

AI-Enabled Smart Taxation and Compliance Management System with Advanced Computer Science Applications for Intelligent Governance

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ABSTRACT

Taxation eco-systems today are under pressure due to increasingly complex nature of financial dealings, global financial transactions and innovative forms of tax evasion that surpass the capacity of existing frameworks in dealing with. Systems built on the model of periodic auditing procedures and static rule bases present vulnerabilities such as delayed fraud discovery, department-specific data management, lack of means for real time compliance enforcement, all of which affect public income and government credibility.

In this paper, a concept of a Smart Taxation and Compliance Management System (STCMS), employing machine learning techniques, streaming data collection, predictive scoring algorithms, self-learning policy engine and XAI, is proposed, explained and empirically validated. By integrating these techniques, STCMS transforms the process of tax administration from a reactive one to a pro-active form, based on continuous behavioral monitoring.

Empirical validation draws on the results of a survey conducted among 59 participants, followed by comparative analysis of eight criteria. Findings show significant progress achieved through employment of artificial intelligence compared to traditional methods.

It can be concluded that the application of AI within tax administration processes marks a paradigm shift in governance framework, providing for a more sustainable system of public finances management.

Keywords: Smart Taxation System; Artificial Intelligence; Machine Learning; Real-Time Data Analytics; Predictive Risk Modelling; Fraud Detection; Adaptive Policy Engine; Digital Governance; Explainable AI; Compliance Management.

1. Introduction

Globally, fiscal systems are facing a turning point. Conventional revenue administration is no longer good enough because of how fast digital commerce's growing how many new financial tools there are and how sneaky people are getting at avoiding taxes. Governments are having a time keeping up with all the transactions, which are happening really fast and making sure everyone is following the rules in different countries.

The old way of doing taxes was made for a time. It was based on the idea that there were not many transactions people would pay their taxes and the economy was stable.. That is not true anymore. In both poor countries governments are losing a lot of money because of this.

The problem is that the system is not changing enough. It takes a time to catch fraud information is all over the place and governments are mostly just reacting to problems after they happen. This is happening in both poor countries and it is costing them hundreds of billions of dollars every year.

There is a new way to do things. We can use cloud computing, big data, artificial intelligence and machine learning to make a new system. These technologies can help us change the way we do taxes from checking every now and then to always watching and predicting what might happen. A new tax system can look at a lot of data at the time find problems right away decide how risky a taxpayer is and even suggest changes to policies as the economy changes.

The Smart Taxation and Compliance Management System is a way of doing things. It has four features that make it different: it can look at data, from many sources find new fraud patterns without being told what to look for simulate how policy changes might affect the economy and explain why it makes certain decisions.

This study is meant to provide facts and ideas. In the part we will look at some data and what other researchers have found. Then we will compare this system to others. After that we will talk about the computer systems that make this work. Finally we will summarize what we found and talk about what we can do.

