e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 8, August 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

© 2024 IJMRSET | Volume 7, Issue 8, August 2024| DOI:10.15680/IJMRSET.2024.0708079

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Leveraging Machine Learning to Enhance Accuracy and Efficiency in Regulatory Compliance

Mohan Kumar Sonne Gowda

Senior Audit Manager, HSBC Bank N.A., USA

ABSTRACT: Automating identification and analysis of regulatory and compliance changes through the advanced Artificial Neural Network (ANN)-based Regulatory Compliance Platform for Financial Services will help alleviate the growing complexity and volume of regulations that Financial Institutions must comply with. The platform incorporates cutting-edge Natural Language Processing (NLP) and Machine Learning (ML) technology to automate the detection, extraction, and analysis of regulatory changes from multiple regulatory agencies, third-party providers of regulatory information like Bloomberg and Thomson Reuters, and other Corporate News Sources. The Compliance Management Process relies on a Comprehensive Architecture Built on the following components: Automated Workflow for Timely Correction of Regulatory Violations, Intelligent Regulatory Risk Assessment (IRRA) that matches the organisation's internal policy; Enhanced Text Processing Capability to interpret Legal Requirements, Efficient Ingestion of Data from Multiple Sources of Regulatory Information, Notification of Regulatory Changes as they occur and a Centralised Repository for the organisation's Compliance Data. The provision of a single Point-of-Access for Compliance Data and real-time access to Compliance Data for all stakeholders will provide: best practices for Transparency; increased readiness to Audit; and improved Compliance with Regulatory Requirements; and decreased Opportunities for Human Error as well as reduced Workload for Both Regulator and Compliance Functions. Since the implementation of the Platform, Organisations have seen improved accuracy in compliance, faster response to regulatory changes, increased areas for regulatory Risk Assessment and reduced Costs of Regulatory Compliance Operations. This article will also discuss Some Future Development Opportunities for designing an integrated Global Compliance Platform with Emerging Security Technologies and artificial intelligence (AI) for Predictive Analytics regarding Regulatory Compliance.

KEYWORDS: Artificial Neural Network (ANN), Natural Language Processing (NLP), Machine Learning (ML), Intelligent Regulatory Risk Assessment (IRRA), Compliance Data, Costs of Regulatory Compliance Operations, Emerging Security Technologies, for Predictive Analytics

I. INTRODUCTION

Regulations are changing worldwide at a fast pace, and as a result, financial institutions have become subject to an increasing number of regulatory requirements and expectations. Therefore, it is essential for financial institutions to quickly develop and implement the necessary compliance structures and processes to be able to comply with all applicable regulations as they evolve to protect and maintain their operational integrity and their customers' trust over an extended period of time. Improper implementation of new regulations into organizational structures may create substantial legal, financial, and reputational risks [1].

Banks' ability to effectively manage regulatory change and remain compliant with newly introduced legislation is an essential component to their ability to continue functioning as a business. By maintaining a proactive approach to monitoring and analyzing regulatory changes, banks can proactively incorporate modifications into their internal procedures while protecting their operational integrity and significantly reducing the potential for confusion regarding regulations and compliance and improving their governance practices. A methodical approach to managing regulatory risk and continuing to build and maintain stakeholders', customers', and regulators' trust, confidence, and reputation [2].

© 2024 IJMRSET | Volume 7, Issue 8, August 2024| DOI:10.15680/IJMRSET.2024.0708079

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Financial institutions are currently dealing with an overwhelming experience of managing compliance with ever-increasing complex regulations regardless of location. Historically, compliance teams have been required to perform time-consuming manual processes in order to keep up with the frequent and ongoing changes in regul.tory requirements, resulting in increased resource utilisation and the potential for missed updates and difficulties in responding to evolving regulation, especially where multiple regulations from different jurisdictions apply and/or where there is overlap or conflict between regulations. All of these inefficiencies are costly, limit the bank's ability to make timely decisions, and raise the probability of regulatory violations with the subsequent risk of fines and damage to the bank's reputation.A bank's ability to manage a continuously changing regulatory environment will depend on its having a scalable and automated way to timely and accurately monitor and interpret regulation changes [3].

If financial institutions do not effectively respond to regulation changes by instituting changes to their regulatory compliance processes, they may incur significant risk to their business through noncompliance with regulatory requirements that can result in large fines, legal action, and increased oversight by regulators. The inability of an institution to adhere to compliance with regulations can inadvertently damage the reputation of that institution. As a result, the level of confidence that both customers and investors have on the institution will begin to diminish. Misinterpretations of regulation may also lead to disruption in the institution's operation due to existing policies being insufficient, thus creating weakness in the institution's operations, failure to pass audits, and increased risk of fraud and security breaches. Regulatory gaps can also prevent the institution from being able to manage risk appropriately, thus creating unforeseen issues when having to make strategic decisions. With that being said, remaining current with regulatory changes is a key driver with the requirements of a financial institution to be able to manage the regulations effectively.

