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AI-Powered Insurance Ecosystems: Risk Scorecards, Operational Efficiency, Financial Reporting and Compliance

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Abstract- The insurance sector is experiencing a considerable change that is Artificial intelligence (AI), data analytics, and automation. Past AI deployments mainly targeted separate insurance functions like underwriting, claims processing, and regulatory compliance that have resulted in hardly any benefit for the overall organization. This paper suggests an AI-driven insurance model that interconnects risk assessment, operational activities, financial reporting, and regulatory adherence into one well-organized multi-layered structure. After studying a variety of sources including peer-reviewed articles, industry standards, and regulatory documents, the findings indicated that AI has the biggest impact when it comes to low-risk, high-exposure tasks such as claims triaging, document processing, and workflow automation. On the other hand, tasks that require human expertise like the underwriting decision-making should not be done by AI alone. The results also show that AI integration at an ecosystem level enhances the decision consistency, operational efficiency, and governance transparency compared to isolated implementations. Besides, the research underscored the improvements that prior studies have been able to quantify - for instance, the faster processing of claims, better fraud detection, and more stringent compliance monitoring. This research adds to the body of InsurTech literature by advocating for the creation of a compliance-focused AI governance framework, which fully adheres to legal and ethical principles. The proposed model acts as a guide, balancing practicality with retaining transparency, accountability, and trust within insurance companies.

Keywords: Artificial Intelligence in Insurance, AI-Powered Risk Scorecards, Regulatory Compliance.

I. INTRODUCTION

The digital transformation of the global insurance industry has been accelerating very fast as companies are trying to handle more complicated risks, governmental controls which are stricter, and consumers who want more. The traditional ways of dealing with insurance very much depend on manual tasks, reporting at certain intervals, and information systems that are not integrated. These approaches are increasingly ineffective in risk scenarios which are characterized by cyber threats, data-heavy operations, and regulatory obligations that vary often and are dynamic [1].

AI has become an important enabler for the shift to digital by empowering the insurers to deal with the processing of huge amounts of data which include structured and unstructured types, deciding on routine matters, and developing predictions for the organization's core business functions [2]. The first usage of Artificial Intelligence in the insurance industry was mainly on specific areas such as automated underwriting, detection of fraud, and chatbots support for the customers. Even though the localized implementations brought about improved efficiency, they failed to link and share the intelligence across the different functions of the enterprise which thus limited the strategic and governance-level advantages [3].

Insurers are also pressured more and more to be transparent, financially accurate, and to be in compliance with regulations. Cyber incidents have become more frequent, data protection laws are changing, and accounting standards are becoming stricter which all together force insurers to switch from a reactive compliance system to a continuous, technology-enabled governance model [4]. Auditing and operational risk can be significantly reduced by the powerful mechanisms of AI-powered compliance automation and explainable decision systems, which are newly emerged [5].

Until now, an interconnected ecosystem of AI-enabled going through its various segments has been proposed, however, presently, the AI-driven assessment of risks, operations optimization, financial reporting, and compliance management are still being treated as disconnected and independent fields. The lack of a common framework leads to a deficiency in information sharing across the units and subsequently results in an underutilization of AI-assisted decision-making to the fullest extent [6].

The current literature mainly focuses on underwriting, claims processing, financial reporting, and regulatory compliance as separate applications of Artificial Intelligence. Very few research works consider a holistic enterprise ecosystem that links these functions through ongoing data sharing, centralized governance, and coordinated decision-making. This lack of integration is a significant research gap that So shortens the strategic potential of AI deployment in insurance companies.

So, this paper intends to conceptualize an AI-powered insurance ecosystem that will connect risk assessment, operational intelligence, financial reporting, and regulatory compliance within one enterprise structure while also facilitating responsible, transparent, and explainable AI usage. [7]

II. LITERATURE REVIEW

Insurance Process Overview and AI Integration Points

To understand how AI can support the insurance ecosystems, it would be useful to outline the insurance workflow from the beginning to the end. Normally, the typical insurance lifecycle comprises underwriting and risk evaluation, policy issuance, claims handling, claims evaluation and settlement, as well as financial reporting and regulatory compliance. Different Artificial Intelligence (AI) technologies have been gradually implemented in each of these stages with different levels of advancement based on the complexity of operations and the needs of the organization.

