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Original Article

Explainable AI Dashboards for Regulatory Governance BI

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Abstract - The Decision Support Systems have to be transparent, auditable and interpretable in the area of re-regulatory compliance, in particular regarding Business Intelligence (BI) uses, for industries such as financial services, healthcare, insurance or public administration. The present research paper proposes an Explainable AI Dashboard Framework for Regulatory Compliance BI system with various dimensions such as Automated Regulatory Compliance Monitoring, Explainable Machine Learning, Regulatory Risk Scoring, Regulatory Audit Trails, Visual Regulatory Decision Making and Data Governance. In essence, the framework is designed to help organisations highlight areas where they don't meet compliance and track any discrepancies, verify AI's results and report back to the regulators or internal auditors with evidence. This includes explainability (e.g. SHAP, LIME), interactive dashboard widgets, 1000s of data and model-outcomes and enterprise data with a model geometry, on which a human can interact in a comprehendible and user-friendly way. The proposed dashboard would enable users to visualize the risk indicators, the information sources, how to read feature level explanations and to get a real-time view of information available regarding compliance. The framework could be leveraged here to address the "black box" issue in BI regarding AI systems to offer improvements in accountability and transparency in the processes. The paper proposes the concept of "Explainable AI dashboards", which could be extended in future to facilitate the regulatory review and readiness to assist trust building efforts via the stakeholders and a continuous compliance management effort. This is particularly useful for the organisations that have high requirements and sensitivity when making operational decisions and/or are exposed to high risk.

Keywords - Explainable AI, Business Intelligence, Regulatory Compliance, AI Dashboard, Data Governance, Risk Monitoring, Auditability.

1. Introduction

Today's business world cannot be thought without Business Intelligence (BI) systems since it plays a crucial part in making decisions in any organization. Gathers, sorts and formats data of all types and sizes for planning, tracking and strategic management, particularly related to operational, financial, customer and compliance information. Today's BI platforms are not all about performance reporting, given today's business climate and the heightened regulatory pressures that exist in today's major industries such as banking, insurance, healthcare, telecommunications, energy and public administration. The use of these for risk identification, to ensure compliance, suspicious activity detection, audit and Governance decisions are growing. The BI system(s) can be more complex and give out information timely, credible and transparent and regulations [1] [2].

Artificial intelligence has given BI the wings to make it more functional and useful to help organisations derive value from the barrage of complex data and identify trends [3]. AI-powered BI tools have the capability of categorizing dangers, project prospective dangers of non-compliance, finding fraud signs, offering remediation ideas, and automating regulatory reporting. A financial institution, for instance, could be employing AI models to recognize atypical deals that might signify a money laundering chance. For a healthcare company, predictive analytics may be able to monitor the access of patient data and detect possible breaches of privacy. For instance, an insurance company might create an AI application that observes the claims within a new zone in a BI dashboard, or even claims that are lacking entirely from reports. Let's take a look at a few of the applications of AI and understand about the importance of AI in compliance management [4] [5].

On the same note, it is important to mention that we have a huge challenge in our faces due to use of AI in BI. There are lots of AI models and machine learning technology which can predict the right outcomes but do not provide any transparency to get their prediction right. This means the decisions of regulators can't be made solely on the basis of the results of the models, and it is concerning for those involved in compliance operations, auditors, regulators and senior management. For example, to operate a compliance environment, the organisation will have to provide an explanation to the customer whose name was pinged, as to why this should be considered a 'High Risk' customer, why a match report results in an alert, or why a particular process should be regarded as a non-compliant process, etc. AI in BI can alleviate concerns regarding a lack of trust, legal and compliance issues and perhaps increase accountability through analysis of its use [6].

One of the solutions to this problem is Explainable Artificial Intelligence (XAI), to make the outputs of Artificial Intelligence more comprehensible and interpretable by human. Using XAI techniques, it can give user an explanation based on features that were used by the model to

make the prediction, if the prediction is regulating compliant or not, and according to the company policies. In a BI-Dashboard world, however, explainability is a first class citizen and is the very contact point between the data's world and the world of data managers, auditor and compliance team [7].



