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Enhancing Tax Technology with AI/ML: Monitoring ERP Transactions for Real-Time Compliance and Efficiency

Prashant Gupta[1], Vinay Singh[2]
[1]*Principal Product Manager, Enterprise Finance, Intuit, USA*
[2]*Oracle Fusion Cloud Lead, McGraw Hill, USA*

Abstract: ***In the complex tax environment of today, companies face more stringent legal scrutiny, more data, and evolving compliance criteria. Though they are essential for managing financial transactions for global businesses, Enterprise Resource Planning (ERP) systems sometimes struggle with the complexity and dynamic character of present tax responsibilities. This study looks at how Machine Learning (ML) and Artificial Intelligence (AI), including advanced approaches like deep learning and reinforcement learning, can transform tax compliance systems. Embedding AI/ML within ERP systems lets businesses achieve adaptive compliance, automatic anomaly detection, and real-time transaction monitoring, so significantly reducing risk and human effort. By means of use cases and case studies, this paper demonstrates measurable gains in operational efficiency and compliance accuracy, hence evaluating the efficacy of AI/ML.***

Keywords: Artificial Intelligence, Machine Learning, ERP Systems, AI Integration, Oracle Cloud ERP, Reinforcement Learning (RL), Predictive Analytics, Data-Driven Decision Making, Operational Efficiency, Large Language Models (LLMs), Digital Transformation.

I. INTRODUCTION

How companies handle financial data—including tax-related transactions—is greatly influenced by enterprise resource planning (ERP) systems as SAP, Oracle Cloud ERP, and Microsoft Dynamics. These systems provide the basis for tax computation, recording, and reporting across several countries. But, given the amount and complexity of modern financial data, conventional tax compliance methods depend mostly on static rule-based engines and human audits, which are growingly unviable. Tax technology may be greatly modernized by artificial intelligence (AI) and machine learning (ML). These technologies offer dynamic classification, anomaly detection, and proactive compliance monitoring by means of real-time analysis of transactional data. While reinforcement learning enables constant adaptation via feedback-driven learning, deep learning can reveal intricate links inside high-dimensional data. Including these technologies into ERP systems will help tax departments to move from reactive reviews to smart, real-time control, so improving accuracy, lowering risk, and optimizing resource allocation.

This paper investigates how ERP-based tax compliance processes can be efficiently run using AI/ML technologies, assesses their advantages via practical case studies, and points out important adoption issues and factors to consider.

II. PROBLEM STATEMENT

Relying on static regulations and manual reviews, traditional tax compliance procedures inside ERP systems are growingly insufficient. These approaches lag the dynamic character of tax rules and the volume of transactional data, which causes inefficiencies and more audit vulnerability.

III. RESEARCH OBJECTIVES

The main goals of this paper are:

- ✓ Examine how these technologies affect anomaly detection and real-time transaction monitoring.
- ✓ Find difficulties and constraints related to including AI/ML into current tax processes.

IV. LITERATURE REVIEW

Recent studies highlight the influence of machine learning and artificial intelligence in tax compliance:

- ✓ By enhancing data analysis artificial intelligence can help in highlighting the unusual tax data and possible risks.
- ✓ Integrating machine learning to ERP systems improves the accuracy and efficiency of data matching and tax computation.

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A. Challenges and Considerations Challenges in ERP-Based Tax Processes

Several structural and operational issues impede tax compliance in ERP systems:

- ✓ Often needing considerable time and effort from tax teams to analyze thousands or millions of transactions, manual data review is still a common practice.
- ✓ Although helpful for pre-defined situations, static rule-based systems lack the capacity to change with subtle or changing transaction patterns.
- ✓ Data pertinent to tax decisions—such as invoice descriptions, purchase terms, and product classifications—is frequently spread across several ERP systems or kept in unorganized formats, which complicates integration.

These elements cause inefficiencies in the general tax process, more audit vulnerability, and late error identification.

V. METHODOLOGY

Sourced from ERP systems, transactional data covered general ledger, procurement, accounts receivable and accounts payable among other modules. Data preparation meant organizing and cleaning this material to enable study.

A. Data Preprocessing

The data for machine learning models was prepared using techniques including normalization and feature extraction. Unstructured data from contracts and invoices was interpreted using natural language processing (NLP) techniques.

B. Model Selection

We used a mix of supervised and unsupervised learning models:

- ✓ Supervised Models: Used for identifying transactions based on historical labeled data.
- ✓ Unsupervised Models: Applied for anomaly detection in unlabeled datasets.
- ✓ Reinforcement Learning: Implemented to optimize decision-making processes over time.