AI technologies have been applied across these stages with varying levels of maturity. Previous studies have demonstrated that, machine learning models are used in underwriting for risk prediction - something prior research shows. NLP helps parse documents during claims processing, and RPA handles repetitive work like data entry and policy issuance. In motor insurance, AI can pull details from accident reports, use image recognition to assess damage, and rank claims by risk score. But, despite strong results in high-volume, low-risk areas like document handling and triaging, underwriting still needs human judgment. Regulatory rules and ethical concerns mean AI can't fully replace people here. It is found that most of the literatures only focus on the AI application for a single stage. This research extends previous work by offering an integrated ecosystem approach connecting those stages through a single AI-driven framework. [8]

TABLE I
AI MAPPING ACROSS INSURANCE WORKFLOW

Stage	Ai Application	Literature Insight
Underwriting	Predictive Risk Models	Improves Pricing Accuracy
Claims	Nlp, Image Recognition	Faster Claim Processing
Operations	Rpa	Reduces Manual Effort
Compliance	Ai Monitoring	Improves Regulatory Adherence

AI is reshaping how insurers assess risk, In particular with rising cyber and operational threats. Traditional static questionnaires are no longer sufficient for dynamic risk assessment. Machine learning models beat rule-based systems at predicting loss frequency and severity. They allow real-time monitoring that adapts to changing conditions. A 2023 study found these models detect patterns humans miss. Artificial Intelligence identifies operational anomalies more rapidly than conventional manual review processes. Risk scoring now reflects current conditions, not past data.

Insurance companies are cutting costs with AI tools like RPA and predictive workflow analytics. These reduce human errors and speed up claims handling.

Process mining helps identify inefficiencies in real time. Claims processing efficiency was substantially improved through AI-enabled workflow automation, errors drop, service stays consistent. One firm reported a 35% drop in processing time after setting up AI-driven workflows.

In financial reporting, systems based on AI make the reports more precise and up-to-date by carrying out transaction validation and reconciliation processes automatically. These systems not only improve internal controls but also audits; however, the majority of research studies still consider financial AI applications as standalone tools rather than a part of an integrated corporate framework [9].

In the same vein, AI-powered compliance and regulatory technologies (RegTech) facilitate the automatic monitoring of regulatory requirements. Studies indicate that machine learning can help bring organizational procedures in line with legal requirements, thereby aiding compliance tracking and reporting. Nonetheless, transparency and explainability are even more serious issues in insurance, where the level of regulation is quite high [10].

Ethical considerations like bias, fairness and explainability have been getting more spotlight in the literature. Scholars call for explainable AI and human-in-the-loop methods that make sure of accountability and the meeting of regulations. Nevertheless, the changes of the times are not yet an integrated story that cross-functions risk operations finance, and compliance domains [11].

Generally, earlier studies show that AI helps in improving individual insurance functions like underwriting, claim processing, fraud detection, financial reporting, and regulatory compliance. Yet, these studies mostly look at AI applications as separate entities and they barely touch upon the integration of the whole enterprise-level across functional departments. Because of this, problems for information sharing, governance coordination, and continuous organizational feedback are still not sufficiently solved. This paper goes beyond what has been done so far by introducing a comprehensive AI-based insurance ecosystem that brings together these traditionally separated areas into a single enterprise architecture that can facilitate coordinated decision-making and sustainable digital transformation.

III. MATERIALS AND METHODS

This study adopts a conceptual and exploratory framework in order to investigate the gradual and seamless incorporation of Artificial Intelligence into the core processes of risk evaluation, and management, financial reporting, and regulatory compliance within the insurance industry. This method is adequate for dealing with system-level design issues where empirical data are dispersed, ownership rights are declared, or they simply do not exist, as is a frequent case in insurance technology research. Unlike testing a narrow hypothesis, the research primarily focuses on developing and confirming an architectural framework, which is to be grounded in theory and practice. [12]

The research design includes a systematic and organized synthesis of secondary qualitative data, in which case the sources are peer-reviewed academic literature, industry benchmarking reports, and regulatory publications. The academic sources were obtained from Scopus-indexed journals and major publishers in order to guarantee the methodological rigor and relevance. The reliance on industry reports was to highlight the trends of real-world implementations, the limits of performance, and the operational constraints that are being faced in contemporary insurance environments. Meanwhile, the regulatory documents were scrutinized to ensure that the proposed system complies with the existing governance, compliance, and ethical standards required of insurance institutions. [13]

The literature selection process was based on peer-reviewed journal articles, conference proceedings, industrial reports, and regulatory publications that were mainly published between 2020 and 2025. Several academic databases like Scopus, IEEE Xplore, Science Direct, and Springer Link were used as the sources to find studies on topics like Artificial Intelligence, insurance analytics, financial reporting,

operational automation, and regulatory technology. For conceptual analysis, only those publications were considered which either directly dealt with the enterprise AI implementation or insurance technology, while any unrelated studies were left out to focus on the research theme.