Figure 1. Conceptual Overview of Explainable AI Dashboard for Regulatory Compliance BI

Compliance BI is more than Technical analytics. Needs to be connected and have a correlation to data governance and regulatory mapping, along with integration with AI model monitoring, explainability and audit trails/visual reporting. Education of data governance will guarantee data accuracy, completeness and security/traceability for compliance analytics. Keeping the relations between the business processes and the data helping to gauge their compliance impact within bounds [8]. The goal of AI model monitoring is to ensure that a predictive model is reliable, fair and to be consistently fair, accurate and dependable over time. Make sure that explainability tools are used, such as SHAP, LIME, feature : importance analysis, rule based explanations, etc. to make sure that the users understand the behaviours of the models. Audit trails - all decisions, alerts, user's actions and data changes, reports etc are tracked. These capabilities can assist organization design their BI system to be transparent, accountable and regulators friendly.

Due to the increasing attention on automated decision making and the need for responsible application of AI, explainable AI dashboards are becoming sought after. But the groups are now proving the need to demonstrate their analytics systems to not only be efficient, but also explainable, auditable, and in line with law [9] [10]. All users need to be told about the circumstances that triggered the score, the data or rule that had been utilized and proof of the score and measures taken to correct the score. It can be especially applicable to financial crime monitoring, credit-risk assessment, healthcare compliance, cybersecurity governance, tax reporting and environmental, social and governance reporting.

2. Framework for Explainable Ai Dashboards for Regulatory Compliance Bi

The framework for Explainable AI Dashboards for Regulatory Compliance Business Intelligence is designed to support transparent, auditable, and regulation-oriented decision-making. The framework connects enterprise data, regulatory rules, AI models, explainability methods, risk monitoring, and dashboard visualization into one integrated BI environment. Its purpose is to help organizations move beyond traditional compliance reporting and build a system that can detect compliance issues, explain risk outcomes, support audit evidence, and guide corrective action.

The framework consists of seven major layers: data acquisition and integration, data governance and quality control, regulatory rule mapping, AI-based compliance analytics, explainability layer, dashboard visualization layer, and audit and feedback layer.



Figure 2. Layered Framework of Explainable AI Dashboard for Regulatory Compliance BI

2.1. Data Acquisition and Integration Layer

The framework has two layers: one to gather the data from a variety of inside and outside sources. Collecting data from transaction, customer, employees, vendors, financial, access, policies, audit, legal or any type of operational system like ERP, CRM, HRM or cyber security systems, consolidating it in one BI system and ensuring of compliance.

It could, for example, fetch data from a banking company regarding its customer's transactions, account opening information, anti-money laundering alerts, risk profile, suspicious activity reports and much more. In the medical field, it could be used to track a patient's consent lists, patient notes, record of patient information accessed, patients' concerns about their data privacy, etc.

The layer's task is to somehow be able to get the data into a format it can be structured and used to meet the compliance requirement. This data can be extracted, cleaned and transformed and loaded or ETL (or even ELT pipeline) into a centralized data warehouse or data lake. This is a simple layer that includes data to adhere to for AI to use when monitoring.