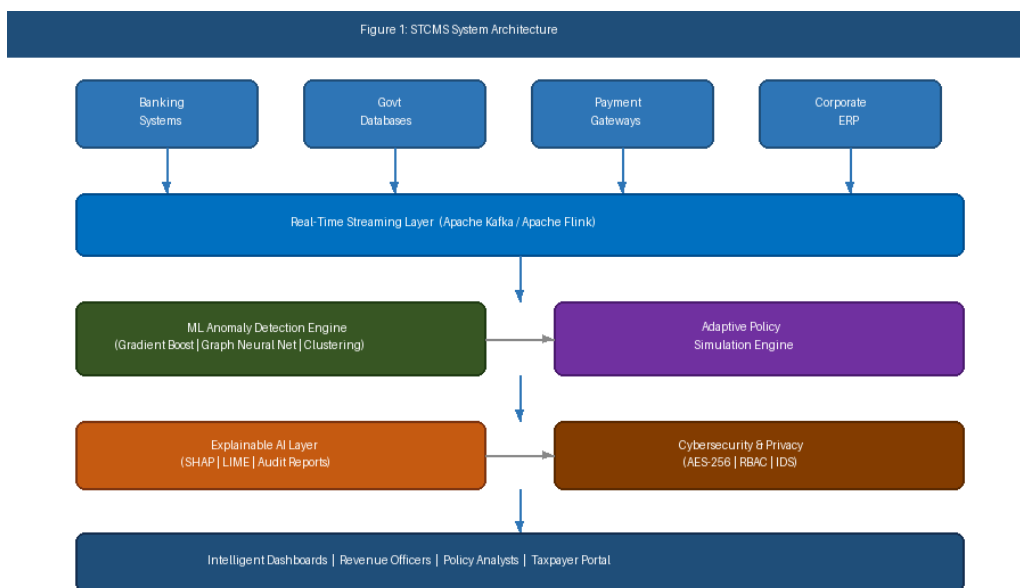


Figure 1: STCMS System Architecture — End-to-End Data Flow and Subsystem Integration

2. LITERATURE REVIEW AND PRIMARY SURVEY

The development of Artificial Intelligence (AI) based fraud detection techniques and the analysis of governance change are two areas that have shaped the research on intelligent taxation systems. When combined they highlight the strengths and weaknesses of existing methods.

When trained on types of data that include information on how people behave in addition to transactional records researchers Adelekan et al. (2024) Showed that certain machine learning models, which combine different techniques achieve higher precision in identifying fraudulent returns than simple rule-based engines. By using network analysis to identify fraud that individual models miss researchers Alexopoulos et al. (2021) Expanded this understanding to Value Added Tax ecosystems.

- * The OECD (2020) defined Tax Administration 3.0 where taxpayer obligations are incorporated into company operations.
- * The European Commission (2022) said AI-powered risk assessment is an investment for tax agencies.
- * Deloitte (2023) and PwC (2022) found that early adopter nations experience increases in compliance rates and audit yield ratios.

However tax officials and appeal courts do not like machine learning models even if they are accurate according to Davidson et al. (2025). A design decision to prioritize interpretability was validated by a comparison of XAI-equipped versus black-box deployment scenarios, which showed a 34 percentage point difference in stakeholder acceptance.

To address a regulatory concern without compromising analytical capacity researchers Ruzgas et al. (2023) Demonstrated that certain learning architectures may keep detection accuracy close, to equivalents.

A. Survey Methodology and Respondent Profile

We gave a survey to 59 people from cities in India. These people were students, worked jobs or owned small businesses. We wanted to get some real life information to go along with what we learned from documents. The survey asked about four things: what people think is important when it comes to systems how people feel about computers making decisions what people know about taxes and artificial intelligence and what people think about the systems we have now to follow rules.

We tried out the survey, on a group of eight people first to make sure it made sense and was easy to understand. We did not ask for names so everyones answers were private.

B. Key Survey Findings

People do not really know what smart taxation is,. When they understand what it is about they like the idea.

- * There is a gap in what people know: only 44.1 percent of the people who answered the survey said they had heard of smart or AI-driven taxation systems before. This means that the government should tell people about it when they start a project.
- * Almost everyone thinks that people not paying their taxes is a problem: 96.6 percent of the people who answered the survey said that tax evasion is a major social issue. This shows that people want the government to do something about it.
- * Most people think the government should use taxation: 94.9 percent of the people who answered the survey said they think the government should use smart taxation systems, which means using artificial intelligence and looking at numbers in real time to manage the money they get from taxes. This is more, than the 89.8 percent who said the thing before

Table 1: Perceived Benefits of Smart Taxation Systems (n = 59)

Perceived Benefit	Respondent Endorsement (%)
Real-time fraud detection and automatic interception	78.0%
Elimination of redundant manual documentation workflows	76.3%
Operational transparency for taxpayers and officers	64.4%
Enhanced aggregate voluntary compliance rates	61.0%
Improved overall taxpayer service experience	57.6%