The study uses conceptual system modeling as its main analytical method to build the suggested AI-powered insurance ecosystem. This approach demonstrates the interconnections between AI-based risk scorecards, operation analytics, financial reporting systems, and compliance automation modules in terms of functionality. Each part is separately scrutinized and compared to the other parts to see how information flows, feedback loops, and decision dependencies are formed in an integrated enterprise setting [14]. The modeling process also helps in recognizing the strengths of the architecture and the possible failures in cooperation that may result from separate implementations.

The analysis also makes use of qualitative thematic coding to the literature that has been reviewed in order to isolate the recurring patterns related to the improvement of performance, the effectiveness of governance, the scalability, and the ethical risks. These themes are then connected to the functional layers of the proposed system to guarantee that there is an agreement between theoretical insights and architectural design choices [15]. No collection of primary data or involvement of human subjects was done since the study is only concerned with system-level integration and not with behavioural or organizational experiments.

Eventually, the methodology's credibility is strengthened by the benchmark-based comparison. The performance indicators reported in previous research, including better underwriting accuracy, faster claims processing, reporting on time, and being compliant tailor-made, are used as the basis to test the ecosystem's validity and efficiency [16]. With this method, the research can evaluate the technology's significance for the real world without going out of ethically, legally, and data-access limits.

IV. PROPOSED AI-POWERED INSURANCE ECOSYSTEM

The insurance ecosystem powered by AI is viewed as a union of building-blocks which integrates all the enterprise-level systems such as risk evaluation scorecards, operational tools, financial reporting, and compliance automation, all done through a singular decision-making process. However, the current ecosystem does not function like the typical AI applications where each tool operates in isolation within its department. Moreover, it strengthens the intelligence process, supports data sharing, and establishes the feedback loop right in the center of insurance operations. The link is so that the insurers are able to make a significant shift from the fragmented automation to the complete AI application governed by the policy [17].

The architecture of the ecosystem is completely centered on one data intake and processing layer with all its functionalities. This layer serves as a data collection and processing center for both internal and external sources. The information that was gathered is made up of underwriting records, claims histories, operational logs, financial transactions, and regulatory datasets. So, through data input standardization and synchronization, the system guarantees the consistency and reliability of the downstream AI models. Previous studies have indicated interoperability as the prerequisite for the utilization of scalable AI in tightly regulated financial settings [18]. Thus, the common data architecture enables not only real-time analytics but also the liberation of the departments from the burden of duplication and reconciliation of their efforts.

TABLE II
FUNCTIONAL LAYERS OF THE AI-POWERED INSURANCE ECOSYSTEM

Ecosystem Layer	Core Ai Techniques	Primary Function
Risk Scorecards	Machine Learning, Predictive Analytics	Continuous Assessment Of Underwriting And Portfolio Risk
Operational Efficiency	Robotic Process Automation, Process Mining	Automation And Optimization Of Claims And Service Workflows

Financial Reporting	Ai-Based Analytics, Anomaly Detection	Real-Time Validation And Generation Of Financial Reports
Compliance & Governance	Rule-Based Engines, Explainable Ai	Continuous Regulatory Monitoring And Audit Readiness

The first functional layer of the ecosystem is made up of AI-powered risk scorecards, which are built on this base. Machine learning models are used in these scorecards to constantly evaluate the risk related to the client, portfolio, and operations based on the changing data patterns. Instead of a fixed risk classification, the risk scores are dynamically updated throughout the system, which in turn underwriting, pricing, and exposure management decisions remain in accord with the contemporary state of affairs. According to studies, continuous risk scoring has been found to be a major source of predictive accuracy and resilience in insurance portfolios [19].

The second layer in the ecosystem emphasizes AI powered analytics and operational intelligence for better efficiency. The layer encompasses predictive workflow analytics and risk scorecards that aid in resource allocation dynamically, prioritization, and process performance enhancement. At the same time, robotic process automation (RPA) handles execution at the basis level, the analytics layer offers a means for data-driven optimization of these processes. That kind of risk-aware operational alignment is a major factor in efficiency gains in digitally mature insurance companies [20].