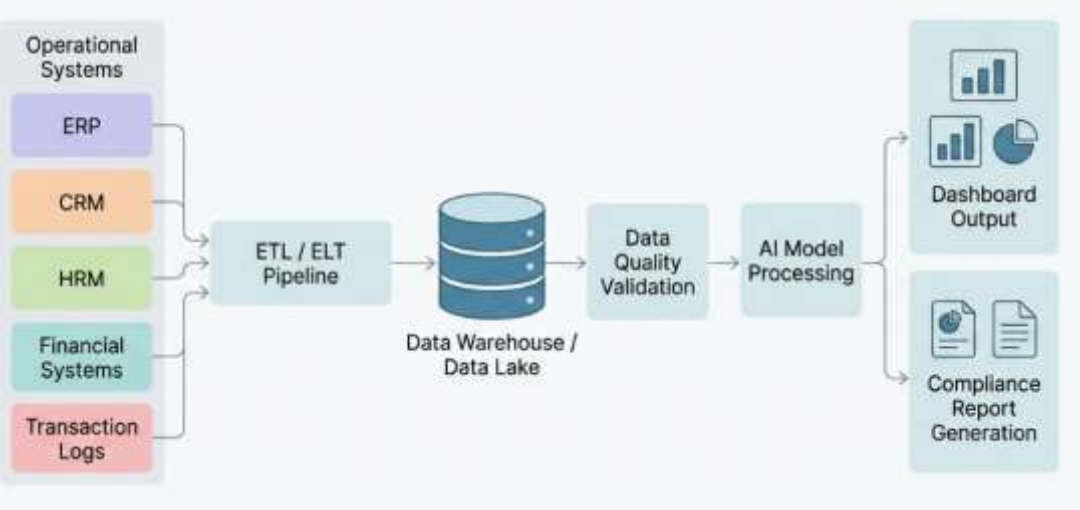


Figure 3. Data Flow Architecture for Compliance BI Dashboard

2.2. Data Governance and Quality Control Layer

The second layer relates to the trust, security, data provenance and data availability. Having that kind of compliance controlling these reports—and decision-making too—plays a vital role in data quality as well. But, if the data quality is poor, poor decisions on risks, false or incorrect information alerts, data not completed and incorrect results of compliance could happen.

This layer ensures that no information is missing and/or inaccurate, eliminates duplication, ensures consistency and ensures that the information is current. Excluding the verified identity details for instance, should indicate low-confidence of risk score to be determined for a Customer. Similarly, when the data doesn't reflect the most up-to-date and correct financial transaction data, the dashboard should be a good warning sign that there are data quality issues.

2.3. Regulatory Rule Mapping Layer

Thirdly, business data to the regulatory requirements. An overlay of this layer are the Measurable Rules, Indicators, Thresholds and Controls for legislative, policy and compliance issues. If not, it could well be that the AI produced the content – which may be accurate – but it lacks applicability in the real world regulatory requirements.

For example, if the transactions value exceeds certain transaction then it should always be considered as high value transaction and should be inquired. An example of one of them may be requiring customers' ID prior to turning on an account. A policy for a medical company could include information on how the patient's information will be made available and ensure every person handling information is duly authorized. These requirements can be converted in to rules and risks/alerts indicator can be set on the dashboard.

Compliance rules can be attached to other data elements, processes, department and evidences. This will render the dashboard more useful and will allow one to view the situation "at a glance" whether there is risk and which regulation, policy or control requirement is related to the risk.

2.4. AI-Based Compliance Analytics Layer

The fourth phase where AI/machine learning can aid in detecting any risk, anomalies, patterns and any possible non-compliance. These can be utilized to model classy, anomaly detection, and bunching frameworks, NLP frameworks, proposal frameworks, and also for anticipating risk scoring.

As an example, anomaly detection can be employed in cryptocurrency trading to discover any suspicious monetary transactions. Ranking of the vendors and/or consumers/cases by low, medium or high risk. A complaint log, policy document, audit notes or NLP regulations could be used to apply NLP, whereby a person would be able to read through

and see if there are compliance issues. Predictive models: Trend analysis – what are the chances of it happening in the future (Relative to the risk of some type of non-compliance action).

An analytics layer should not be viewed as "black box. Should be included in compliance layer in the regulatory mapping layer. This basically means curbing the predictions rendered by the AI model by means of rules and a business context. If there is a high risk of a transaction being deemed high risk by the system there should be a feedback to the reason behind why – Is it due to the number of transactions conducted, some other location, customer behaviour, frequent failed verifications or some other reason.

The contents of this layer have been developed with the intent to create the Risk scores/alerts, the probability of violation, anomaly labels, compliance status, model confidence and suggested action. These in turn are transferred to interpretability layer (interpretation).