To improve compliance with federal and state regulations for financial institutions, an automated solution to provide regulatory monitoring/analysis could be implemented for the effective management of regulatory compliance for financial institutions. The proposed automated solution would include several different advanced technologies including artificial intelligence and natural language processing. The advantages of an automated process for monitoring and analysing regulatory changes will enhance the speed and comprehensiveness of identifying important changes to regulations, and allow the institution to utilise automated tools to assist in ensuring regulatory compliance when implementing changes to internal operating processes based upon the implications created by regulatory changes. The automated solution would also allow for the automation of multiple operational processes related to the overall compliance effort for an institution and provide immediate notification to institutions when a change occurs, provide an audit-ready process for documenting compliance efforts and create a central repository for tracking all regulatory changes. In addition, machine learning will enable financial institutions to predict and avoid compliance failures by allowing financial institutions to identify compliance-related threats and develop proactive measures for avoiding risks.The Strategy Framework enables companies to quickly adapt to changes in regulatory requirements, which can occur rapidly and frequently.

The objectives of the regulatory compliance system are to ensure companies have a streamlined way to manage compliance activities and responsibilities, allowing for increased employee output; provide real-time alerts regarding regulatory change, enabling proactive actions related to compliance; enable management of processes more effectively by automating the collection and processing of regulatory compliance documents so they will be readily available for audit purposes; and to utilize machine learning methods to identify possible compliance risks by recognizing trends and anomalies that may indicate compliance issues or areas of concern.

The framework has been developed with a view of including the regulatory compliance processes for managing agencies by multiple National and International Regulatory Bodies. The successful implementation of this regulatory Compliance Solution is dependent upon the timely collaboration of a variety of stakeholders, including Compliance Officers, IT Departments, Business Partners, Data Administrators, and Change Managers. Each subgroup provided critical input, support, and resources toward the development of the Compliance Solution. Business Partners serve as the foundation of the framework to provide assurance that the Compliance Solution works as intended and to assist in ensuring compliance with their respective regulations. Compliance Departments provide expertise with respect to what regulatory compliance documents are required and ensure that the data is of high quality and managed according to appropriate governing policies. Senior Leadership provides direction and resources, and the Technology Department provides opportunities to development AI and NLP Tools to automate many of the compliance management processes

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

through increased efficiency. The combination of these elements created a culture of proactive compliance within the organization, promoting effective communication and integration among the various stakeholders involved in the project and allowing for the identification and response to regulatory changes in a timely manner [5].

The focus of the project was on the US regulatory environment, which is very complex due to the numerous federal and state agencies that regulate it (SEC, FINRA, FDIC, CFPB, OCC), with each agency having its regulations that continuously and often drastically change over time. Because of these fragmentations, compliance in the regulatory landscape has become significantly more time-consuming and difficult to track, interpret and comply with the various regulations. By concentrating on only the US jurisdiction, the system was successfully managed through the high-risk situations for which it was designed to manage, which required ongoing monitoring and analysis. Further, it provides comprehensive support for complying with the most important and significant banking regulation enacted in the US (such as the Dodd-Frank Act and the Bank Secrecy Act). The use of the system has demonstrated how a solution can effectively navigate the complex and ever-changing regulatory environments that frequently exist within the context of international banking.

The use of AI/NLP technologies on regulatory compliance efforts advances the field significantly and automates many of the manual process employed within many compliance organizations. AI/NLP allows organizations to quickly scan, interpret and analyze the multitude of complex regulations and remain up to date with their compliance obligations in a timely manner. Thus, the use of machine learning, natural language understanding and data management increases the accuracy of identifying new regulatory changes and decreases the amount of time required to respond to regulatory changes, allowing organizations to stay in compliance with all regulatory requirements. In addition, the automated documentation and a common platform that facilitate audit readiness provide organizations with a consolidated set of data for all compliance-related matters, which are traceable throughout history and accessible to all organizations. The AI/NLP-driven ability to detect financial risks will aid organizations in proactively identifying potential legal violations and fraudulent activity, and as such, will enhance an organization's operational resiliency to changes in the regulatory environment, while simultaneously decreasing compliance costs and improving the ability to monitor regulatory compliance by regulators and other organizations [6].

