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The role of digital technologies in enhancing the efficiency and effectiveness of tax administration: Artificial intelligence and the Internet of Things as a model

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Abstract:

This study explores the role of digital technologies specifically Artificial Intelligence (AI) and the Internet of Things (IoT) in enhancing the efficiency and effectiveness of modern tax administration. By reviewing international experiences and recent OECD reports, the study demonstrates how these technologies improve transparency, strengthen compliance, reduce fraud, and support the transition toward intelligent and automated tax systems.

The findings highlight the growing importance of AI and IoT-based solutions in shaping future tax administration models, especially in developing countries.

Keywords: Artificial Intelligence; Internet of Things; Tax Administration; Tax Complianc ; Digital Transformation.

JEL Classification: H21 ; O33.

1. Introduction:

In recent years, the digital revolution has profoundly transformed public administration, with tax systems experiencing some of the most significant changes. Moving beyond traditional manual and paper-based processes, tax administration is increasingly driven by digital technologies that enhance efficiency, transparency, and engagement with taxpayers. Governments are implementing e-filing platforms, automated processing systems, artificial intelligence (AI), and the Internet of Things (IoT) to streamline tax compliance, monitor transactions in real time, detect irregularities, manage risks, and deliver timely services. This evolution has given rise to Tax Administration 3.0, representing an integrated, seamless, and intelligent approach that aligns with the digital habits and expectations of modern taxpayers (Sibarani , 2025, p. 6).

Artificial intelligence and the Internet of Things are key technologies for enhancing tax compliance and business operations. They help tax authorities curb revenue leakage, streamline procedures, detect fraud and tax evasion, and allocate resources more efficiently (Bundala & Mjema, 2025, p. 187).

1.2. Problem Statement

Building on the above, we have formulated the following research question: **How and to what extent digital technologies, particularly AI and IOT, can enhance the efficiency and effectiveness of modern tax systems?**

1.3. Study hypotheses

H1: Artificial intelligence adoption significantly improves the efficiency of tax administration;

H2: Internet of Thing (IoT) integration enhances transparency, real-time monitoring, and fraud detection;

H3: The combined use of Al ternate and IoT contributes to higher taxpayer compliance and a better tax system performance.

1.4. Objectives of study

1. To analyze the role of Artificial intelligence ternate in improving tax administration efficiency;
2. To assess how Internet of Thing supports real-time monitoring and fraud detection;
3. To present selected international case studies on digital tax technologies.

1.5. The importance of Study

This study highlights how digital technologies can modernize tax systems, reduce revenue leakage, improve compliance, and support the transition toward intelligent and automated tax administration, offering valuable insights for policymakers.

1.6. Methodology

The study uses a qualitative analytical approach based on a review of academic literature, OECD reports, and international case studies related to AI, IoT, and digital tax administration.

1.7. Research Design

The research is structured into four parts:
1. Theoretical framework (TAM, AI, IoT);
2. Analysis of AI and IoT applications in tax administration;
3. Case studies from selected countries;
4. Discussion, conclusions, and recommendations.

2. Theoretical Basis

2.1. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis (1989), is rooted in the study of user behavior toward technology adoption. The model posits that technology acceptance is primarily determined by two key factors: perceived usefulness and perceived ease of use. According to Davis (1989), perceived ease of use refers to the extent to which an individual believes that engaging with a given technology will require minimal effort. The model further establishes a cause-and-effect relationship between system design and user acceptance (O'Dea , 2024). The tax administration employs the Technology Acceptance Model (TAM) to assess the extent to which new digital technologies are accepted. The adoption of digital tools related to tax administration is expected to enhance tax compliance, particularly voluntary compliance and tax payment in countries.

2.2. Using AI Technology and IoT in Tax Administration

Technology like artificial intelligence, internet of thing (IOT) some important tools which are effective in tax collection. With the help of technology tax evasion can be reduced with minimum cost and human effort (Kumar et al, 2025, p. 1). With the advent of digitalization, information technologies and blockchain have begun to be integrated into tax management. Tax procedures that were previously conducted in a physical environment have been transferred to the electronic domain through the use of computer technologies, leading to the development of tax systems via applications such as e-declaration, e-filing, and e-payment (Adelekan et al, 2024, p. 312). The incorporation of AI technology into tax management has further enhanced efficiency, transparency, and the security of tax processes. Conducted in an electronic environment, these operations not only improve the state’s revenue collection capacity but also foster greater taxpayer compliance within a trust-based tax system (Adelekan et al, 2024, p. 315).