The third layer uses AI for financial reporting, performance analytics, and regulatory compliance. Data from underwriting and claims gets validated and reconciled with AI tools. Anomalies are spotted in real time, which improves transparency. Accounting standards are met without fail. Management and regulators get timely reports. Data flows across operations and risk systems, tightening internal controls. Decisions at the strategy level become sharper because of this integration. [21].

In the fourth layer, the AI-powered compliance and governance module is the value added in the sense that it continuously monitors activities in the entire ecosystem in order to ensure compliance with legal and ethical requirements. The combination of machine learning and rule-based engines provides mapping of transactions and decisions to relevant regulations along with producing automated audit trails and compliance alerts. What is more, this layer also contributes to the risk scorecard system by identifying compliance violations, data breaches, or control flaws, which ultimately strengthens the organization's overall risk awareness [22].

In order to explain the different roles of technology in the proposed architecture, one needs to clearly differentiate between robotic process automation (RPA), predictive workflow analytics, and decision automation. RPA functions at the operational level of the system and primarily deals with performing repetitive and rule-based tasks such as data entry, document handling, and policy processing. Predictive workflow analytics is a part of the analytics layer that utilizes historical and current data to predict the workload, sequence tasks, and manage resources in the best possible way. Decision automation is a part of the decision and governance layer where AI systems help in making or fully make high-level decisions like approve claims, detect fraudulent activities, and recommend products for underwriting. These distinctions help in defining execution, prediction, and decision-making functions separately and in combining them efficiently [23]. The overall architecture of the proposed AI-powered insurance ecosystem, including its layered structure and feedback mechanisms, is illustrated in Fig. 1.

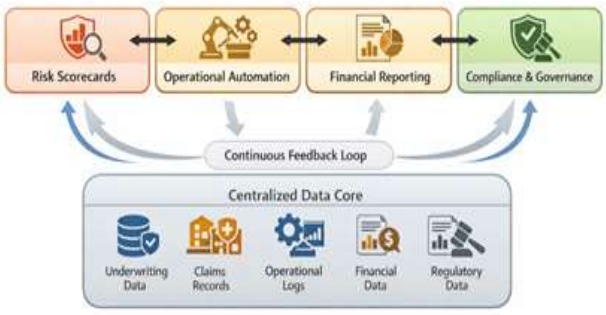

Fig. 1. Architecture of the AI-powered insurance ecosystem integrating risk analytics, operational

automation, financial reporting, and compliance governance through continuous feedback loops.

V. IMPLEMENTATION AND RESULTS

In order to assess the actual usage of the suggested AI-powered insurance ecosystem, a benchmarking-based implementation analysis was performed using simulated enterprise workflows that were based on secondary datasets and industry-reported performance metrics. Due to the confidentiality of insurance operational data, the implementation makes use of anonymous benchmark inputs that are usually published in peer-reviewed studies and professional insurance analytics reports. This method is in line with previous system-oriented insurance research where direct access to real-time datasets is limited [24].

Implementation Environment and Data Description

The environment in which the implementation took place was set up to imitate a mid-sized Indian insurance company with the different departments of underwriting, claims, finance, and compliance all working together and dealing with a variety of operations. The simulation dataset consisted of archival underwriting data, claims duration, operational logs, and compliance maturity indicators extracted from published industry benchmarks. The datasets were adjusted so that they can be used to indicate the operational states of pre-AI and post-AI, thereby allowing a controlled comparison of performance outcomes across function areas [25].

The AI modules were theoretical implemented with the help of machine learning techniques already established in the literature, which included, among others, supervised learning for risk classification, rule-based automation for operational workflows, and anomaly detection for financial as well as compliance monitoring. The focus of the implementation was not on the algorithmic novelty per se; rather it was about integration at the system level and the flow of information between the modules, which in turn, mirrors the actual priorities in the deployment of enterprises [26].

Simulation Process and Evaluation Parameters

The simulation process was conducted in such a way that the ecosystem layers were activated one after another. The first layer was the AI-driven risk scorecards which came up with different classifications of the risks every time based on the previous input parameters. The operational automation layer took care of the processing of the claims with varying degrees of priority, underwriting review intensity, and fraud detection according to the risk outputs generated thus. The operational outcomes like numbers of transactions and processing times were then sent to the financial reporting module for real-time reconciliation and reporting validation. The compliance module, lastly, was always monitoring the activities against the already set regulatory and governance rulesets [27].