II. RELATED WORK

Regulatory compliance oversight is traditionally predominantly dependent on traditional manual methods such as documentation, on-site audits, and meetings; while the regulatory compliance division monitors all regulatory updates via third party regulatory bodies (SEC, FDIC) via documents sent to them via email or via below-standard spreadsheet methods using Microsoft Outlook or other email notification systems. Semi-Automated methods generally incorporate rudimentary types of tools like basic rule-based systems, simple software scanning programs that can recognize keywords, self-assessment tools, and training tools that help train employees to understand compliance requirements. Based on previous evaluation methods, Semi-Automated and Automated observations of Regulatory Changes are generally superior to Manual Compliance Audit observations; due to the efficiency of Automated Methods, Manual Compliance Audit observations will more than likely result in long delays and an increase in errors as compared to Automated Regulations Monitoring processes. Although Manual Compliance Audits can yield very detailed results related to regulatory issues, Automated Compliance Data Analysis can allow for efficient processing of data at higher levels of automation than would be possible with standard Manual Audits [7].

The Automated Compliance Monitoring Process uses Artificial Intelligence to provide continuous monitoring of regulatory updates and process this data in real time by using large amounts of data. Automated compliance monitoring is superior to Traditional Compliance Monitoring methods because Automated Regulatory Monitoring allows for significantly reduced error rates, maintains constant coverage of all times, and works seamlessly with Existing Systems. As a result of these characteristics, Automated Compliance Monitoring reduces Manual Efforts by close to 78% and creates fewer false positives, which reduces potential liability [8]. Manual Compliance Audit observations have a variety of limitations, such as a delay in updating information as a result of slow processing speeds (due to reliance on Human Document Analysis). As a result, regulatory developments may be notified later than they should. Another impact of this is that teams must assess and react to many more regulatory updates, making it very difficult for a team to make timely decisions. Team members can become fatigued and fatigued by having to process information, resulting in misinterpretation of the regulation, inaccurate compliance, or regulatory gaps. Teams are not able to expand their

efforts to keep pace with the growing regulatory demands. A team's capacity can become severely restricted if they have numerous jurisdictions, and thus, many larger organizations can only achieve sufficient coverage by dedicating a disproportionately larger number of resources [8].

To improve compliance monitoring and keep up with increased regulatory scrutiny, financial institutions must utilize automated compliance technology. Centraleyes, Scrut, OneTrust, LogicGate Risk Cloud, and Compliance.ai offer financial institutions a way to respond proactively by providing dashboards and email alerts based on company-specific thresholds and rules for regulatory violations and updates. They also greatly reduce the amount of time it takes to collect and organize documents through automated evidence collection and centralized document repositories with version control, while also providing an effective means of managing rules and internal controls through easy access and regular updates to all compliance documentation. All of these platforms use keyword recognition and basic NLP techniques to provide tracking functionality for regulatory changes while also being very effective in highlighting key compliance updates and providing useful summaries [9].

Over the last few years, numerous research studies have demonstrated how AI technologies such as Natural Language Processing (NLP) and Machine Learning (ML) will fundamentally change how corporations develop and manage their compliance documentation. Through advanced data extraction techniques, AI technologies can extract regulatory obligations from large quantities of text and categorize them appropriately and perform a quick and accurate analysis of those obligations. The speed of the review process can be enhanced using AI-Powered NLP Algorithms, which allow for the automated extraction of relevant regulatory requirements from non-structured textual documents, as well as to organize the required documents into regulatory categories and understand the implications for internal company policy. NLP algorithms also offer contextual analyses that enable a thorough examination of the differences between emerging and existing regulations. With the introduction of automation to this process, financial institutions and other regulated entities now have a tool that helps them maintain compliance with numerous regulations, keep abreast of the status of their audits, and minimize the potential for risk associated with misinterpretation of regulatory requirements. According to [10], this is particularly beneficial in managing the exponentially increasing complexity associated with regulatory requirements for both financial services and regulated industries, respectively [10].

Recent studies have shown significant improvements in the speed and accuracy of NLP models developed to extract text from regulatory documents. The most noteworthy of these developments is a successful blend of large language models (LLMs) with deterministic NLP methods used by IQVIA to extract important information from regulatory documents quickly and efficiently; therefore drastically improving the time taken to perform a manual review of the documents. From conducting the AIReg-Bench study, various types of leading LLMs were compared to see how accurately they would produce annotations regarding compliance with regulations relative to the judgments made by experts. Findings showed great reliability with models such as Gemini 2.5 Pro and Gemini 2.5 Flash, both as it pertains to separating compliant and non-compliant regulatory extracts, with low mislabeling rates, high correlation and F1 scores. Moreover, research has proven that modern NLP architectures, specifically deep learning models, particularly LSTMs, outperform traditional ML methods in the ability to extract sufficient data. There are impressive micro-averaged F1 scores associated with these advanced NLP solutions for the extraction and categorization of regulatory text that are essential for effective compliance management [11].

