector organizations of Khyber Pakhtunkhwa. This includes accountants, audit officers, account officers, finance officers, internal auditors, and other officials directly involved in accounting and auditing practices. These respondents are considered appropriate for the study as they possess relevant professional knowledge, practical experience, and exposure to accounting and auditing practices, as well as emerging technological applications such as machine learning within public sector organizations of Khyber Pakhtunkhwa.

2. Sample Size and Sampling Technique

The sample size for this study consists of 562 employees representing accounts and audit related personnel in public sector organizations of Khyber Pakhtunkhwa. The sample is drawn from an estimated population of 32,500 employees engaged in accounting and auditing roles across public sector organizations in the Khyber Pakhtunkhwa, including finance officers, account officers, audit officers, accountants, auditors, and related professionals. The determination of the sample size is supported by established methodological guidelines. According to Tabachnick and Fidell (2001), a minimum of five respondents per item is required for factor analysis, which this study satisfies. Moreover, Gaur and Gaur (2009) suggest that a sample size between 200 and 300 is sufficient for reliable statistical analysis, while Tabachnick (2007) recommends a minimum sample size of 300 for robust multivariate analysis. The selected sample size of 562 respondents therefore exceeds these thresholds, ensuring adequate statistical power, strong representation of the population, and reliable empirical findings. This sample size provides a solid foundation for examining the impact of machine learning on accounting and auditing practices and for testing the moderating role of the regulatory framework within public sector organizations of Khyber Pakhtunkhwa.

Table 1 *Distribution of Sample Respondents in the Study Area*

Descriptions	KP	District Peshawar
Total Public Organizations	210	146
Total Employees related to Accounts and Audit Sections	32500	3750
Selected Sample of account & audit related employees in the public sector organizations of KP located in Capital District Peshawar		562

Source: (AG Khyber Pakhtunkhwa Human Resources Information Management, 2024).

(Gaur and Gaur, 2009; Tabachnick, 2007; Tabachnick and Fidell, 2001).



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This study employs a multistage sampling technique to select a representative sample from a large and geographically dispersed population of accounting and auditing professionals working in public sector organizations across Khyber Pakhtunkhwa. In the first stage, district Peshawar is purposively selected as the study area due to its strategic importance as the provincial capital of Khyber Pakhtunkhwa and its high concentration of public sector organizations. In the second stage, stratified random sampling is applied to public sector organizations located in Peshawar, categorized into sectors such as Finance, Accounts and Treasury Offices, audit, Health, Education, and Municipal Services. In the third stage, simple random sampling is used to select individual respondents from accounting and auditing staff. Limited convenience sampling is applied only to address practical constraints.

3. Data Collection Method

This study uses a structured questionnaire to collect primary quantitative data from accounting and auditing professionals working in public sector organizations of Khyber Pakhtunkhwa. The questionnaire consists of four sections: demographic information, machine learning, accounting and auditing practices, and the regulatory framework. All items are measured using a five-point Likert scale.

4. Data Analysis Techniques

This study employs both descriptive and advanced multivariate statistical techniques to examine the impact of machine learning on accounting and auditing practices in public sector organizations of Khyber Pakhtunkhwa, including the moderating role of the regulatory framework. Descriptive statistics such as frequencies, percentages, means, standard deviations, minimum, and maximum values are used to summarize the data and assess its suitability for further analysis. Correlation analysis is conducted to determine the strength and direction of relationships among the study variables. The Structural Equation Model is applied as the primary analytical method to test the proposed hypotheses and assess the direct effects of machine learning on accounting and auditing practices, as well as the moderating effect of the regulatory framework through interaction analysis (Hair et al., 2019). Additionally, multiple regression analysis is performed as a supplementary technique to validate and strengthen the robustness and consistency of the structure equation model results.

Econometric Model

The following econometric models are specified for empirically examine the impact of machine learning on accounting and auditing practices with the moderating role of regulatory framework in public sector organizations of Khyber Pakhtunkhwa.