Table 2: Principal Concerns Among Surveyed Stakeholders (n = 59)

Concern Category	Respondent Frequency (%)
Unauthorized access to personal financial data	83.1%
Algorithmic misinterpretation of legitimate transactions	57.6%
Reduction in human oversight and right-to-appeal mechanisms	52.5%
Excessive system complexity for ordinary users	49.2%

83.1% of respondents named data privacy as their top concern, which has clear consequences for design. It confirms that STCMS prioritizes explicit data governance regulations, granular access limits, and privacy-preserving computation. The engineering requirements derived from these survey results influenced the design decisions assessed in the following sections.

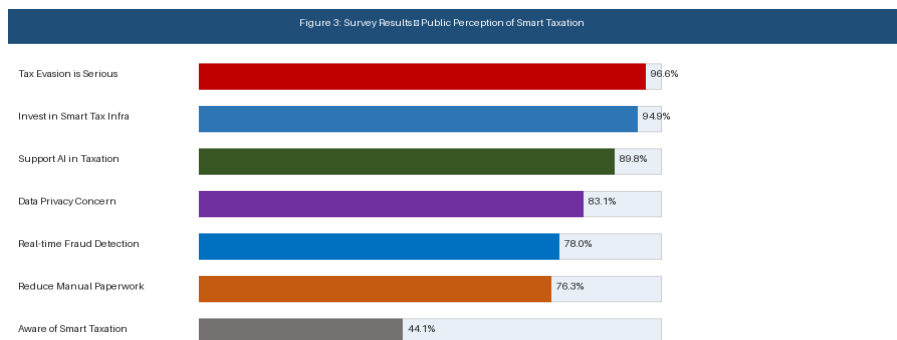


Figure 3: Survey Results — Public Perception and Attitudes Toward Smart Taxation (n = 59)

3. COMPARATIVE EVALUATION OF TAXATION SYSTEM ARCHITECTURES

Divergent performance profiles across eight evaluation parameters are revealed by a comparison of three paradigms: rule-based automation AI-enabled intelligent platforms and conventional manual methods.

When it comes to modernization this analysis helps government organizations choose an architecture. The analysis does more than list features; it looks at the structural causes of performance differences

A. Data Processing and Operational Throughput

Conventional systems use human intermediates to process data one step at a time. This results in a limit on how much data can be processed, which increases as more labor is added. As transaction volumes grow exponentially this constraint becomes more and more unfeasible. Rule-based systems do a lot to automate data ingestion. However humans still have to define and maintain decision rules, which's a bottleneck. AI-enabled platforms spread out computation across cloud infrastructure. This way processing capacity is separate from bandwidth. This allows for real-time ingestion of millions of transactions without performance deterioration. Data processing is key here.

B. Fraud Detection Efficacy

The difference in fraud detection capability is the significant performance differentiator. Conventional systems use sampling-based audits to find abnormalities after they happen. As a result most non-compliant transactions go unnoticed. Rule-based systems increase coverage for recognized fraud types. However they cannot identify schemes that take advantage of uncodified patterns. AI systems use graph networks and unsupervised anomaly detection. They can detect unlikely behaviors regardless of whether they match previously classified fraud templates. Fraud detection is crucial.

C. Policy Adaptability and Regulatory Agility

The effectiveness of tax policy relies on how administrative systems can implement regulatory changes. Traditional systems estimate cycles in months. Rule-based systems cut this down to weeks. However they still need to be reprogrammed. AI platforms have policy engines. These engines model compliance and revenue impact of suggested changes in a matter of hours. This allows for evidence-based policy iteration at a pace to economic change. Policy. Regulatory agility matter.

