

Leveraging AI for sustainable risk assessment in the insurance industry

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Abstract

The context of introducing Artificial Intelligence technologies to assess risks has thrown the insurance industry into a transitional mode across industries. Fast replacing the AI-based models, traditional methodologies provide not only better accuracy but also efficiency and sustainability in assessing risks. The paper further explains how various AI tools help sustain risk assessment within the insurance industry. Large data sets and real-time information, facilitated by AI, enable the easy identification of emerging risks, optimization of underwriting processes [1], and the development of custom insurance product plans. Moreover, AI-based proactive risk management enhances financial performance with ESG goals. Thus, the paper presents a case study in the form of real-life applications that highlight how AI can mitigate the negative impacts on the environment and social realms, ensuring resiliency and sustainability [2] for the long-term business plan. It addresses issues of data privacy, algorithmic bias, and regulatory compliance [3], emphasizing the importance of responsible AI development [4]. The findings draw the right use of AI towards sustainable development paradigms, thereby creating more resilience and responsibility in the insurance industry.

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1. Introduction

Risk assessment within the insurance industry plays a vital role in premium charge determination, underwriting, and general insurance business operation viability [5]. Risk assessment had traditionally relied on actuarial science and underwriting operations that drew on historical data, statistical analysis, and professional judgment [6]; [7]. Actuaries use statistical models to approximate the probability of various events, while underwriters provide estimates of risks surrounding certain policies [8]. These methods, though effective, are limited by their reliance on historical data and can struggle to accurately predict emerging risks, such as those arising from climate change, pandemics, or technological disruptions [9].

Despite the progress made in the field of risk modeling, certain issues persist in the existing insurance environment. A few of the major challenges are inaccuracy of data, fraud detection, and operational cost [10];[11]. The inherent imperfections also contribute to inaccurate underwriting decisions, which can lead to financial losses [12]. From a continuous perspective, detecting fraud is always challenging, as conventional means largely fail to detect advanced fraudulent activities in a timely manner [13]. Moreover, human risk evaluation and decision technologies, which are operational costs, can be exorbitant, impacting the bottom line of insurance companies [14].

Problem Statement

These traditional (actuarial tasks) approaches can also rely on past experience [15], which is inadequate for anticipating new threats, including climate change, pandemics, cyberattacks, fraud, and technological disruptions [16]. This hinders insurers from limiting unexpected risks and making prudent decisions. The objective of this study is to evaluate the capability of AI for improving risk estimation[17] based on the inclusion of ESG factors[18] in sustainable insurance models and decision-making.

2. Literature Survey

The Function of Artificial Intelligence (AI)

Artificial Intelligence: the ability of a machine to imitate human intelligence. In insurance, AI is the combination of machine learning (ML), natural language processing (NLP), and predictive analytics, all of which enable precise, automated risk analysis. Such innovations analyses

colossal amounts of information in a short span of time and reveal patterns that humans cannot. AI enhances decision-making, customer feedback for policy innovation and experience and risk management within the industry. AI enhances risk modeling accuracy by assessing unstructured data, such as social behavior and social media. Its flexibility with new data allows for the adaptation of accurate estimates and the insurer's capacity to adapt to market innovations [18].

AI Applications in Insurance

AI reinsures insurance by maximizing risk management, customer service, and efficiency. ML, NLP, and predictive analytics reveal patterns in data for time and decision-informedness; (Choi et al., 2019). NLP translates unstructured inputs, such as claims and comments, and predictive analytics forecasts trends towards best practices.

AI models condition underwriting based on risk analysis with a wide range of information sources, including the behavior of customers, weather, and claim history, rather than traditional judgment-based procedures [12]. Claims forecasts are improved by predictive models over actuarial processes. Individual pricing dynamically adjusts premiums in relation to actual risk based on lifestyle and behavior data [16].

AI in Risk Assessment

ML and deep learning improve risk assessment by identifying concealed patterns and predictive accuracy. Underwriting is enhanced by AI to deliver high-fidelity data, and accurate policy decisions can be made. Telematics and social media in real-time improve estimates of behavior risks.

Sustainable Risk Assessment with AI

ESG factors are incorporated in sustainable risk assessment. Conventional models lack such flexibility, but AI models have flexible ESG data to enhance systemic risk detection. AI utilizes satellite and geospatial inputs for climate risk modeling, NLP to monitor social sentiment, and real-time governance scores from compliance and finance data.