C. Evaluation Metrics

Accuracy, precision, recall, and F1-score were used to evaluate model performance. The models' capacity to change with fresh transaction patterns and tax rules was also assessed.

VI. AI/ML CAPABILITIES FOR ERP TRANSACTION MONITORING

By adding intelligence, adaptability, and real-time insights into the monitoring of financial activities, AI and machine learning are changing tax technology. By means of pattern recognition and deviation detection that can indicate misclassifications, compliance concerns, or even fraudulent activity, these technologies are quite successful in spotting anomalies in transaction data. AI learns from past data and adjusts when new patterns appear instead of depending just on strict rule-based systems. While supervised models get more accurate over time as they are exposed to known mistake situations and exception scenarios, unsupervised models such as clustering algorithms and autoencoders can autonomously discover anomalies without the requirement for labeled examples. By examining transaction-level data—including invoice values, customer jurisdictions, and sales volumes—AI may provide dynamic monitoring in the field of billing and tax compliance by revealing early signs of regulatory risk. For example, in the EU, VAT registration criteria differ by nation and could be activated when cross-border sales surpass specified thresholds. AI models can monitor these limits in real-time and immediately alert when a company is approaching or over them. Rather than respond after a breach has happened, this proactive strategy helps guarantee that tax teams can act ahead of time. Natural language processing (NLP) methods can also examine contract language and invoice text to find mentions of taxable services, business use, or buyer location, all of which affect regulatory responsibilities.

Among the main advantages and features are:

- ✓ Real-time anomaly detection to identify odd tax code use, duplicate billings, or misclassified transactions.
- ✓ Particularly in cross-border EU situations, threshold monitoring for jurisdiction-specific VAT registration limits.
- ✓ Predictive notifications forecasting possible compliance problems before they lead to penalties or unmet responsibilities.
- ✓ Context-aware analysis of client data and invoice narratives to identify possible application of regulatory laws.
- ✓ Ongoing education honing accuracy over time depending on audit results and changing tax rules.

Organizations can change from static compliance checks to smart, responsive monitoring by including artificial intelligence straight into billing and ERP systems, hence lowering risk and strengthening trust in their tax status.

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When dealing with high-dimensional data or when conventional techniques make pattern identification challenging, deep learning—especially with neural networks—is quite useful. These models can study complex interactions between combinations of transaction characteristics like vendor profiles, invoice descriptions, tax codes, and jurisdictions. In global companies where tax treatments differ by area and product category, and where contextual elements are important, this is particularly useful.

Another field where artificial intelligence shows significant advancements is classification. Machine learning algorithms can automatically identify the proper tax treatment of a transaction depending on its traits using previous labeled data. This covers choices on nexus, taxability, jurisdictional allocation, and input tax credit eligibility. By reading product descriptions, contracts, and invoice narratives to get tax-relevant context, NLP methods and deep learning-based text models can help to improve classification even further.

Tax automation is made dynamic using reinforcement learning. Unlike supervised models that depend on static datasets, reinforcement learning agents engage with their environment, get feedback (rewards or penalties), and enhance their actions over time. A reinforcement learning agent in the realm of tax technology could be taught to recommend corrective measures for misclassified transactions, improve the sequence of review for flagged records, or dynamically change anomaly detection thresholds depending on changing audit activity. The system learns from results and tailors its behavior to enhance compliance results with least human intervention over time.

AI also makes it possible to intelligently extract data from unstructured papers including contracts, customs declarations, and invoices. Systems can extract pertinent data fields, standardize them, and link them to ERP transactions by merging deep NLP models with OCR. This greatly increases the completeness of data accessible for tax decision-making and decreases the human load of data entering.

A. System Architecture for Integration

Including artificial intelligence and machine learning into ERP transaction monitoring calls for a layered architecture connecting structured ERP data, unstructured documentation, and intelligent processing. Fundamentally, transactional data from modules including general ledger, procurement, accounts payable, and sales is extracted and preprocessed into a uniform format. By producing tax-relevant characteristics and combining contextual information, a feature engineering layer enriches this data. Trained and deployed in a model layer interacting with the data layer either in real time or in batch mode, machine learning models—including deep neural networks and reinforcement learning agents—are run and operated.