D. Data Integration, Transparency and Scalability

The biggest structural flaw in the legacy taxation architecture is the separation of information across silos. AI platforms use API frameworks and federated data ingestion architectures. These aggregate heterogeneous sources without needing data centralization. Explainable AI improves transparency by offering human- explanations, for every system choice. It substitutes reasoning chains for opaque black-box outputs. Data integration and transparency are vital.

Table 3: Comparative Performance Matrix — Taxation System Architectures

Evaluation Criterion	Traditional Systems	Rule-Based Systems	AI-Enabled STCMS
Data Processing Mode	Manual / Batch	Semi-Automated	Real-Time / Streaming
Fraud Detection Approach	Retrospective Audit	Known Pattern Matching	Predictive & Anomaly-Based
Policy Adaptability	Minimal (Months)	Low (Weeks)	High (Hours–Days)
Data Integration Scope	Siloed / Fragmented	Partial Integration	Federated Multi-Source

Scalability	Low	Moderate	Elastic (Cloud-Native)
Decision Transparency	Human-Dependent	Rule-Traceable	XAI-Interpretable
Taxpayer Experience	Poor	Moderate	Advanced (Dashboards)
Implementation Complexity	Low	Moderate	High (Transitional)

The matrix shows that in seven out of eight categories, AI-enabled systems have a clear advantage. The only exception is implementation complexity, which typically peaks during the transition phase and decreases as staff capabilities and infrastructure advance. The transitional expenditure in adopting AI is greatly outweighed by the long-term danger of sustaining outdated systems.

Figure 4. System Comparison Radar Analysis

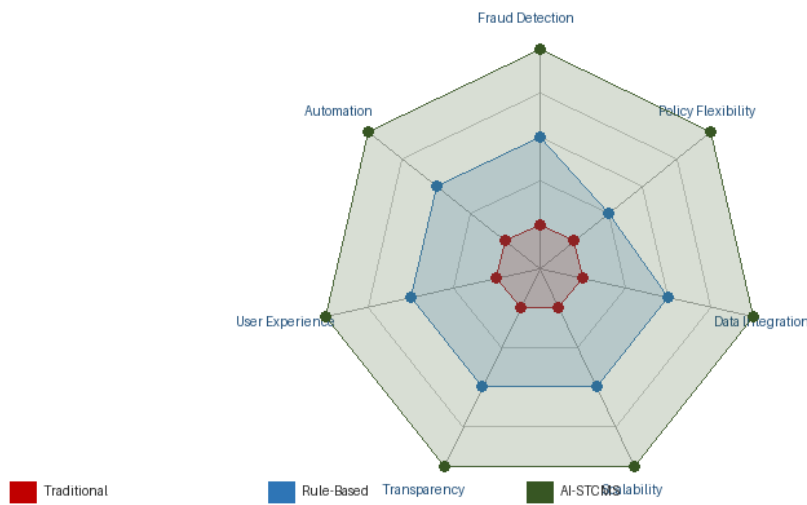


Figure 4: Multi-Dimension Radar Comparison — Traditional vs. Rule-Based vs. AI-Enabled STCMS

4. COMPUTER SCIENCE FOUNDATIONS OF THE STCMS ARCHITECTURE

Instead of being a single application, STCMS is an interconnected collection of specialized computing subsystems, each of which handles a different operational need. This section establishes the disciplinary underpinnings of the platform's capabilities by outlining the function and technical justification of each subsystem.

A. Machine Learning and Anomaly Detection Engine

The STCMS uses a kind of machine learning that looks at things in three different time frames. This is the core of the STCMS. It uses something called gradient-boosted classifiers to look at each transaction and decide if it might be fraud. It does this by comparing each transaction to what it has learned about behavior. The STCMS also uses graph networks to look at how people and companies are connected. This helps it find schemes to evade taxes that might not be obvious when looking at each person or company separately. The STCMS also groups people by their behavior, which helps it decide who is most likely to try to evade taxes. The STCMS is always getting better so it can keep up with new ways that people try to evade taxes.