AI and Emerging Risks

By dynamically reviewing massive amounts of real-time data, AI accurately predicts future risks like climate change, pandemics and socio-

economic patterns. AI predicts natural disasters on the basis of weather and climatic data, predicts pandemics through health and travel data, and predicts socio-economic developments that affect insurance needs.

Objectives of the Review

1. To examine the effectiveness of AI instruments like ML, NLP, or predictive analytics in improving insurance risk analysis.
2. To understand the best way of AI so that it operates sustainably in the future with less carbon footprints and with equity and transparency.

3. Research Design and Methodology

This review article examines whether risk assessment can be made sustainable in the insurance industry by analyzing the role of Artificial Intelligence (AI) through a qualitative case study design. This selected the five relevant actual case industries of high-performing global insurance companies that were already effectively using AI-based advanced technologies, e.g., ML, NLP, and predictive analytics in processes concerning insurance risk assessment. The selected examples feature various organizational contexts and functional domains within which AI is being applied in attempts to attain operational efficiency as well as sustainability.

Furthermore, content analysis has been used in thematically mapping the application of AI across the world in the major domains of insurance, which are underwriting, claims management, risk detection and reduction, policy customization, and customer service. Content analysis was performed to look for emerging trends, applied AI technologies, achieved process improvements and sustainability benefits in each case.

Data Collection

Secondary Data: Research papers, industry journals, and corporate reports concerning AI and risk and sustainability.

Case Studies:

- **Allianz:** AI-based device BRIAN for underwriting and operational efficiency.

- **Lemonade:** Used a Chatbot named “Maya” based on AI to detect fraud and claims in real-time.
- **Swiss Re:** Modelled Climate Risk – Application of an AI model (RDA) Rapid Damage Assessment.
- **AXA:** Artificial intelligence to expand availability to a wider population at lower prices.
- **Progressive:** Climate risk modelling for underwriting and assessing climate risk.

4. Leveraging AI for Sustainable Risk Assessment: Industry Examples and Case Studies

The application of AI technology in the insurance sector is well advanced, and several of the largest insurers are already utilizing AI globally as part of their risk assessment processes (Fang & Chen, 2018) to great success.

- For example, there is **Lemonade**, which is a technology-enabled insurer that offers real-time customized insurance coverage using AI. Lemonade utilizes an Artificial intelligence chatbot “**Maya**” for servicing customer claims and **real-time risk assessment**. It utilizes machine learning to continually improve its risk models (Adams & Brown, 2019), enhance the customer experience, and reduce business costs. Through automating the claims process, it cut the time to close claims, which has been one of the best customers selling points. Its application of AI has also made the company customer-oriented, where AI is used in risk management and fraud prevention and where **low-risk clients pay lower premiums**.
- **One** of the best-known real-life examples of the same is that of **Allianz**, the insurance giant of the world has launched an AI-powered tool named **BRIAN** (Underwriter Guidance Tool) to improve the **accuracy of risk assessment** and automate procedures. Allianz uses machine learning algorithms to drive through huge amounts of data from various sources, including customer transactions, past claims, and external environmental data outside the organization, and Fraud Detection Algorithms to search for potential fraud risks in attempting to help the organization to better determine risks and effectively. This incorporation of AI has resulted in faster approval of policies, reduced operational costs, and increased personalized customer prices.

AI is also used to evaluate climate- and environment-based risks, and to create sustainability-enhancing insurance programs. AI is an enormous tool that can be leveraged for sustainability, but the primary value that AI brings is its ability to predict how climate change will influence risk assessments.

An example of this is **Swiss Re** a re-insurer on a global scale that has developed an AI model that is called as (RDA), **Rapid Damage Assessment** which can predict the economic loss that is caused from extreme **weather conditions** because of climate change AI capabilities allow Swiss Re to predict potential risks from natural disasters **like floods, hurricanes, and wildfires based on trends** in locations and climate patterns and socio-economic factors. The findings are enabling the company to develop more precise **climate-risk pricing models** and to better quantify the potential loss from such events. The models also help the company understand where its greatest vulnerabilities are to the impacts of climate change and allow insurers to have information around potential future risk.