Orchestration workflows control the data flow through models, hence activating reviews or automated actions depending on confidence criteria and business logic. An interface layer provides dashboards and alerts to tax professionals, offering interpretability tools such as SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-Agnostic Explanations) provide transparency by showing which features influence a model's decision, making it easier for tax professionals to interpret complex outputs from black-box models. Ultimately, the design guarantees that AI insights are included inside the larger tax compliance and reporting ecosystem by means of APIs connecting it to current tax engines and filing systems.

B. Benefits of AI-Driven ERP Tax Monitoring

Adding machine learning and artificial intelligence to tax monitoring offers many strategic and operational benefits. Accuracy is significantly improved when models learn from past misclassifications and reduced manual errors. Running continuously, artificial intelligence systems offer real-time or near-real-time detection of issues typically only generated during month-end closes or audits. Automation helps tax teams to focus on high-value tasks including strategy planning or regulation interpretation rather than manual inspections by increasing efficiency Deep learning models can grow across nations, corporate divisions, and tax categories by learning from large volumes of data unencumbered by rule sets. Reinforcement learning lets systems adapt to new tax rules, organizational changes, or external feedback—such as audit results—without requiring total retraining, hence increasing resilience. Furthermore, artificial intelligence-driven solutions increase audit readiness and reduce the likelihood of conflicts and penalties by providing obvious, reasonable decision trails for every flagged or classified transaction.

C. Risks and Considerations

Though artificial intelligence/machine learning in tax technology has great promise, key issues still need to be resolved. Particularly in countries with rigorous compliance standards like GDPR, data privacy and governance must be preserved. Especially in tax situations where choices could have legal and financial consequences, AI systems should be built with explainability in mind.

Tools like LIME, SHAP, or attention visualization can assist clarify complicated models. Organizational change management is also very important; tax experts have to be educated to grasp AI results and include them into current review and escalation procedures.
AI models also require constant monitoring and updating. Models could lose performance or need retraining to preserve accuracy and relevance as business conditions and rules change. A set of procedures called MLOps (Machine Learning Operations) helps to automate and control the lifespan of ML models, hence guaranteeing their accuracy, currency, and readiness for production. Implementing machine learning operations (MLOps) techniques guarantees correct versioning, testing, and deployment of models in production settings. Ultimately, although artificial intelligence can automate and improve many areas of tax compliance, it should support rather than substitute human judgment under governance systems supervising important choices.

D. Case Studies

To evaluate the practical relevance and advantages of the AI/ML models, several case studies were carried out inside various organizational settings. Results showed decreases in manual review times and increases in compliance rates.
Infosys – Automating Tax Audit Proposal Process
Infosys developed an AI/ML system to automatically generate tax audit proposals for a worldwide professional services corporation. The technology standardized parts of presentations across clients and sectors by pulling data from previous bids, hence lowering manual work and improving consistency. This strategy maximized talent allocation and reduced human intervention in the bidding process.
PwC – AI-Driven Tax Optimization with Halo
To update tax optimization, PwC included artificial intelligence into its Halo system. The AI-driven technology cut operational expenses, guaranteed smooth regulatory compliance, maximized deductions, and increased tax reporting accuracy by 20%. Real-time information on financial commitments enabled companies to more precisely negotiate complicated tax legislation.

MTN Group – AI for Financial Reporting and Tax Compliance
A telecoms company, MTN Group used Oracle Cloud EPM to streamline its budgeting procedure throughout 23 operating areas. The artificial intelligence system increased accuracy, cut budget preparation time by 50%, and enhanced tax-provisioning supervision. Real-time, centralized data visibility enabled better decision-making and cooperation.

E. Research Contributions

By means of this work, intelligent tax compliance is advanced in the field of:

- ✓ Showing how several AI/ML models—including reinforcement learning and NLP—can be operationalized inside ERP systems.
- ✓ Suggesting a multi-layered system architecture for real-time compliance that combines structured and unstructured data.
- ✓ Offering industry case studies that confirm theoretical ideas by means of practical results.
- ✓ Describing tax-related MLOps and explainable artificial intelligence best practices and governance policies.