2.3. AI and Tax Administration

AI technology is a broad, overarching concept that encompasses numerous sub-technologies, including machine learning, natural language processing, robotic process automation, explainable AI, and applications of advanced data analytics (Zaqeeba et al, 2024, p. 1578). The application of AI in enterprise taxation encompasses several key areas. It includes tax risk prediction, where machine learning identifies potential compliance risks; intelligent tax declaration, which automates form filling and optimizes tax strategies; and the detection of false transactions by combining AI with IoT data to identify abnormal patterns. Additionally, AI-powered customer service robots facilitate more efficient communication between tax authorities and enterprises, saving both human and material resources. AI in tax administration relies on three core technologies: natural language processing for identifying compliance issues, machine learning for analyzing tax data and predicting risks, and computer vision for automatic invoice verification and detection of forged document (Gao, 2025, p. 752). The use of AI technology, like other digital tools, can enhance transparency and efficiency in tax management while positively influencing the relationship between the administration and taxpayers (Adelekan et al, 2024, p. 313). AI systems collect, organize, and analyze large volumes of taxpayer data, enabling proactive interventions by identifying non-compliant or potentially fraudulent taxpayers during the segmentation process (Adelekan et al, 2024, p. 314) .Consequently, AI can help prevent tax evasion through risk assessment and fraud detection mechanisms (Adelekan et al, 2024, p. 313).

2.4. IoT and Tax Administration

This section highlights the significant role of the Internet of Things (IoT) in tax administration, focusing on three main areas. First, real-time data collection enables continuous monitoring of logistics processes through GPS and wireless sensors, ensuring accurate tax collection. Second, intelligent invoice management integrates IoT with blockchain technology to create a system where RFID tags track the entire invoicing process, enhancing authenticity, compliance, transparency, and review efficiency. Third, IoT supports the management of fixed assets by using RFID technology to monitor asset status and location, facilitating precise depreciation calculations, optimizing asset management, and reducing tax compliance risks (Gao, 2025, p. 752).

3. Selected Case Studies on the Use of Advanced Technologies in Tax Administration

When the OECD's Forum on Tax Administration (FTA) vision for the future of tax administration ''Tax Administration 3.0'' was published in 2020, many tax administrations had already embarked on a digital transformation journey, introducing new digital initiatives and innovations to support tax compliance and reduce burdens. Since then, many more have

followed fully embracing the long-term vision and working to make tax become a more seamless experience for citizens and businesses (OECD 2025, p. 12).

One of the most prevalent applications of AI in tax administration is the use of digital assistants or chatbots, which represent general purpose AI technologies. Taxpayers can submit their tax-related inquiries to these AI-powered chatbots and receive prompt responses. For instance, VAT assistants have been deployed in Spain as chatbots since 2017 (Ihnatišinová, 2021, p. 5).

Another example is the Swedish Tax Agency's (STA) AI-powered risk assessment model, which distinguishes between high- and low-risk cases. Using this system, the STA identified and cancelled incorrect tax deduction claims totaling SEK 300 million, corresponding to SEK 42 million in tax (OECD 2023). In tax dispute resolution, AI can also identify similar case files and assign them to the same court clerk, thereby expediting decisions, as demonstrated in Brazil's litigation project (OECD 2022).

AI also offers significant benefits at audit points within tax authorities. For instance, in France in 2019, approximately one-quarter of tax inspections related to tax losses and evasion were supported by AI-driven data mining. The integration of this technology with human tax inspectors led to a 30% increase in tax collection compared to 2018. Another example is the use of AI to collect data from multiple databases and cross-check it against declaration data for fraud detection, a practice in place in the UK since 2010. Although costly, the Connect AI risk assessment system has helped the UK recover more than GBP 3 billion in taxes since its implementation (Kuzniacki el al, 2022, p. 5).

The Boston Consulting Group (BCG) Foundation in 2018 reported that Australia has successfully leveraged advanced AI technologies, such as machine learning and natural language processing to improve tax collection. The Australian Taxation Office (ATO) recovered over $530 million in late taxes and prevented $2.5 billion in fraudulent claims. These AI systems have helped the ATO analyses large amounts of data, identify patterns of non-compliance, prevent fraud, and improve the efficiency and integrity of its tax collection system. Despite significant advances in AI-based tax collection worldwide, many African countries have yet to adopt AI technology in central government revenue collection. For example, the Nigerian's revenue collection agency hesitates to fully embrace this technology, which has hindered the country's revenue and value-added tax (VAT) revenue collection (Bundala & Mjema, 2025, p. 188).

Kenya has successfully grown its economy with the help of AI and has been an active participant in the Fourth Industrial Revolution (4IR). For example, in Kenya's Revenue Collection, there are 49 AI applications, covering 15 sectors, including finance, education, trade and security. However, despite the full adoption of AI systems, there are still many challenges facing the revenue collection system. These challenges include skills gaps, regulatory environment, connectivity issues, insufficient investment in research, and lack of data due to poorly trained algorithms that use inaccurate and unreliable data, leading to

wrong results (Bundala & Mjema, 2025, p. 188).

