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A BIBLIOMETRIC ANALYSIS OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN THE INSURANCE INDUSTRY: RESEARCH TRENDS FROM 2006 TO 2025

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ABSTRACT

This study presents research trends from 2006 to 2025, providing a comprehensive bibliometric analysis of AI applications in the insurance industry. It also aims to identify the intellectual framework, thematic development, and international collaborative networks in this emerging interdisciplinary field. A total of 796 articles published in peer-reviewed scientific journals were systematically selected using the PRISMA framework and the Scopus database. The search strategy used logical search operators to combine important AI terms like "machine learning," "deep learning," "predictive modelling," and "telematics" with insurance-related keywords. We used VOSviewer to look at co-authorship, co-citation, and keyword co-occurrence. The digital transformation of the insurance sector has contributed to a significant increase in publication volume, especially after 2015. Florida Atlantic University and the University of Barcelona lead in institutional output, while the United States, China, and India are the most prolific contributors by country. Notable authors include Montserrat Guillén and Taghi M. Khoshgoftar. Focusing on emerging areas such as climate risk, Medicare fraud, and personal underwriting, thematic analysis reveals a shift from basic AI approaches (such as artificial neural networks) to more advanced AI techniques (such as deep learning and usage-based insurance).This study emphasizes how important interdisciplinary cooperation is becoming and demands that AI research be more thoroughly incorporated into actuarial science and insurance practice, the results guide future strategies for using AI to improve insurance services' creativity, effectiveness, and personalization.

KEYWORDS: Artificial Intelligence, Insurance Industry, Machine Learning, Predictive Analytics, Bibliometric Analysis, Big Data.

1. INTRODUCTION

Advances in machine learning (ML) and artificial intelligence (AI) have significantly changed the insurance sector in recent years. Traditional insurance functions such as risk assessment, fraud detection, claims management, underwriting, and customer engagement are being transformed by these technologies (Abdalla et al., 2025). AI gives insurers the ability to improve operational efficiency, lower costs, and provide individualized products and services by facilitating real-time decision-making and predictive analytics. AI's role has grown to be both complementary and essential to contemporary insurance strategies as insurance companies embrace digital transformation increasingly.

Based on this, the following research questions have been formulated:

1. What is the distribution of documents on artificial intelligence and machine learning applications in insurance industry from 2006to 2024?
2. What are the most relevant journals in AI and ML within insurance industry analytics research?
3. What are the most significant countries in artificial intelligence and machine learning within in insurance industry research?
4. What are the most significant educational institutions in artificial intelligence and machine learning within in insurance industry research?
5. Who are the most prolific authors in the field of artificial intelligence and insurance industry research?
6. Who are the most cited articles the field of artificial intelligence and insurance industry research?
7. "What are the patterns of international research collaboration in the field of Artificial Intelligence and Machine Learning applications in the insurance sector?"
8. What are the main research themes in AI and ML applications in the insurance sector based on keyword co-occurrence analysis?
9. What are the intellectual linkages between dominant research topics, leading authors, and contributing academic institutions in AI applications within the insurance industry?
10. What is the distribution of corresponding authors across countries in AI and insurance?
11. What are the evolving research trends in the application of Artificial Intelligence in the insurance industry over time?
12. How are research themes in AI-insurance studies positioned in terms of relevance and maturity based on thematic mapping?
13. How have the research themes in Artificial Intelligence applications within the insurance industry evolved between 2006–2025.

2. MATERIALS AND METHODS

The study employs a comprehensive bibliometric analysis to map the intellectual, thematic, and collaborative structure of Artificial Intelligence (AI) applications within the insurance industry. Through this approach, the study examines the most frequently used keywords, the most influential and highly cited journals, leading countries and institutions, co-authorship networks, keyword relationships, and the most prolific authors contributing to this domain (Zupic & Čater, 2015; Kraus et al., 2020). Bibliometric and visualization techniques are particularly effective for processing large volumes of scientific publications and identifying thematic clusters, influential research actors, and evolving intellectual patterns (Donthu et al., 2021; Aria & Cuccurullo, 2017). Data for the analysis were retrieved from the Scopus database owing to its extensive coverage of peer-reviewed journals, resulting in an initial dataset of 7,512 records. A systematic selection process was ensured by applying the PRISMA protocol, which refined the dataset to a final sample of 796 journal articles published between 2006 and 2025.