2.5. Explainability Layer

The explainability layer is the lowest of the proposed framework. This explains and adds value for compliance officers, auditors, managers and regulators in the interpretation of predictions of an AI model. This will be our 'Why' and will contribute to our achieving the following: What are the Justifications in this situation? What factors had an effect on the model? Will the prediction come true or not? What information is there behind this Alert?

Some of explainable AI technologies are: SHAP, LIME, feature-importance ranking, counterfactual explanation, decision rules and natural language explanation that can be applied to this layer. A customer's risk score may indicate a patterned risk score because of: high number of transactions; low completion of KYC; alerts history; and/or unusual geographic behavior of the customer, who is defined as a high-risk customer.

A good explainability layer will provide different layers of explainability. All that might be necessary to a senior manager would be the answers to a few questions: “This case is a bit risky: there were multiple, unusual transactions but we don’t have anything to back them up.” As a compliance analyst they might need to know the rule they are talking about, from where the data that they used to come from, and feature level (confidence of the model). An Audit Trail might need to be kept or Evidence to keep Logs and History of Keeping might need to be made.

Also indicators of confidence and warnings of uncertainty are to be put on this layer. Worthwhile clues about the little data or low quality data on the dashboard should be apparent that this AI prediction should be manually reviewed. This alleviates the risk of these benefits being overly dependent on AI and encourages users to make informed decisions.

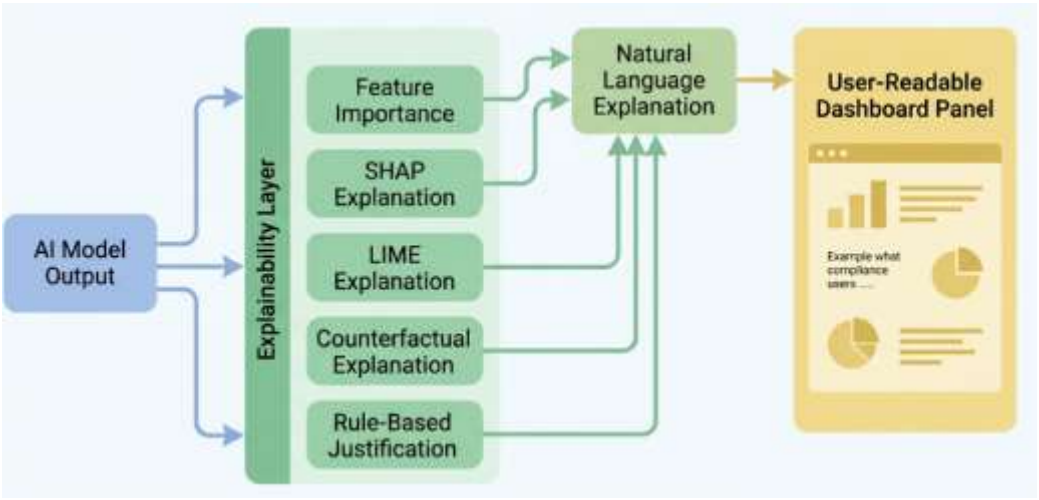


Figure 4. Explainability Layer Using SHAP, LIME, and Rule-Based Explanation

2.6. Dashboard Visualization Layer

Easy-to-understand compliance information is also available, and is visualized on the interactive, dashboard visualization layer. That's the single UI that the framework has! Save time with a more intuitive and user friendly Dashboard for tech and non-tech.

Something like trend graph, model explanation charts, audit evidence links, compliance indicators, risk-heat maps, work flow status/corrective action trackers are some of the other important parts of a dashboard. For example, if it is a compliance officer, he can be provided a compliance dashboard that will provide an overview of alerts, high risk open alerts, overdue alerts and policy violations that are yet to be remediated and risk trend information for the last 6 months.

The data in the dashboard should be easily able to be filtered by department, regulation, type of risk, date, business unit, geography and/or severity of risk. Another under-used and possibly too neat-yet-useful-a-thoughtout feature would be a ‘drill down'. An overview up to even a case level view

should be conducted. For high-risk transactions, information about the transaction, the data source, the AI reason and the compliance rule(s) being triggered on and history of alerts and recommended action should be shared.