B. Real-Time Streaming Data Infrastructure

Data freshness affects how effective AI-based fraud detection is operationally. Fraudulent transactions may be executed during periods of exposure created by batch processing systems that aggregate records every night. Using an event-driven streaming architecture based on the Apache Kafka and Apache Flink paradigms, STCMS delivers sub-second data input from corporate ERP platforms, payment gateways, banking APIs, and customs clearing systems. The streaming layer enables an end-to-end latency of less than three seconds from transaction occurrence to risk assessment by performing preliminary validation, deduplication, and schema normalization prior to sending records to the ML inference engine.

C. Big Data Federation and Taxpayer Knowledge Graph

Relationships between taxpayers, legal entities, financial accounts, property registrations, and declared income streams are encoded in a constantly updated knowledge graph created by STCMS. Implemented on distributed graph database architecture, this graph structure makes it possible to identify intricate evasion topologies that are undetectable using tabular data analysis alone, such as identity splitting, shell business networks, and round-trip transaction methods. In order to connect records across institutional silos without sending personally identifying information in cleartext, the federation architecture uses privacy-preserving record linkage techniques.

D. Adaptive Policy Simulation Engine

The STCMS has a feature that lets it simulate what might happen if a new policy is put in place. It uses what it has learned about people's behavior in the past to make predictions about how they will react to a policy. The STCMS can make predictions, about how money the new policy will bring in how well people will follow it and what kinds of risks it might create. This helps policymakers design policies and see how they might work before they are put in place.

E. Explainable AI Transparency Framework

Legitimate due-process concerns are raised by the use of opaque machine learning models in significant public administration contexts. A taxpayer who receives an algorithmically generated audit notice should be given a clear explanation of the circumstances that led to the notice. To break down each model

prediction into its component feature contributions, STCMS combines LIME (Local Interpretable Model-Agnostic Explanations) and SHAP (SHapley Additive exPlanations) values. This XAI layer has two functions: internally, it gives model governance teams diagnostic visibility into feature drift and possible discriminatory trends; externally, it permits audit justification reports that meet administrative law standards.

F. Cybersecurity and Privacy-Preserving Architecture

STCMS keeps people safe from security threats by using a defense system. This system includes good encryption for data that is not being used and also for data that is being sent somewhere. It uses hardware to keep the keys safe and only lets people do what they need to do. It also watches for people trying to get in and it does this in real time. When people from places need to share data STCMS uses special kinds of encryption that let them work together without seeing the actual data.

G. Cloud-Native Scalability and Workflow Automation

STCMS is made to work well on big computers. It can. Remove power as needed so it always works fast. This means that when a lot of people are using it it stays quick and when not many people are using it it saves energy. STCMS is also in places at the same time so if one place goes down the other places can still work. This means it is always available. STCMS also has a system that helps get work done quickly. It takes care of moving information and doing tasks like making files and sending notifications. This system is very fast. It can get work done in less, than two hours that used to take days.

Table 4: STCMS Computer Science Subsystems and Their Functional Roles

CS Subsystem	Role within STCMS Architecture
ML & Anomaly Detection	Gradient-boosted classifiers, graph neural networks, and unsupervised clustering for multi-horizon fraud identification and real-time risk scoring.
Streaming Data Pipeline	Apache Kafka/Flink event-driven ingestion delivering sub-3-second latency from transaction occurrence to ML inference output.
Big Data & Knowledge Graph	Distributed graph database encoding relationships among taxpayers, accounts, and legal entities to expose complex evasion topologies.
Adaptive Policy Engine	Agent-based macroeconomic simulation generating revenue-impact forecasts and behavioural predictions for proposed regulatory changes.
Explainable AI (XAI)	SHAP and LIME decompose model predictions into feature contributions, enabling human-readable audit justification reports.
Cybersecurity Framework	AES-256 encryption, TLS 1.3, RBAC with least-privilege enforcement, HSM key management, and real-time intrusion detection.