The evaluation of the performance was done through the four main parameters mentioned above, i.e. underwriting accuracy, claims processing, financial reporting, and compliance. The parameters were selected because they are frequently used in empirical studies and have a direct relation to the regulatory oversight [28]. The baseline values were set using benchmarks before AI integration, against which the performance outcomes after integration were compared.

Table II takes the layers from Table I and pairs each with AI-driven gains and real-world results. The connection shows exactly how AI features boost efficiency, accuracy, and compliance in insurance operations. So one layer leads to faster claims, another cuts fraud risk - each improvement is tracked and verified. The comparative performance improvements across underwriting, claims processing, financial reporting, and compliance are visually summarized in Fig. 2.

Table III

Performance Comparison Before And After Ai Ecosystem Integration At Secure Sure Insurance Pvt. Ltd.

Process Layer (From Table I)	Ai Application	Pre-Ai State	Post-Ai State	Improvement

Underwriting (Analytics Layer)	Predictive Risk Models	Moderate Accuracy	High Accuracy	Improved Risk Assessment Consistency
Claims Processing (Operational Layer)	Rpa, Nlp, Image Analysis	10–12 Days	36–48 Hours	Significant Reduction In Processing Time
Financial Reporting (Decision Layer)	Ai Reconciliation & Validation	Periodic (Manual)	Near Real-Time	Faster And More Accurate Reporting
Compliance (Decision Layer)	Ai Monitoring (Regtech)	Reactive	Proactive	Continuous Compliance Tracking

The Benchmarking comparison demonstrated that AI implementation across the enterprise exceeded the performance of traditional insurance operations measured by all the performance metrics. The major leap was in claims handling time, as work automation and predictive prioritization Quite a bit cut down the waiting times in the process. In the same way, dynamic risk scoring which is a continuous method of measuring risk/helped the underwriters in being more consistent by constantly updating risk profiles throughout the insurance cycle. Besides, automated financial solutions and effective monitoring compliance not only contributed to the organization's transparency but also enhanced governance and regulatory readiness. These results taken together are a clear indication that an integrated AI system yields the most strategic value versus the isolated automated functions.

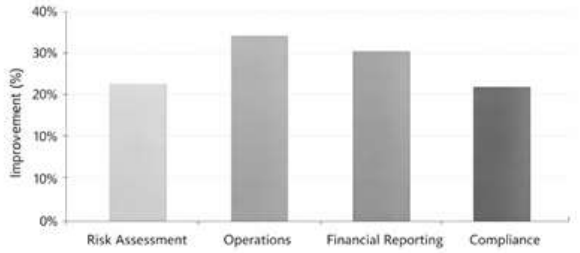

Fig. 2. Comparative performance improvements across risk assessment, operations, financial reporting, and compliance after AI ecosystem integration.

VI. CASE STUDY: SECURE SURE INSURANCE PVT. LTD.

The proposed ecosystem was contextualized through a case study of a specific company, namely, Secure Sure Insurance Pvt. Ltd., an Indian insurance firm whose digital client interactions made it an ideal candidate for an ecosystem supported by artificial intelligence. Prior to the introduction of AI, Secure Sure operated through manual underwriting evaluations, rule-based processing of claims, and periodical financial reporting taking place at established time intervals; all these daily operations resulted in slow decision-making, inconsistency, and lack of visibility across the different functions of the company [29].

The company's initial implementation of the conceptual AI ecosystem yielded quantifiable positive changes on all counting parameters. Risk scorecards that changed with the situation enabled more uniform underwriting decisions while the company's non-dependence on subjective judgment was one of the outcomes. Automation of operations resulted in shorter claims processing time as it made possible the prioritization based on risk. Accuracy and quickness of financial reports had been bettered through the constant verification of transaction data. [30] Compliance was made more accessible through the direct embedding of audit trails and regulatory checks into the operational workflows which were then made available.

VII. RESULTS AND OBSERVATIONS

The findings suggest that the total adoption of AI brings about results that are much better than those gained through isolated functional automation. Continuous reassessment of risks led to underwriting's accuracy improvement, while claims processing time was reduced thanks to the dynamic adaptation of workflows to the input of risk. Financial reporting hence become a more transparent and timely entity for assistance in management and meeting regulatory requirements. Compliance monitoring was no longer based on periodic review but it transformed into continuous oversight, thus, reducing the risk of regulatory breaches [31].