The general model is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_5 X_5 + \epsilon \quad \text{Equ (i)}$$

Econometric Model for Accounting Practice

$$AP = \beta_0 + \beta_1 ML + \beta_2 RF + \epsilon \quad \text{(Eq. ii)}$$

Econometric Model for the moderating effect of the regulatory framework on accounting practice,

$$AP = \beta_0 + \beta_1 ML + \beta_2 (ML \times RF) + \epsilon \quad \text{(Eq. iii)}$$

Econometric Model for Auditing Practice

$$AU = \beta_0 + \beta_1 ML + \beta_2 RF + \epsilon \quad \text{(Eq. iv)}$$

Econometric Model for the moderating effect of the regulatory framework on auditing practice

$$AU = \beta_0 + \beta_1 ML + \beta_2 (ML \times RF) + \epsilon \quad \text{(Eq. v)}$$

Where:

AP = Accounting Practices

AU = Auditing Practices

ML = Machine Learning

RF = Regulatory Framework

β_0 = Intercept

β_1, β_2 = Regression coefficients

ε = Error term

5. Results and Discussion

6. Descriptive Statistics Analysis

Table 1 presents the descriptive analysis for the key variables in the study. The mean values indicate that respondents generally agreed with the statements related to Machine Learning (mean = 3.89), Accounting Practices (mean = 4.01), Auditing Practices (mean = 3.94), and Regulatory Framework (mean = 3.76), suggesting a positive perception of these factors. The standard deviations, ranging from 0.58 to 0.66, show a moderate variation in responses among participants. The minimum and maximum values indicate that all response options from the scale were utilized by some respondents, reflecting a range of opinions. Overall, these results suggest that the respondents recognize the importance of machine learning, accounting and auditing practices, and the regulatory framework in the public sector organizations of Khyber Pakhtunkhwa.

7. **Table 1** *Descriptive Statistics*

Variable	Mean	Std. Deviation	Minimum	Maximum
Machine Learning	3.89	0.61	2.40	5.00
Accounting Practices	4.01	0.58	2.60	5.00
Auditing Practices	3.94	0.63	2.30	5.00
Regulatory Framework	3.76	0.66	2.10	5.00

Correlation Analysis of Variables

Table 2 presents the correlation analysis of the study variables. machine learning shows a significant positive correlation with accounting practices ($r = 0.57, p < 0.05$) and auditing practices ($r = 0.61, p < 0.05$), indicating that higher implementation of machine learning is associated with better accounting and auditing performance. machine learning also correlates positively with the regulatory framework ($r = 0.49, p < 0.05$), suggesting that strong regulatory guidelines can support the adoption of machine learning. Furthermore, the regulatory framework is positively correlated with accounting practices ($r = 0.65, p < 0.05$) and auditing practices ($r = 0.59, p < 0.05$), emphasizing its role in enhancing effectiveness of accounting and auditing practices. Overall, these results suggest that machine learning positively impacts accounting and auditing practices, and a robust regulatory framework may strengthen this relationship, highlighting its moderating role in public sector organizations of Khyber Pakhtunkhwa.

8. **Table 2** *Correlation Analysis*

Variable Relationship	Correlation (r)	Sig. (p-value)
Machine Learning & Accounting Practices	0.57**	0.002
Machine Learning & Auditing Practices	0.61**	0.001
Machine Learning & Regulatory Framework	0.49**	0.004
Regulatory Framework & Accounting Practices	0.65**	0.001
Regulatory Framework & Auditing Practices	0.59**	0.002

Source: Primary Survey (2024) Note: *Correlation is significant at the $p < 0.05$ level (2-tailed).

9. Structural Equation Model Results

Table 3 presents the results of the structural equation model assessing the impact of machine learning on accounting and auditing practices in the public sector organizations of Khyber Pakhtunkhwa. The findings show that machine learning has a significant positive effect on accounting practices ($\beta = 0.42, t = 5.98, p < 0.05$) and auditing practices ($\beta = 0.38, t = 5.21, p < 0.005$). these results indicate that higher adoption of machine learning leads to better accounting and auditing practices. The significant t-values and p-values confirm that the proposed hypotheses are supported, demonstrating that machine learning is an effective artificial intelligence tool for enhancing accounting and auditing practices in the public sector organizations of Khyber Pakhtunkhwa.