AI/NLP automated impact analysis will be used in conjunction with assessing the impact of regulatory changes on companies' internal processes, predicting necessary changes, and removing human effort from the process. Through automating the risk assessment process, companies such as Lucinity will provide real-time mapping of regulatory requirements to their corporate regulations through centralised repositories and real-time regulatory updates through automated task management, as illustrated with Lucinity. AI-enabled regulatory platforms, such as FlowForma and Solvexia, are also designed to facilitate the real-time alignment of regulatory requirements with corporate guidelines and can provide information on tracking regulatory changes in real-time, as well as providing meaningful records for compliance through traceability and minimising regulatory silos. Compliance workflows can enhance productivity and prepare a company for audits by automating tasks, issuing alerts, and creating reports for companies to manage compliance continuously through customised procedures. Examples of compliance workflow tools include Sprinto and Zluri [12].

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Current regulatory compliance solutions for complex financial entities experience numerous limitations because of several gaps associated with their design; for example, most solutions lack capabilities for providing timely notifications to stakeholders about potential issues, which often delays their recognition and response actions. The absence of a single centralised platform leaves the systems/procedures for compliance to be distributed across many individual systems/technologies, creating multiple repositories of incompatible data stored in silos. Additionally, these systems lack adequate collaboration capabilities, hindering the ability of users to work together to develop regulatory compliance processes. Furthermore, due to the excessive number of complex-jurisdictional laws, the likelihood of misunderstanding or failing to comply with these regulations increases with a lack of a solution for facilitating compliance. Therefore, to meet these challenges, there is a need for and opportunity to develop a centralised regulatory compliance platform using Artificial Intelligence/NLP technology to continuously monitor regulatory changes and assist compliance personnel by providing real-time notifications of those changes. Doing so would improve the communication channel between teams within an organisation, help to automate compliance-related tasks and interpret regulatory language accurately, and ultimately minimise operational risk and governance overhead. In turn, this would satisfy the increasing need for highly scalable and integrated compliance management systems to successfully navigate the growing complexity of regulatory compliance across the financial industry [13].

III. SYSTEM ARCHITECTURE

The developmental cycle was structured to be detailed down to the processes needed to complete different phases of the project including how to identify scope, how to determine total effort, how to review progress, how to manage all changes, how to oversee delivery of work, and lastly, how to provide continued assistance after all phases of a solution are complete to ensure all deadlines and budgets were met. In addition to creating and executing the project plan process as part of project development, the planning phase focused specifically upon the creation of project scope, the creation of machine learning and predictive analytic algorithms, testing through various forms of testing and the generation of reports to summarize the results of the testing and to define the attributes of the project. The project team used Agile Metrics to provide early warning indicators of project velocity and quality so teams could keep projects moving towards completion of milestones while also using Thinking Positively and collaborating to identify solutions to problems they faced throughout the project lifecycle and to ensure that each project was completed on time. At the onset of the project lifecycle, proactive risk management was used to identify and control potential impacts on resources, technology, and workflow processes.

The solution architecture of the Compliance Solution featured a central web-based platform for automatically monitoring compliance to regulations within multiple regulatory jurisdictions around the world. This architecture provided for standardising workflows, automated detailed analysis of the impact of regulatory changes and using automated processes for creating and sending messages to regulatory authorities based upon the structure of the document and the use of multiple regulatory authorities to support continual compliance, real-time alerts.

The project was a team effort where strong leadership contributed to establishing the cross-functional teams needed to produce high-quality results, all within budget and timeframe constraints. The entire product development cycle from concept through delivery was managed with operational alignment to comply with the compliance objectives created through the standardisation and integration of the custom business applications developed to support this project. By recruiting, mentoring, and training staff, the project leadership team developed a culture that supported best practices in the software development and engineering disciplines. The ongoing, interactive collaboration with the senior management and the stakeholders allowed the project team to ensure that the project technology solution was continually evolving to fulfil the organisation's Risk Management needs.