AI usage in AXA, the world insurance leader to further social responsibility mission in low cost insurance provision **for low-income families** Machine learning techniques like Random Forests and Decision Trees are used by AXA to evaluate the risk burden on such families and provide exemplary policies that are cost-efficient and tailored according to the needs of the customers. The process serves AXA's customer group while enhancing **financial inclusion and social justice**.

An example is Progressive Insurance, which uses AI to measure environmental risk and promote business sustainability. The company has integrated AI models to quantify the environmental sensitivity of underwriting processes, such as energy usage, waste management, and greenhouse gas emissions. These applications of AI enable Progressive to create green insurance products and reduce the environmental impact of its business operations.

Such drawings point out the growing use of AI to achieve sustainability in insurance. With AI applied to business, insurance entities can enhance the assessment of environmental and climate risk social obligation, and green products [2] and services. The impact of such undertakings proves that AI has the capability of promoting good change through the orchestration of business practices aligned to overall sustainability aims, risk mitigation, and consumer satisfaction.

5. Content Analysis

AI-based underwriting tools such as predictive modeling (AXA) and chatbot systems (Lemonade's "Maya") have already improved the speed and accuracy of underwriting processes. For instance, AIG (USA) and Max Life Insurance (India) are both using machine learning and natural language processing (NLP) to streamline operations and increase efficiency. [AIG (USA): Streamline operations, Improved Efficiency; Max Life Insurance (India): Streamline operations, Improved Efficiency][1] These improvements can also reduce human error and have sustainability benefits, such as minimizing resource waste or allowing for data-driven policy decisions.

Insurers such as ICICI Lombard are using computer vision and AI-powered algorithms to quickly and accurately assess damages, for greater efficiency and ethical sustainability. Other tools such as FROPS (Fraud Risk Operational Solution) are helping organizations like the Association of Serbian Insurers effectively calculate fraud risk, to achieve ethical sustainability. AI helps in reducing losses while also increasing customer trust through more effective fraud prevention processes as well as greater damage assessment accuracy.

AI-powered insurance innovations can be seen in the United States with companies such as Hippo Insurance. Hippo Insurance uses machine learning algorithms and data analytics to offer homeowners personalized policy options and customized pricing that is tailored to individual needs and ensures that coverage is aligned with real-time risk factors, which ultimately supports economic sustainability. Similarly, Progressive, another American-based insurance company, has also been utilizing AI along with telematics and machine learning technologies for usage-based insurance models, which are also used as a tool to support reductions in claims and provide further support for economic sustainability through premium adjustments based on policyholder behavior.

AI-empowered solutions have been adopted by various prominent insurance providers. For instance, Fukoku Mutual, and Aviva, leverage AI platforms such as IBM Watson and virtual claim systems, resulting in swifter processing times and enhanced payout accuracy. In India, ICICI Prudential Life Insurance has embraced the My Coach AI Platform and bot orchestration for automating claims, while HDFC Life Insurance has implemented bots like SPOK, Etty, and machine learning tools. These initiatives yield tangible benefits like expedited settlements, enhanced operational margins, (example: 25% margin at HDFC Life and quicker

payments) and overall cost savings. Collectively, these improvements contribute to sustainable economics by increasing efficiency, curbing operational expenses, and ensuring the dependability of services [2].

Examples of customer service-driven ESG initiatives include those that use AI-powered tech to increase access to more customers in a sustainable way. Kotak Life Insurance uses bots like KAYA to cover a larger customer base in a more consumer-friendly way. By reducing the dependence on staff, the initiative helps further social sustainability. SBI Life Insurance uses video-based KYC and OCR solutions that use AI to help it reduce its dependence on manual servicing, and Transamerica and AIG use machine learning and big data analytics to increase customer segmentation so that the companies can reach customers more personally and directly, increasing revenues. These initiatives can help to reach out to more people and provide insurance products to them, making insurance a more inclusive industry in a way that furthers social and operational sustainability goals [2].

6. AI Constraint and Constraint in Risk Estimation

Quality and Availability of Data

AI relies heavily on high-quality, granular data. Low-quality, outdated, or incorrect data will lead to inaccurate forecasts, incorrect premiums, and suboptimal risk estimates. Insurance data are typically separated into different systems, which can consume significant time and effort during the integration process. Also, the unstructured data, such as social media or emails, is hard to extract and requires sophisticated algorithms and data platforms in order to be trustworthy [12].