10. **Table 3** *Structural Model Results*

Path	Standardized β	t-value	p-value	Result
ML \rightarrow Accounting Practices	0.42	5.98	<0.001	Supported
ML \rightarrow Auditing Practices	0.38	5.21	<0.001	Supported

Source: Survey 2026

11. Moderating Effect of Regulatory Framework

Table 4 shows the results of the moderation analysis, examining whether the regulatory framework strengthens the relationship between machine learning and accounting and auditing Practices. The results indicate that the interaction of machine learning and regulatory framework has a positive and significant effect on Accounting Practices ($\beta = 0.19$, $t = 2.87$, $p = 0.004$) and auditing practices ($\beta = 0.21$, $t = 3.11$, $p = 0.002$). This means that a strong regulatory framework enhances the positive impact of machine learning on both accounting and auditing practices. In other words, machine learning is more effective in improving accounting and auditing practices when the regulatory framework is robust in the public sector organizations of Khyber Pakhtunkhwa.

12. **Table 4** *Moderation Analysis Results*

Relationship	Interaction Term (β)	t-value	p-value
ML \times RF \rightarrow Accounting Practices	0.19	2.87	0.004
ML \times RF \rightarrow Auditing Practices	0.21	3.11	0.002

Source: Survey 2026

13. Multiple Regression Analysis

14. Table 5 presents the results of the multiple regression analysis, which was conducted to support the structure equation model findings. The results show that machine learning has a positive and significant effect on accounting practices ($\beta = 0.39$, $t = 6.12$, $p < 0.001$) and on auditing practices ($\beta = 0.36$, $t = 5.48$, $p < 0.001$). This means that higher adoption of machine learning leads to improvements in both accounting and auditing practices in public sector organizations. These results confirm the structure equation model findings and further support the conclusion that machine learning plays an important role in enhancing accounting and auditing practices in the public sector organizations of Khyber Pakhtunkhwa.

15. **Table 5** *Multiple Regression Results*

Dependent Variable	Independent variable	Interaction Term (β)	t-value	p-value
Accounting Practices	Machine Learning	0.39	6.12	<0.001
Auditing Practices	Machine Learning	0.36	5.48	<0.001

Source: Survey 2026

Conclusion

The study concludes that machine learning has a significant positive impact on accounting and auditing practices in public sector organizations of Khyber Pakhtunkhwa. Employees who use machine learning technologies experience improvements in efficiency, accuracy, transparency, and overall effectiveness in accounting and auditing practices. Furthermore, the regulatory framework strengthens this positive effect. A strong regulatory structure ensures proper implementation, ethical use, compliance, and accountability in the adoption of machine learning tools. Therefore, the successful digital transformation of public sector organizations depends not only on technological adoption but also on effective governance and regulatory support. Overall, machine learning is an effective tool for improving accounting and auditing practices in public sector organizations of Khyber Pakhtunkhwa, and its benefits are maximized when supported by a strong regulatory framework. This study is limited to public sector organizations in Khyber Pakhtunkhwa, which may restrict the generalizability of the findings to other provinces or countries. The study used a cross sectional research design, which captures data at one point in time and does not reflect long term changes in machine learning adoption. In addition, the use of self reported data may introduce response bias. The study focused only on machine learning and the regulatory framework. Other artificial intelligence technologies such as robotic process automation, data mining, hybrid systems, natural language

processing, and expert systems were not included. Organizational factors such as employee skills, technological readiness, leadership support, and organizational culture were also not examined. Future research may extend this study to other provinces of Pakistan or conduct comparative studies across different public sector organizations to improve generalizability. Longitudinal studies are recommended to examine the long term impact of machine learning adoption. Further studies may also investigate other artificial intelligence tools and explore organizational factors as mediating or moderating variables in digital transformation initiatives.

Recommendations

- i. Public sector organizations in Khyber Pakhtunkhwa should actively adopt machine learning technologies to improve accounting accuracy, auditing effectiveness, and operational efficiency.
- ii. Policymakers should develop and strengthen regulatory frameworks that ensure ethical, transparent, and compliant use of machine learning in financial management processes.
- iii. Regular training and capacity building programs should be conducted to enhance employees' knowledge and skills in machine learning and artificial intelligence based accounting and auditing tools.
- iv. Public sector organizations should integrate artificial intelligence technologies into their strategic financial planning and digital transformation policies.
- v. Collaboration between government institutions and academic researchers should be encouraged to explore additional artificial intelligence applications and evaluate their impact on public sector financial management.

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