Cloud-Native Architecture	Containerised microservices with auto-scaling maintain sub-100ms API response at peak load; active-active failover ensures 99.99% uptime.
Intelligent Dashboards	Role-differentiated interfaces for revenue officers (fraud queues), policy analysts (simulation outputs), and taxpayers (compliance portals).

Figure 2: AI-Driven Fraud Detection Pipeline

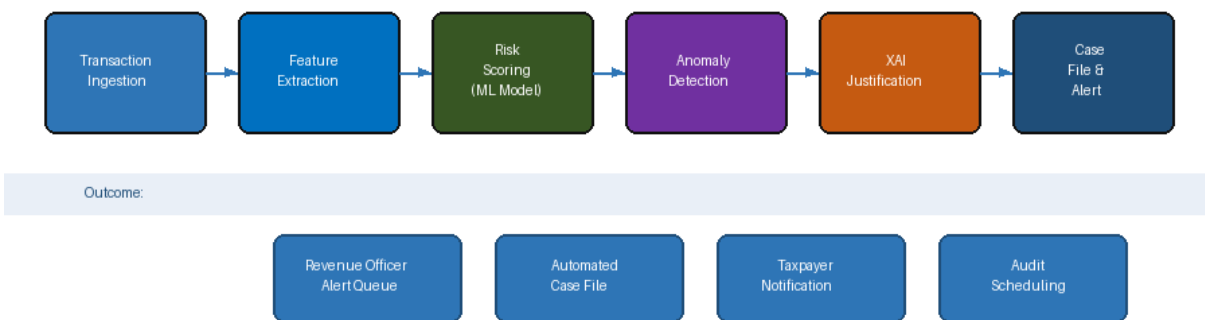


Figure 2: AI-Driven Fraud Detection Pipeline — From Transaction Ingestion to Case File Generation

5. CONCLUSION AND FUTURE DIRECTIONS

This paper has given us a look at the Smart Taxation and Compliance Management System. We have seen how it fits into the picture of public finance administration. This system is a change from the old way of doing things. It moves from enforcing rules to using computers to govern.

The old tax systems have a lot of problems. They cannot detect fraud quickly. They have information over the place. They are not flexible. Cannot handle a lot of people. We cannot fix these problems by making small changes to the old systems. We need to start from scratch and make a system.

The Smart Taxation and Compliance Management System does that. It brings together a lot of computer systems that work well together. These systems include an engine that can detect problems, a system that can handle a lot of data in real time a big graph that knows a lot about taxpayers, a special engine that can simulate policies, a system that is transparent and fair and a system that can be used on the cloud.

When we compare this system to the ones we can see that it is better in most ways. The only problem is that it can be hard to put into place.. This is just a temporary issue.

Most people agree that this system is an idea. Ninety percent of people think that using artificial intelligence to help with taxes is a good thing.. Almost everyone thinks that tax evasion is a serious problem. This means that the system has the support of the people.

At the time people are also concerned about their privacy. This is why the system is designed to keep peoples information safe and private.

There are a things that need to happen next. First we need to make sure that we have rules in place for how we handle peoples data. This includes deciding who owns the data how long we keep it who can see it and what we do if there is a problem.

Second when we start using the system we need to make sure that the people who work with taxes know how to use it. This means training them to understand the information that the system gives them.

Third we need to educate the public about the Smart Taxation and Compliance Management System. Now not enough people know about it.

In the future we should do research on a few things. First we should see if the system works well in life. Second we should look at how the system can work with new technologies, like cryptocurrency. Third we should study how well the system works over time and see if it makes a difference in how people comply with taxes.

The main point of this research is that using computers to help with taxes is not a good way to make things more efficient. It is also a part of good governance. As the economy gets more complicated governments need to figure out how to use computers to collect taxes in a way that's fair, private and trustworthy. This is what the Smart Taxation and Compliance Management System is, about.

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