2.7. Audit Trail and Evidence Management Layer

All of what you need that's been happening in the system is being recorded all by the audit trail. It involves any change in data, the generation of models, user actions, checking alerts and making corrective decisions, as well as changing the rules or generating reports. This layer is critical as compliance need to be traceable.

For example: When the Auditor requests information as to why a vendor was identified as “high risk” three months ago, the following information should be outputted for the Auditor: Data that informed the Auditor about why they determined the vendor would be “high risk” three months ago, the model used, the Auditor who determined the vendor was “high risk”, the action performed, and the Auditor's conclusion. In this manner your BI system is able to become “audit ready”.

Evidence Management – Document, notes, screenshots of compliance items and investigation results can be associated to the compliance case. This will provide full compliance history which will aid in auditing.

2.8. Feedback and Continuous Improvement Layer

Finally, the system output (to the user) is left-reflected to the AI and alerts are given to the user via dashboard UI. The “resolved”, “escalated” or “closed” status can be added to the alerts list that can be configured by one of the Compliance Officers based on the status of the individual compliance checks. This could be utilised to help optimise performance of the model, and helps to avoid excessive alerts being triggered.

In addition, using transaction analysis feedback can retrain and/or recalibrate the model, since there are situations where a transaction may be classified as suspicious, yet may be a valid transaction. Similarly, as new regulations become available the regulatory rule repository can be updated and the parameters to the indicators appearing in the dashboard can also be altered.

This is the layer to support continued compliance management. Checking compliance shouldn't be something few times every few years for compliance report purposes, but can be facilitated by real-time monitoring, user feedback and AI explainability/user governance allowables.

2.9. Overall Working of the Framework

The first half of the framework is about locating the data in enterprise systems and bringing it in. Data Quality checks, Data Governance and Data cleansing are carried out. Based on the regulatory requirements rules & indicators are defined. Non) compliance areas, anomalies and risk are identified and analysed based on the managed data by AI models. Explaination of the AI predictions is through the explainability layer. This occurs when graphic elements are on the dashboard which display interactively. Review and validate Regularity – Audit & Evidence records. It enhances the built model accuracy and the usefulness compliant by collecting users feedbacks, enhancing the model accuracy will be helpful for use usefulness in the future.

The next Foundational is the key enabler to get to intelligent XAI (Explainable and Accountable) BI systems. To ensure AI isn't only predictive, but can assist you to make decisions on compliance that you can rely on, link to evidence and regulation.

3. Performance Evaluation

3.1. Evaluation Objectives

Explainable AI Dashboard Framework for Regulatory Compliance can be measured with 4 technical standards: Technical accuracy, interpretability, usability and audit ready / compliance support. It is wrong to determine regulatory compliance – and the transparency and accountability that rely on predictions – exclusively based on the accuracy of those predictions. Equally important is to assess the system by considering its capability to communicate the AI-generated results, as well as its efficiency in informing of non-compliant situations, user friendliness and evidence log for audit purposes.

3.2. Model Accuracy and Risk Detection

In terms of the correctness of the AI model to identify compliance risk the first is. The accuracy, precision, recall, F1-score and area under curve are the common metrics used for classification models. Anomaly detection is important and relevant terms are the false positive/negative rates, detection rate and alert relevance. Remembering is particularly significant to a compliance BI system as the failure to remember a grievous miscarriage of justice can entail a significant legal, financial and reputational risk. There has to be a balance in accuracy as well since letting too many "false alerts" will have a negative impact on team workload that performs compliance checks. Therefore, the desired state in the model is to be in a state with a balanced performance.

3.3. Explainability and Interpretability Assessment

The second measurement shows how clear and how explained we need to be to understand and what the Dashboard provides us. Can be judged based on the coherence of the results of a feature-importance (or explained based on coherence of explanations or level of justification for all rules) or usability (user understanding). For a high-risk scoring transaction, for instance, the dashboard needs to illustrate that this is because of a high transaction value, abnormal conduct, poor (or no) payments history record, or missing documentation. Compliance officers can monitor and check the quality of explanations, by way of their own case, case scenarios and professional checks, surveys and validation.