VII. CONCLUSION

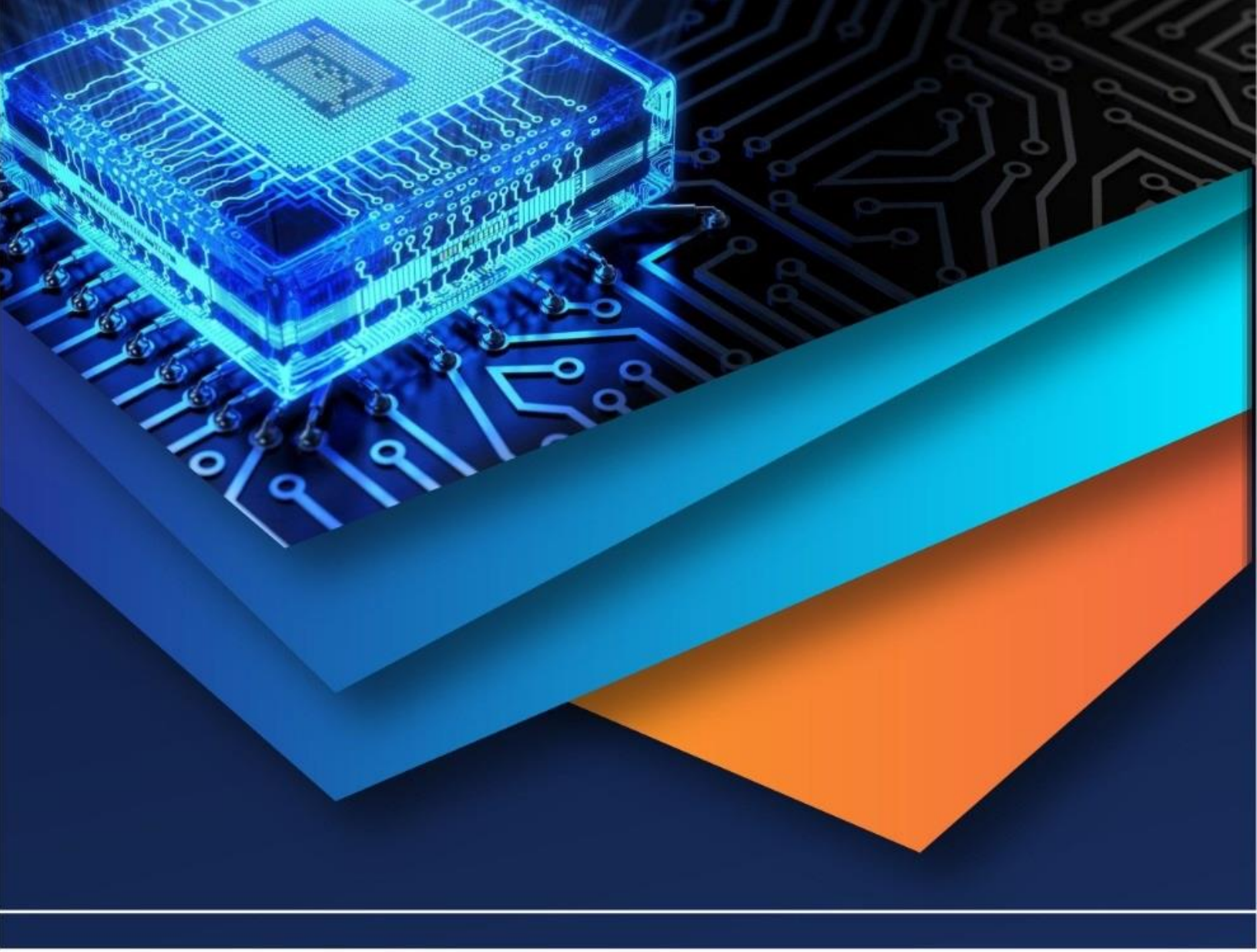
ERP-based tax compliance is being transformed for companies by the inclusion of artificial intelligence and machine learning, which changes their management of operational efficiency and regulatory risk. AI-enabled systems can smartly monitor tax-relevant data in real time by means of supervised learning for transaction classification, unsupervised learning for anomaly detection, and reinforcement learning for adaptive decision-making. From automated tax audit proposal generation to predictive tax optimization, industry case study findings show significant reductions in manual effort, enhanced accuracy, and prompt compliance actions.
Furthermore, by means of explainable AI models and dashboards, these smart systems provide more transparency, so helping tax experts to grasp and rely on automated results. Although issues still exist—such as preserving data privacy, guaranteeing explainability, and controlling model drift—strong governance systems and MLOps techniques can help to solve these.
In the end, companies that include AI/ML technology into their ERP systems will be better able to negotiate the changing tax environment, expand their compliance activities, and achieve long-term strategic advantages.
Although issues still exist—such as preserving data privacy, guaranteeing explainability, and controlling model drift—strong governance systems and MLOps techniques can help to solve these. Future studies could look at the creation of AI-driven worldwide tax standards, comparative research across several ERP systems, and the integration of large language models (LLMs) for automated tax document generation.

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