Open communication between the compliance and the business side of the industry paved the way for strengthening the working relationship with our clients and ensured all compliance processes were executed correctly and optimally. The impact of the project was significant, as it allowed for automating the monitoring, analysis, and implementation of regulatory changes to ensure the organisation maintained compliance with changing regulations. Automating much of the manual work and reducing the number of human errors allowed the organisation to quickly determine the impact of the regulatory updates on their operations. The transparency of the analysts' decisions to prepare for regulatory change and to support the impact determination provided the compliance personnel with an excellent trust factor in the decisions being made to maintain compliance. Automating the majority of the compliance processes created a reduced

© 2024 IJMRSET | Volume 7, Issue 8, August 2024| DOI:10.15680/IJMRSET.2024.0708079

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

risk of violating compliance regulations, and therefore, eliminated the associated risks of being subject to financial penalties and of causing damage to the company from a reputational standpoint, thereby providing a competitive advantage in a very highly regulated environment, while maintaining the institution's integrity and ensuring continuity of operations.

The Compliance Regulations Monitoring Platform uses the technologies of AI and Natural Language Processing (NLP) to monitor, analyze and orchestrate processes automatically as part of the Compliance Solution. The Compliance Solution has a modular, tiered architecture that makes use of Ingestion Pipelines as the method of managing regulatory data. Impact assessment and interpretation of regulatory updates are achieved using machine learning algorithms. The end result is providing actionable insights to the Compliance Solution users via the Dashboard found in Figure 1 below.

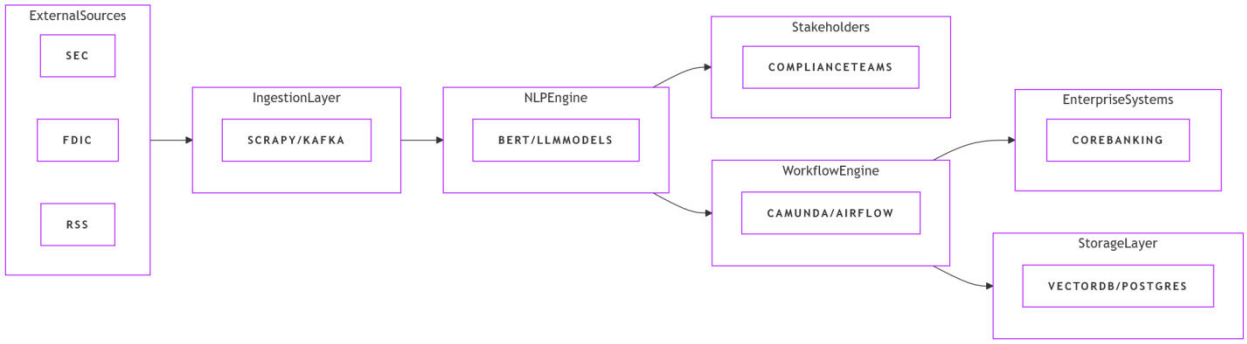

Figure 1: Layered Architecture Integrating AI/NLP

1. **Data Ingestion Layer:** The ingestion of data includes the continuous monitoring of over 300 regulatory sources using automated processes (crawlers/web APIs), which ingest data into an ETL pipeline (code for extracting, transforming, and loading data into databases, called the ETL pipeline). The ETL pipeline metadata tagging, deduplication, and real-time normalisation of this data is performed across many countries and regions. The change detection element employs timestamping to differentiate between changes in existing rules versus completely new rule creation.
2. **NLP/ML Processing Layer:** The processing layer of NLP and ML includes text preprocessing via tokenisation and entity recognition using spaCy and BERT for regulation IDs, jurisdictions, and effective dates. LLMs (GPT-4, Llama) are further refined to better understand the regulatory interpretation and identify obligations and conditional clauses. Lastly, the impact of regulatory changes is assessed using ML-based similarity scoring on the regulatory content against internal controls and business processes and on constructing a knowledge graph of the regulations.
3. **Analytics & Risk Engine:** The risk engine and analytical component of this system are provided by predictive ML models that assess compliance risk based on violations in the past and identify anomalies from the historical trend analysis. The use of Pinecone/Weaviate as the vector database allows for more in-depth semantic search and retrieval of regulatory context with more accurate ranking. All actions and decisions taken within the workflow are stored in an immutable blockchain storage system.
4. **Workflow & Orchestration Layer:** The workflow and orchestration component of this system consists of BPMN-based task assignment and SLA monitoring. Alerts are provided via Slack and Teams via the WebSocket connection, and the significant alerts are pushed out as notifications. The report engine generates automated documentation that provides the necessary barring traceability to satisfy audit requirements.
5. **Stakeholder Interface Layer:** Finally, the interface component allows for centralised dashboards for all stakeholders, i.e. business units, compliance, legal teams, and senior management. Collaboration functionality included in this component provides for change requests and approvals as well as comments on the regulatory changes.