The analysis was further enhanced through VOSviewer software to construct maps of co-authorship, co-citation, and keyword co-occurrence, enabling a clear visualization of global research linkages, dominant themes, and evolving scholarly trajectories (Aria & Cuccurullo, 2017; Donthu et al., 2021). This methodological framework is well suited for capturing how AI and Machine Learning (ML) have been integrated into insurance functions such as underwriting, fraud detection, claims management, pricing, and telematics-based analytics. To identify relevant literature, the search strategy relied on a set of AI-related terms—including "Artificial Intelligence," "Machine Learning," "Deep Learning," "Telematics," and "Big Data Analytics"—combined with the keyword "Insurance," yielding broad coverage of interdisciplinary contributions. A rigorous set of inclusion and exclusion criteria was applied: only English-language journal articles were retained; conference papers, books, theses, and non-journal sources were excluded; and subject areas were restricted to Business, Management and Accounting, Decision Sciences, Economics,

Econometrics and Finance, Computer Science, and Engineering. After this filtering process, a total of **796 publications** were included in the final dataset, as summarized in Table 1 and illustrated in the PRISMA (Moher et a.,2010). flow diagram (Figure 1).

2.1. *Prisma Framework:*

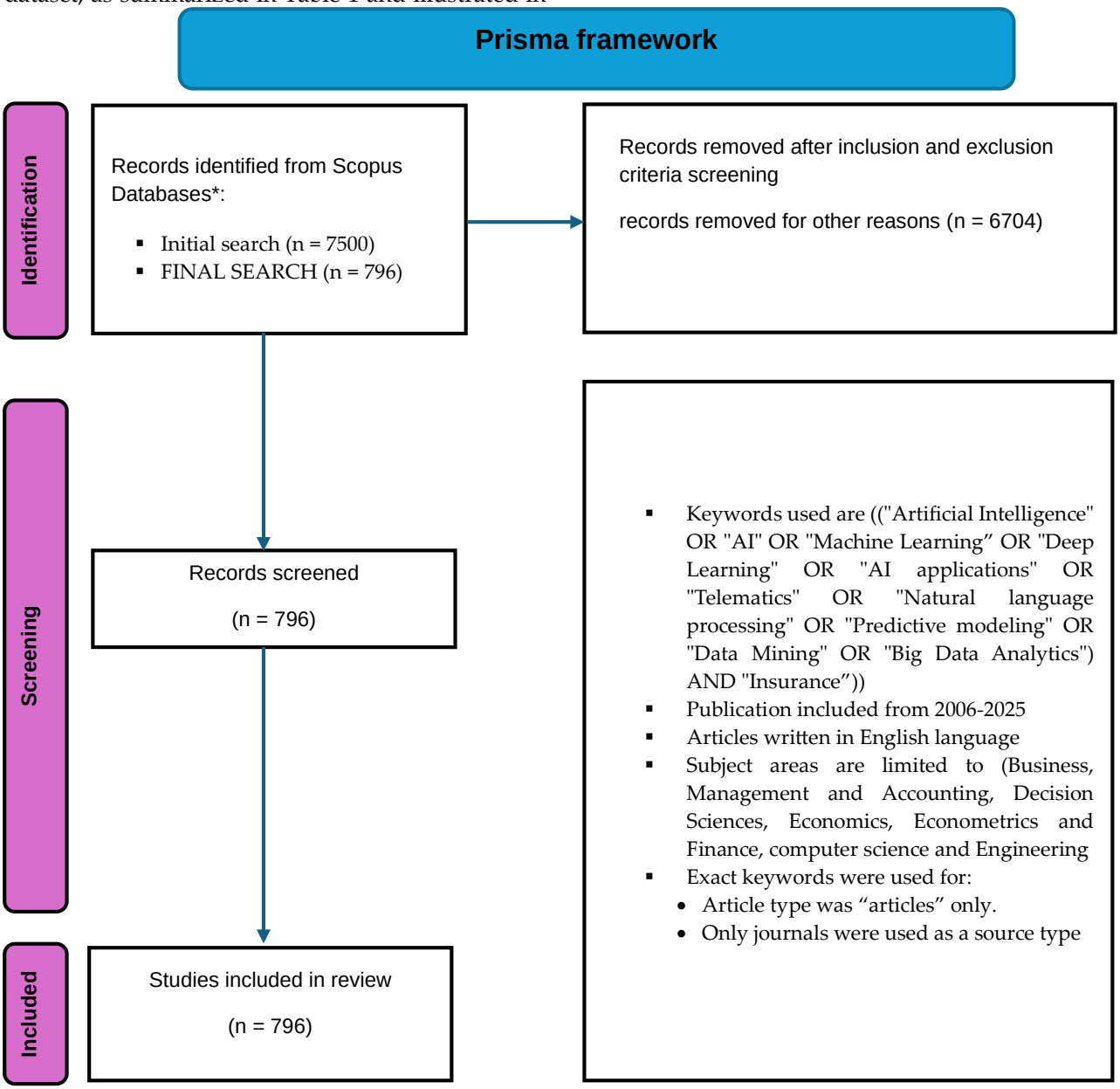

Figure 1: Prisma Framework for This Review.