AI Transparency and Interpretability

The “black-box” nature of AI, and of deep learning specifically, constrains transparency in decision-making, with the following fairness and compliance issues in regulated markets like insurance. Explainable regulation, like the EU’s upcoming AI Act, requires explainable, accountable AI systems, with insurers compelled towards more transparent AI models.

Ethical Challenges in AI Risk Assessment

AI systems can get historically biased through data, developing discriminatory coverage or price outcomes [12]. Discriminatory data can

even result in the exclusion of vulnerable groups, violating principles of fairness and inclusion. Moreover, while AI generates efficiency, human judgment cannot be avoided—most particularly in changing environments—providing fair, ethical judgments. The insurers should promote justice, transparency, and collaboration between humans and AI in the hope of encouraging ethical practices.

AI in insurance faces several key challenges: First, it demands high-quality, detailed data—poor or outdated data can result in inaccurate forecasts and risk assessments, while integrating disparate and unstructured data sources (like social media) is both complex and time-consuming [12]. Second, AI models, especially deep learning, often lack transparency, which raises fairness and compliance concerns in regulated markets, prompting the need for more explainable and accountable systems as required by evolving regulations such as the EU AI Act. Third, ethical challenges persist, as AI can inherit biases from historical data, potentially leading to discriminatory outcomes and exclusion of vulnerable groups; thus, insurers must balance efficiency gains with human oversight to ensure fairness, transparency, and ethical decision-making [12].

7. The Future of Artificial Intelligence in Risk Assessment and Insurance

Innovations and Trends

The risk assessment of insurance is being revolutionized by artificial intelligence using newly emerging technologies such as blockchain and quantum computing. Blockchain adds security, transparency, and trust regarding data so that AI systems can be supplied with more diversified and accurate data for improved risk analysis. Quantum computing, being a new technology, has the possibility to perform more sophisticated and faster simulations of risk, especially on unexpected risks such as pandemics and climate change. The combined technology has the potential to transform insurers' calculations, pricing, and risk transfer.

Potential for Global Impact

AI facilitates wider insurance coverage, particularly to the underinsured and untapped markets. By processing various sources of information and automatically assessing them, AI can tailor products to a local level and reduce costs based on neighborhood risks. For example, I can leverage satellite imagery or cellular activity to estimate agricultural

and economic risks, and provide solutions specifically tailored to vulnerable communities.

Increasing Access for Underprivileged Segments

These traditional approaches often overlook low-income or rural segments because they lack sufficient customer data. AI can help overcome this knowledge gap by harnessing emerging data sources, such as mobile usage and social media, and enabling insurers to offer relatively inexpensive, inclusive coverage [16]. AI removes barriers such as thin credit histories by employing non-traditional inputs, ensuring a more even risk assessment [12], and ultimately providing greater financial inclusion and better coverage.

8. Conclusion

Key Findings

This review was crucial in establishing the impacts of the AI paradigm on insurance risk underwriting. AI technologies such as ML, NLP, and predictive analytics enhance accuracy, efficiency, and fairness of underwriting, claims adjusting, and fraud detection. AI also aids sustainability through resource optimization, bias elimination, and open decision-making, which directly fulfills the review's demands.

There are still issues, however. Good data needs to be utilized, and lower-quality or corrupted data sets reduce performance. And the explainability of some AI models and inherent biases are both ethical and regulatory issues and need to be interpretable and accountable systems.

Implications for the Future

Artificial intelligence can also assist in making insurance more sustainable by applying ESG metrics and targeting lower-income segments of society with new alternative data sets. The convergence of AI, blockchain, and quantum computing holds some of the most promising directions to more secure, scalable, and reliable risk models. The capacity to grow AI capabilities to identify increasingly sophisticated threats caused by climate change and socio-economic instability will be crucial to industry survival.

9. Closing Remarks and New Developments

AI is revolutionizing the insurance industry with more sustainable and fairer frameworks for risk assessment. To reach its full potential, however, it must resolve data, transparency, and ethics issues. Insurers will need to invest in ethical research into AI, regulation, and worker training. Areas that may involve future research include the explainability of AI, its alignment with cutting-edge technology, and how it serves the masses comprehensively and can cover fringe markets [4].

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