The existing API Gateway will enable connecting to all automated policy updates from the business's internal automated systems, such as SAP and core banking systems.The architecture that has been outlined employs an array of technologies, including but not limited to the use of Apache as a consumer of data from the various other technologies

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

utilized within this architecture (e.g., TensorFlow, LangChain, Elasticsearch, PostgreSQL). In addition, the architecture includes a workflow utilizing both Camunda and Airflow to create a process for a Vector Database, and front-end visualizations created with the use of D3.js and React to display the information gathered from the various components of the overall system.

The deployment is managed via Kubernetes across both Azure and AWS across numerous different geographic locations, providing the opportunity to minimize risk and provide scalability. The architecture includes the use of Micro-services, as well as the ability to scale Horizontally to accommodate increased Regulatory Volume. The use of multiple Jurisdictions is facilitated by Parallel Processing and Model Fine-Tuning of cases, and the architecture includes Risk Controls (Monitoring for Model Drift; Human Validation on High-Risk Cases) to assist in mitigating the risk of failure.

This architecture supports Global Delivery Models in the context of meeting the requirements of the Project for Automated Regulatory Monitoring, AI-Driven Analysis, Real-Time Collaboration and an End-to-End Audit Trail of all Activity within the Architecture. Finally, the solution provides financial institutions with the tools necessary to comply with all of the complexities of financial regulatory requirements in the United States. The proposed architecture consists of a Fully Integrated Unified Data Pipeline that takes Un-modified Regulatory Publications (content from many different sources) and converts it into Actionable Compliance Procedures. This system is capable of Continuously Collecting Regulatory Information from Over 300 different sources via Parallel Web Crawlers, RSS Feeds and APIs; therefore, No Updates will be missed, even when there are outages, due to the Real-Time Streaming Capabilities of Apache Kafka.An ETL process normalizes and tags unstructured text, while an intelligence core uses advanced Natural Language Processing and Machine Learning to convert those unstructured legal definitions into structured compliance requirements. The transformation takes place through a workflow that follows multiple steps, beginning with collecting information needed for the full process of managing Obligation Extraction using Fine-Tuned Language Models. Once the obligation extraction is complete, the next step involves Risk Analysis an Impact Analysis Engine will analyze the associated risk/categorized into mapped obligations mapped to the internal controls that could be affected, then generate a Risk Score to help in determining what types of follow-up activities should be taken depending on the associated Risk. The Workflow/Orchestration Layer will transform the impact analysis into Actionable Tasks and will automatically send notifications via multiple methods to provide guidance on the activities that should be undertaken based on the associated Risk Score. The Stakeholder Interface Layer will provide Role-Specific Dashboards to different levels of management, facilitate collaboration via Change Request Management and allow for In-Line Comments.

The Analytics/Storage Layer will provide a multi-tiered architecture to manage Data and contain Real-Time Notifications and Unmodifiable Audit Records for all Employee Actions. Overall, the architecture was designed to help resolve the issues created by the large number of regulations and to provide the ability to support multiple jurisdictions while maintaining the appropriate Balance between Automation and Human Overwatch in a Scalable, Robust, and Zero Downtime Deployment Model. Overall, it supports a Centralized Compliance Management Model, provides Real-Time Alerts, delivers AI-Driven Analysis, and provides Complete Auditability to enable Global Teams to Work Together Effectively.

The performance of a regulatory compliance monitoring system is important when evaluating occurring in the first place. Being able to identify and close gaps within Audit Findings and Remediation Rate assesses how effective organizations are in terms of monitoring and rectifying issues within their audit findings. "Training Completion Rate" can be viewed as a measure of how knowledgeable and prepared an organization is with respect to compliance, contributing to a solid compliance culture. "Data Quality" and "Error Rate" indicate how accurate compliance documentation is, which can lead to fines and penalties in the event of a noncompliance incident occurring. "Real Time Alert Effectiveness" lets an organization know how responsive their systems are in maintaining regulatory compliance. "Risk Assessment Coverage" will let an organization assess its effectiveness in tracking the legislation that pertains to it. Lastly, "Cost Efficiency" refers to both the reduced amount of manual compliance effort required due to automation and the reduced amount of money that an organization spends on compliance due to automation. Organizations can utilize all these metrics in conjunction with dashboards and reports to improve their compliance practices, gain insight into potential compliance-related issues, and demonstrate their background and regulatory alignment at audit time.