2.2. *Identification Database Selection*

This review was conducted on July 3, 2025. The Scopus database was selected as the primary source for data collection, owing to its comprehensive coverage of peer-reviewed literature across multidisciplinary fields. Its rigorous indexing standards and wide international acceptance make it a trusted and credible platform for conducting bibliometric investigations. (Van Eck & Waltman, 2010; Aboelfotoh et al., 2025)

2.3. *Inclusion And Reporting:*

The keywords used in the search strategy included "Artificial Intelligence," "AI," "Machine Learning," "Deep Learning," "Telematics," and "Insurance," which generated an initial dataset of 7,512 documents. After applying the predefined inclusion and exclusion criteria—limiting the results to English-language journal articles and excluding conference papers, book chapters, and non-scientific sources—the dataset was refined to a final sample of

796 publications, resulting in the exclusion of 6,716 records. The selection process is summarized in Table 1 and visually detailed through the PRISMA diagram (Moher et a.,2010).

Table 1: Filtering Process for AI And ML Literature in the Insurance Industry.

Keywords: (("Artificial Intelligence" OR "AI" OR "Machine Learning" OR "Deep Learning" OR "AI applications" OR "Telematics" OR "Natural language processing" OR "Predictive modelling" OR "Data Mining" OR "Big Data Analytics") AND "Insurance"))	
Initial results	7,512
Inclusion and exclusion criteria (automatic filtering)	
Publication year	
Including years from 2006 to July 2025	7,247
Subject area	
Business, Management and Accounting, Decision Sciences, Economics, Econometrics and Finance, computer science and Engineering, Social Sciences	4,707
Document type	
articles only	1,822
Filter by keyword	
Insurance, Health Insurance, Insurance Companies, Insurance Industry, Insurance Claims, Usage-based Insurance, Automobile Insurance, Life Insurance, Insurtech, Insurance System, Insurance Frauds, Insurance, Health, Insurance Sectors, Machine Learning, Artificial Intelligence, Data Mining, , Big Data, Internet Of Things.	820
Source type	
Only journal	815
Language	
English	796

The search query was constructed using a Boolean combination of terms, specifically: (("Artificial Intelligence" OR "AI" OR "Machine Learning" OR "Deep Learning" OR "AI applications" OR "Telematics" OR "Natural language processing" OR "Predictive modelling" OR "Data Mining" OR "Big Data Analytics") AND "Insurance")).

The first search turned up 7512 documents. Applying a multi-stage filtering procedure helped to guarantee academic rigor and relevance:

1. **Temporal Scope:** Publications were confined to the years 2006 through July 2025, in line with the recent acceleration in artificial intelligence and machine learning developments and their expanding impact on risk management. This temporal limit cut the dataset to 7247 articles.

2. **Subject Area Filtering:** To enhance disciplinary focus, the study narrowed results to specific domains—Business, Management, and Accounting; Decision Sciences; Economics, Econometrics, and Finance; and Computer Science, the deliberate inclusion of interdisciplinary subject areas underscores the cross-functional nature of AI/ML applications in risk management. This step refined the dataset to 4707 articles, ensuring that the selected studies were grounded in both technical and managerial perspectives.
3. **Document Type Constraint:** Only peer-reviewed articles were retained to maintain high academic quality, excluding conference papers, reviews. This filtering stage further narrowed the selection to 1,822 articles.
4. **Keyword-Based Relevance Filtering:** Using a focused collection of risk-related keywords—including "Risk Assessment," "Risk Analysis," "Credit Risk," "Supply Chain Risk Management," and others—we sought to capture subtle features of risk research. Using this thematic filtering, 820 papers directly related to the study goal.
5. **Source Type and Language Filtering:** The final selection retained only English-language articles and journal-based publications, leading to a final dataset of 796 articles.