3.4. Dashboard Usability and Decision Support

For the third dimension the analysis of the dashboards is carried out based on usability. Visual clarity along with the response time, drill downability and most importantly filter accuracy and usefulness of filters are important indicators. A practical dashboard ought to be capable to discover evidence/'flip flop' at the case level or at the summary level. User satisfaction scoring (conducted over a period of time) and error numbers and feedback from compliance teams can also offer some significant hints and clues as to the usability. Successful dashboard should be expected to facilitate users in making quick, well documented and clear decisions.

3.5. Audit Readiness and Compliance Reporting

An assessment of "audit ready" is given in the fourth dimension. It is important that this information is recorded in the system: Data sources, Models versions, Explanations outputs, User actions, Reviews comments and rule changes and final decision. Evaluate audit activity for the completeness of the logs, traceability of decisions and time to deliver compliance reports. The effectiveness of the dashboard can be claimed to be fairly good if an auditor is able to easily view the reason for the risk identified, and what has been done about it.

3.6. Continuous Improvement

The last criterion is user feedbacks and effectiveness they have in improving the systems in future. Because of the false alerts and lack of hazard detection, a chance for feedback to further develop the rules, retrain the models or redesign the dashboard exists. Appropriately enables adaptive and reliability compliant monitoring in the long-term.

4. Conclusion and Future Work

4.1. Conclusion

As this is a research paper, they have been looking at the support they can offer Regulatory Compliance Business Intelligence in the form of an Explainable AI Dashboard. While BI dashboards are good for reporting, they can still come up short when it comes time to make compliance decisions that are transparent, auditable, and fact-based, the study contended. To summarize, explainable output is steadily gaining more and more importance in an age when the use of AI for risk detection, monitoring, fraud detection, data privacy and reporting to regulators is growing.

The layers described in this paper all connect to data collection, data governance, regulations mapping, AI-powered data analytics, explainability, dashboards visualization, audit trail and feedback. This multi-level construct provides a better understanding for the organisation around the reasons why the risk was identified, how it was identified, what they found and if required what they will need to do. This kind of an effort ought to help contribute to the demystification of AI, and make BI more appropriate for regulated sectors.

In a unified visualisation, the explanation of what is demonstrable (and can be thrown on an explainable AI dashboard) for the following measures can be very useful for compliance officers, auditors, management and technical functions: The measures give an overview on the risks of certain feature, statistical evidence on the correctness of these risks, and reference to the rules and audit memos. This stops to contribute to the enhancement of the level of trust, accountability and quality of decision making. It applies to any organisation that can have repercussions if they are not compliant with the rules, and there are many which would fall into this category; banking, public, regulated authorities, healthcare, cyber security, insurance, financial reporting just to mention some.

Overall, the study indicates that explainability should be regarded as a part of the compliance BI responsibility, rather than the technical option. However, when they can participate in ALL the above activities in one location, and they can make it happen in a way that helps them make informed decisions, that's when compliance dashboard can be a lifesaver.

4.2. Future Work

The extended version of the work, which still has to be developed and assessed based on the actual data on compliance is not available. Request industry-specific variations, such as on instances of anti-money laundering, healthcare privacy, tax compliance, ESG report and Cybersecurity Governance. Moreover, it will be interesting to see how various different explainability features, such as SHAP, LIME, counterfactual explanations, rule based models etc. work out in this scenario and which of them will be useful to the users in a back to back compliance scenario.

A user based evaluation – at least for the user role as compliance officer and auditor – should also be included as future studies are concerned since it will indicate suitability of use and whether it is trusted or not, whether explanations are acknowledged or not and whether decision is taken or not and whether it is understood. The other, equally important, factor is how to connect to the realtime updating of regulatory requests, automatic report generation and secure audit trail. This would result in explainable AI dashboards that are more flexible, functional and ready to engage in continual compliance monitoring against regulators.

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