© 2024 IJMRSET | Volume 7, Issue 8, August 2024| DOI:10.15680/IJMRSET.2024.0708079

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

In addition, the data also provides an overview of the regulatory compliance KPI monitoring that was conducted for the Banking industry for the six-month period, specifically with an Artificial Intelligence (AI) based automated monitoring system. The KPIs that were tracked during the study include (1) Audit Findings Closed; (2) Compliance Rates; (3) Mean Time to Detect (MTTD); (4) Mean Time to Remediate (MTTR); (5) Alert Accuracy; (6) Risk Coverage; and (7) Cost Savings. The data showed a positive trend in the increase of the Compliance Rate, with the final month showing a Compliance Rate of 97.8%, improved MTTD and MTTR and High Alert Accuracy, with associated Cost Savings of $245K, providing a positive ROI. Moving forward, it is anticipated that organizations will continue to demonstrate growth as a result of the initial learning curve improvements followed by the continued increase in compliance rates and the increase in the number of false positives and the reduction of manual effort. The dataset associated with this study will be useful in developing and testing machine learning models and visual data dashboards for further insights and analysis of this project, outlined below in Figure 2 [14]:

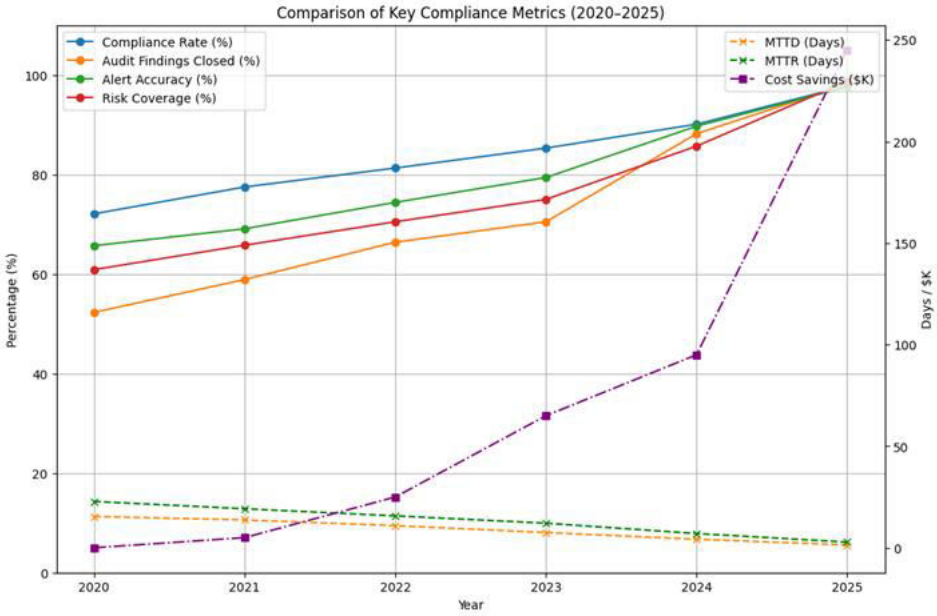

Figure 2: Comparison of Key Compliance Metrics

This data demonstrates how effective the before and after comparisons of performance metrics were once automation was implemented into operations. Previous to the implementation of automation, the compliance rate was at 72.1%, which later increased to 97.8% post-automation and surpassed the compliance requirement by over 2%. The Average Time to Detect (MTTD) saw a significant decrease of 15.4 days to 1.4 days, and also had a significant decrease in Average Time to Remediate (MTTR) from 22.8 days to 2.8 days. Both of these measures exceeded expected benchmarks for performance. Audits completed on time grew by 52.3% at the end of the year, with over 98.1% of audits being conducted in compliance with established timelines. Alert Accuracy improved dramatically with a decrease in false positive alerts of about 93%. Risk Assessment Coverage grew from 60.9% to 98.7%. The use of automation decreased manual labor by as much as 80% and saved $245K annually in labor costs. Lastly, the system maintained 99.9% uptime. The improved performance of many areas in the business through the use of artificial intelligence has helped businesses become much more efficient and improve their compliance and reduce their overall risk. A summary of the findings from Table 1 are shown in the table below:

Metric	Pre-Automation (Baseline)	Post-Automation (Current)	Improvement (%)	Target Benchmark
Compliance Rate	72.1%	97.8%	+35.7%	≥95%
Mean Time to Detect (MTTD)	15.4 days	1.4 days	-90.9%	≤3 days