Spain has implemented an AI-based Virtual Assistant for VAT to improve the consistency and clarity of tax-related information. The system uses a natural-language chatbot that allows both taxpayers and tax officials to ask questions about invoice registration and correction, foreign-trade obligations, chargeability, taxable amounts, tax rates, exemptions, and real-estate deductions. The assistant guides users by completing their queries and providing standardized answers, along with links to relevant regulations and supplementary resources. Conversations can also be saved for reference. This tool offers several benefits, including 24/7 instant support, reduced administrative burden, interactive guidance, and enhanced legal certainty (OECD, 2020, p. 58).

The Argentine Federal Administration of Public Revenues (AFIP) employs a risk profiling system known as SIPER, which enables the monthly assessment of taxpayers. SIPER categorizes taxpayers as compliant or non-compliant and provides a risk rating ranging from low to high. Decisions based on AI-driven categorization are explained to taxpayers, who are also given the opportunity to correct any discrepancies in the system by submitting alternative data in the event of an AI error. This risk management approach allows the Argentine tax authority to concentrate on high-risk taxpayers, monitor them closely, and initiate judicial proceedings for any offenses without unnecessary delays (OECD 2022).

4. Applications Frameworks of AI and IoT in Enhancing Tax Administration

4.1. The Brasil ID System

The Brasil ID system is an initiative launched in 2007 by Brazil's Ministry of Finance, the National Tax Bureau, and state tax authorities to improve interstate tax administration using Radio Frequency Identification (RFID) technology. The system addresses weak regulatory oversight and widespread tax evasion related to the ICMS tax on interstate goods and services. By attaching RFID tags to goods, collecting data automatically through highway antennas, and comparing it with tax records in real time, the system enables effective compliance verification. By 2023, Brasil ID had been adopted in 13 states, reducing transportation time by about 15%, lowering compliance costs by millions of dollars, and significantly limiting tax evasion thereby advancing the modernization of Brazil's tax administration (Gao, 2025, p. 753).

4.2 California Road Tolling Pilot Program

The California Road Tolling Pilot Program, launched by the California Department of Transportation (Caltrans) in August 2024, is an innovative response to declining fuel tax

revenues caused by the rise of electric vehicles. The program uses telemetry technology to collect real-time vehicle mileage through OBD-II sensors or smartphone applications, with an option for manual mileage reporting. Collected data is transmitted to the cloud to calculate road fees at a rate of 1.8 cents per mile, accompanied by a fuel tax credit. Early results show that automated tracking achieves over 95% accuracy, and nearly 90% of participants pay on time, demonstrating the viability of mileage-based taxation. The system also generates data on urban-rural differences in road usage, supporting future policy design. Although the pilot program continues until January 2025, preliminary assessments suggest that this model could increase Caltrans's annual road maintenance revenue by several hundred million dollars, highlighting its potential as a modernized approach to road taxation (Gao, 2025, p. 753).

5. Future Trends in Digital Technologies for Tax Administration

Future technological trends indicate that the integration of AI and IoT will continue to transform tax administration by improving system intelligence, strengthening compliance, reducing fraud, and increasing operational efficiency. Emerging technologies, particularly blockchain, are expected to enhance the transparency and security of tax data and further optimize management processes. Despite these advancements, tax administrations still face challenges such as outdated infrastructure, information asymmetry, talent shortages, and weak data governance. Addressing these issues requires government support, improved data sharing, and stronger institutional coordination to build an integrated intelligent tax ecosystem. In the long term, automated tax filing systems powered by AI and IoT will streamline procedures, reduce errors, and support more accurate and efficient tax compliance (Gao, 2025, p. 755).

6. CONCLUSION AND DISCUSSION

This study demonstrates that digital technologies, particularly Artificial Intelligence (AI) and the Internet of Things (IoT), are transforming modern tax administration by improving efficiency, transparency, and accuracy. The reviewed literature and international cases show that AI enhances risk assessment, fraud detection, and taxpayer services, while IoT strengthens real-time monitoring, asset tracking, and invoice authentication. The transition toward Tax Administration 3.0 depends on integrating these technologies within interconnected tax ecosystems, supported by automated processes and intelligent systems. Overall, AI and IoT represent essential pillars for building more effective, responsive, and technology-driven tax administrations.

The analysis of international experiences included in the study such as Spain's Virtual VAT Assistant, Sweden's AI-based risk model, Brazil's RFID-based Brasil ID system, and California's mileage taxation program shows that advanced digital technologies can significantly improve tax compliance and operational performance. The findings also highlight that successful adoption requires strong digital infrastructure, skilled human

resources, reliable datasets, and clear institutional frameworks. While AI and IoT offer major opportunities, challenges such as data quality, system integration, regulatory adaptation, and cyber security remain crucial considerations. The study emphasizes that tax administrations aiming to modernize must balance technological innovation with governance, transparency, and long-term sustainability.

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