The filtering strategy demonstrates methodological rigor and thematic precision. By progressively narrowing the scope through clearly defined criteria, the study ensures that the resulting dataset is both comprehensive and contextually aligned with the research question. The layered filtration also reflects adherence to best practices in bibliometric research, particularly those aligned with the PRISMA protocol.

3. RESULTS

This section provides a comprehensive and structured bibliometric analysis of the Scopus dataset, aligned with the thirteen research questions that frame this study. The analysis opens by exploring the distribution of documents from 2006 to 2024 (RQ1), capturing the temporal growth and scholarly interest in Artificial Intelligence (AI) and Machine Learning (ML) applications within the insurance industry. It then identifies the most

relevant journals (RQ2), offering insight into the leading publication venues that disseminate cutting-edge research in this domain.

The geographical landscape is examined through an analysis of the most influential countries (RQ3) and educational institutions (RQ4), reflecting global contributions and institutional productivity. In parallel, the study identifies the most prolific authors (RQ5) and the most cited articles (RQ6), revealing the intellectual drivers and foundational works in AI-insurance scholarship.

To assess the global collaboration structure, the study investigates the patterns of international research collaboration among countries (RQ7), highlighting cross-border partnerships and scholarly networks. This is followed by a keyword co-occurrence analysis (RQ8), which uncovers major research themes, conceptual linkages, and the evolution of dominant topics in the field.

Further, the analysis examines the intellectual connections between central research themes, key authors, and productive institutions (RQ9), providing insights into the field's structural coherence and knowledge integration. The geographic distribution of corresponding authors (RQ10) is also assessed to understand the spatial dynamics of authorship and influence.

In addition, the study addresses emerging and evolving research trends over time (RQ11), supported by trend topic visualizations that reflect shifting thematic priorities. The thematic mapping (RQ12) evaluates the positioning of research themes in terms of maturity and relevance, while the thematic evolution analysis (RQ13) highlights how specific topics have developed, persisted, or declined between the periods 2015–2020 and 2021–2025.

Together, these analytical components offer an integrated perspective on publication dynamics, thematic development, collaboration patterns, and intellectual structures that define the landscape of AI and ML research in the insurance industry.

The following section will start addressing the research question.

Figure 2. Annual distribution of publications AI and ML applications in the insurance industry (2006–2025)

3.1. What Is the Distribution of Documents on AI And ML Applications in the Insurance Industry 2006 To 2025?

The Figure 2 illustrates a gradual yet notable surge in research activity related to the applications of artificial intelligence (AI) in the insurance industry. From 2006 to 2014, scholarly output remained relatively modest, with no more than 12 publications annually. This suggests that the field was still in its exploratory phase.

A turning point began in 2015, as the number of publications started to increase steadily. This growth accelerated significantly between 2020 and 2024—a period that can be considered a true research boom. This escalation likely reflects the broader digital transformation sparked by the COVID-19 pandemic, which prompted rapid adoption of AI-driven solutions in critical sectors such as insurance (Kraus et al., 2020), In 2024, the number of publications peaked at 128, the highest recorded in the dataset, indicating both a maturation of scholarly interest and increasing recognition by researchers and industry professionals alike. This publication pattern clearly signals a transition of AI from an emerging concept to a core driver of innovation in the insurance sector, The subsequent decrease to 77 publications in 2025 is explained by the incomplete data collection, as the year is still ongoing