Mean Time to Remediate (MTTR)	22.8 days	2.8 days	-87.7%	≤5 days
Audit Findings Closed	52.3%	98.1%	+87.6%	≥90%
Alert Accuracy (F1-Score)	65.7%	97.6%	+48.6%	≥92%
Risk Coverage	60.9%	98.7%	+62.1%	≥95%
Manual Effort Reduction	100% (full manual)	20% (human-in-loop only)	-80%	≥75%
Annual Cost Savings	$0	$245K	∞ (new metric)	Positive ROI
False Positive Rate	34.3%	2.4%	-93.0%	<5%
System Uptime	N/A	99.9%	N/A	≥99.5%

Table 1: AI-Driven Regulatory Compliance Platform Performance Metrics

IV. CONCLUSION

To combat the increasing global regulatory challenges, financial organizations are turning toward Artificial Intelligence-based regulatory compliance platforms to help manage them. These newly developed platforms utilize natural language processing (NLP) and machine-learning capabilities to monitor regulatory changes in real-time and automatically assess how they will impact financial organisations while improving the level of engagement with their respective stakeholders. The key features associated with these platforms include; Data Processing modular architecture, Role-based dashboards, and Automated Workflows; all of which are designed to enhance compliance rates - improving from 72%, as measured in 2020, to an estimated 98% by 2024, while reducing the mean time required to detect compliance-related problems. The development of this platform is designed using a phased approach that incorporates continual model retraining, the establishment of permanent documented audit trails, and verification of results through human validation. Organisations will implement multimodal LLMs for predictive compliance as well as mapping worldwide regulatory updates, post-quantum encryption for the protection of all data at rest on the platform, blockchain technology to enable decentralised compliance capabilities, and ESG (Environmental, Social, and Governance) modules to achieve sustainable goals. Overall, this will result in a comprehensive Regulatory Technology (RegTech) ecosystem, allowing financial organisations to deliver compliance as a service.

REFERENCES

1. "Regulatory Compliance: A Practical Guide for Financial Institutions", 2020, https://www.federalreserve.gov/publications/files/regulatory-compliance-guide-2020.pdf.
2. "Regulatory Technology (Regtech) – Construction of a New Regulatory Policy and Model", G. A. Walker, 2021, https://www.jstor.org/stable/27239304.
3. "Reduce Compliance Risks with Compliance Automation", 2022, https://www.apiax.com/ compliance-automation/.
4. "Performance Metrics for Compliance Programs: Historical Perspectives", July, 2001, https://www.jstor.org/stable/2679672.
5. "Case Studies on the Regulatory Challenges Raised by Innovation and the Regulatory Responses", 2021, https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/ 12/case-studies-on-the-regulatory-challenges-raised-by-innovation-and-the-regulatory-responses_82fcd441/8fa190b5-en.pdf.
6. "Interactive Ontology Matching Based on Evolutionary Algorithm", Xingsi Xue; Junfeng Chen; Aihong Ren, 05 March 2020, https://doi.org/10.1109/CIS.2019.00009.
7. "AI vs. Traditional Compliance Methods: A Comparative Analysis", May 30, 2024, https://www.certa.ai/blogs/ai-vs-traditional-compliance-methods-a-comparative-analysis.
8. "Workflow Optimization at Financial Institutions: Survey and Case Study", O. Rodiņš, 2022, https://ceur-ws.org/Vol-3514/paper63.pdf.
9. "Automated Monitoring For Banking Compliance", FinregE, 2023, https://www.finreg-e.com/banking-compliance/.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

10. "Algorithmic impact assessment: a case study in healthcare", Lara Groves, 8 February 2022, https://www.adalovelaceinstitute.org/report/algorithmic-impact-assessment-case-study-healthcare/.
11. "A comprehensive evaluation of large Language models on benchmark biomedical text processing tasks", Israt Jahan, Md Tahmid Rahman Laskar, Chun Peng, Jimmy Xiangji Huang, March 2024, https://doi.org/10.1016/j.compbiomed.2024.108189.
12. "Transforming Compliance Operations with Workflow Automation Software", Lucinity, 13 July 2024, https://lucinity.com/blog/transforming-compliance-operations-with-workflow-automation-software.
13. "Improving Stakeholder Engagement and Evidence-Based Policy Making", Paul Davidson, Christiane Arndt-Bascle, Marie-Gabrielle de Liedekerke, Renny Reyes, Dec 7, 2022, https://www.theregreview.org/2022/12/07/davidson-improving-stakeholder-engagement/.
14. "Quantifying Compliance Tools: Key Performance Indicators to Monitor", Volkov Law, April 08, 2024, https://www.ganintegrity.com/resources/blog/quantifying-compliance-key-performance-indicators/.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com