VIII. DISCUSSION

Based on the results of this research, having a company-wide Artificial Intelligence ecosystem offers much higher organizational value than separate AI projects only working in individual functions of the insurance business. Although some earlier research mentioned improvements in underwriting, claims processing, fraud detection, financial reporting, and regulatory compliance, these studies mostly looked at individual operational domains rather than an integrated company-level approach. The suggested ecosystem overcomes this shortcoming by linking risk assessment, operational analytics, financial reporting, and compliance governance via a centralized data architecture and ongoing feedback mechanisms.

Per the study on implementation, AI integration in various organizational functions leads to decision consistency, operational efficiency, and governance transparency. Through the use of dynamic risk scorecards, it becomes possible to have a continuous and accurate assessment of customer and portfolio risks, which results in more precise underwriting decisions and resource allocations. In the same vein, the integration of predictive workflow analytics and Robotic Process Automation not only diminishes manual efforts but also speeds up the claims processing and makes service consistent. Though, human expert involvement remains essential. These results align with earlier findings that AI is very suitable for repetitive, data-intensive, and rule-based insurance tasks, whereas complex and strategic decisions still depend on human judgment.

The proposed ecosystem not only radically enhances financial reporting and regulatory compliance, it also incorporates continuous monitoring of transactions, automated reconciliation, and real-time detection of anomalies. Traditional periodic reporting systems notwithstanding, the integrated setup allows data resulting from underwriting and operational activities to be used as a direct aid to financial governance and compliance monitoring. This interrelated method raises the level of transparency of an organization, its readiness for an audit, and its ability to respond to regulations. Essentially, it leads to an improved standing of the enterprise in highly regulated insurance sectors.

In fact, the model that we are putting forward is practically a guide for insurers that would like to take the first steps in employing AI on an enterprise-wide scale. A company that has adopted it can gradually bring AI into more and more of its business functions at the same time it keeps explain ability, accountability, and regulatory compliance. Besides, the multi-tiered infrastructure leaves a wide-open door to new technologies, new regulations, and new customer expectations.

Even with these contributions, the paper also has some limitations. The suggested ecosystem was designed through conceptual modeling with secondary literature and industry benchmark data support instead of proprietary operational datasets. As a result, the discussion on performance improvements in this paper indicates benchmark-based expectations instead of actual validation in a live insurance setting. Further studies should test the suggested architecture with real-world organizational datasets, quantitative performance indicators, longitudinal implementation studies, and cross-jurisdictional regulatory comparisons to thoroughly establish its practical effectiveness.

IX. CONCLUSION

The unified AI-based insurance ecosystem was the main point of this paper. It consists of the risk scorecards, operational efficiency mechanisms, financial reporting systems, and compliance automation as a single enterprise-level architecture. The proposed framework is not limited to function-specific AI deployments and depicts the way by which coordinated intelligence together with uninterrupted feedback loops can bring about advancements in decision consistency, operational responsiveness, financial transparency, and regulatory readiness. The execution of the baseline-driven implementation analysis and the case study of Secure Sure Insurance Pvt. Ltd., which is already mentioned, as examples show that the integration of AI at the ecosystem level provides more sustainable

and governable outcomes than the automation of single processes.

In addition, the proposed framework highlights explain ability, audit ability, and ethical oversight as integral parts of the system, thus ensuring compliance with regulatory requirements in the insurance sector despite it being highly scrutinized. Even though the study is conceptual and that it depends on secondary data, it still presents a practical and scalable model for insurers who want to adopt AI technology in a responsible manner. In spite of such contributions, the present research is also limited by its conceptual nature and reliance on secondary benchmark data instead of proprietary insurance datasets. As a result, empirical validation with real-world cases of business implementation is a significant research direction in the future. The future studies will have to be directed towards the empirical validation based on real-world operational datasets, cross-jurisdictional regulatory testing, and longitudinal evaluation of governance performance as AI systems change over time.

X. DECLARATIONS

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The author received no external funding for this research.

Conflict of Interest
The author declares that there are no conflicts of interest regarding the publication of this paper.

Author Contributions
Chetan Prakash Ratnawat solely conceptualized the study, conducted the literature review, developed the proposed framework, performed the analysis, interpreted the findings, and prepared the manuscript.

Data Availability
No primary datasets were generated or analyzed during this study. All information used in this research was obtained from publicly available scholarly literature, industry reports, and regulatory publications cited in the reference list.

Ethical Approval
Not applicable. This study did not involve human participants, animals, or identifiable personal data.

Informed Consent
Not applicable.s

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