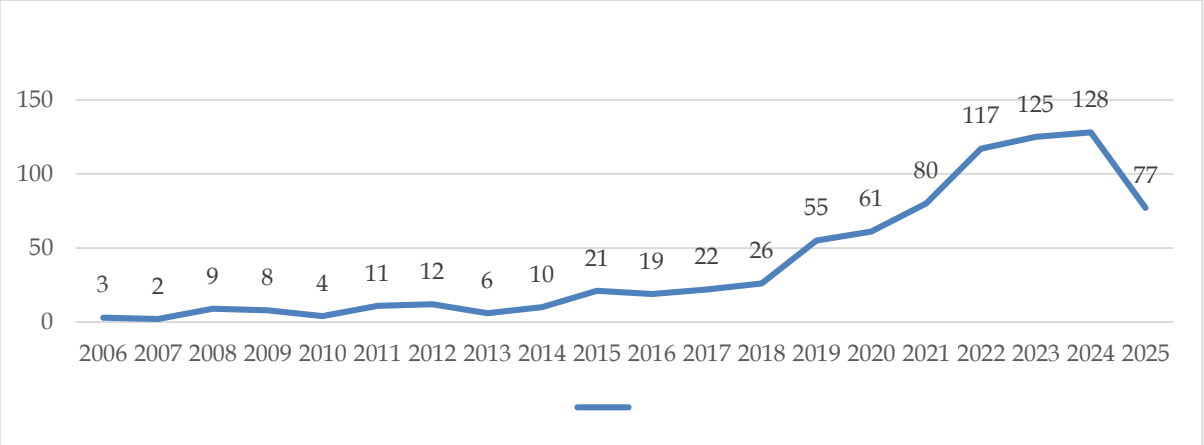

Figure 2: Annual Distribution of Publications AI And ML Applications in the Insurance Industry (2006–2025).

3.2. What Are the Most Relevant Journals in AI And ML Applications in the Insurance

Industry Analytics Research?

Through Figure 3 revealed that IEEE Access emerged as the most prolific journal, contributing 40 publications to the corpus, followed closely by Expert Systems with Applications with 35 articles. These outlets demonstrate a strong alignment with the intersection of artificial intelligence and applied domains such as insurance, decision systems, and intelligent technologies. Other prominent sources include Journal of Biomedical Informatics (23 articles) and Journal of Big Data (16 articles), indicating a notable overlap between AI applications in health-related data analysis and broader data-driven industries. Journals such as Accident Analysis and Prevention, Frontiers in Digital Health, and International Journal of Advanced Computer Science also contributed equally with 13 publications each, reflecting interdisciplinary interest in safety, health informatics, and computational frameworks. Additionally, titles like Computer Methods and Programs in Biomedicine, Decision Support Systems, and NPJ Digital Medicine each contributed 11 publications, highlighting their relevance in advancing AI-supported decision-making and predictive modelling. Collectively, these journals form the intellectual backbone of research at the convergence of artificial intelligence and applied analytics, which is increasingly pertinent to the insurance sector.

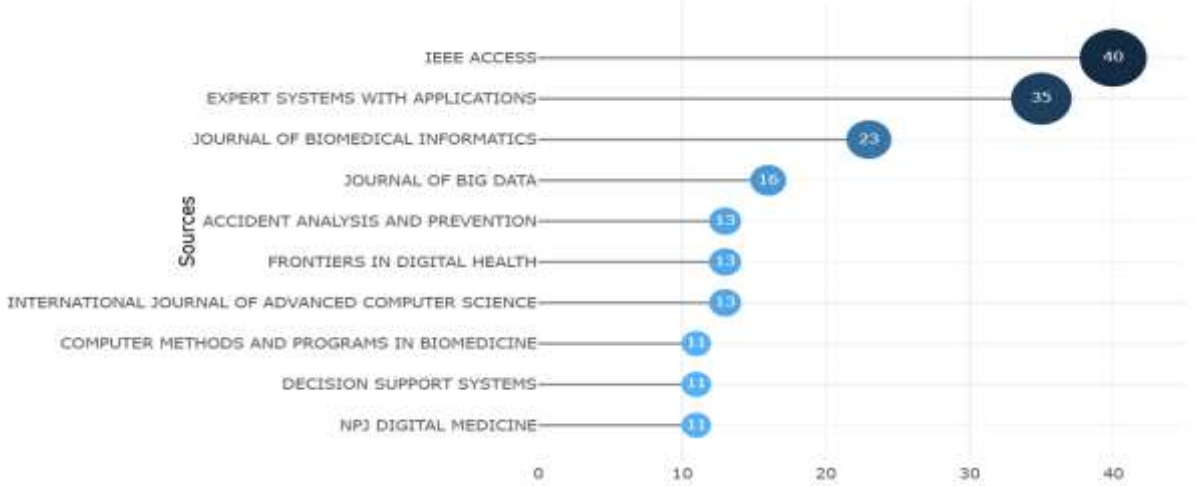

Figure 3: Top 10 Journals Publishing AI And ML Applications in the Insurance Industry (2006–2025).

The data presented in Table 2 reveal a clear dominance of high-impact, Q1-ranked journals in shaping the intellectual foundations of AI and machine learning applications within the insurance industry. IEEE Access stands at the forefront, supported by an extensive publication volume (TP = 44,988) and an exceptionally high citation count (TC = 402,859). Its most cited contribution "An ensemble random forest algorithm for insurance big data analysis" with 262 citations illustrates the journal's strong orientation toward large-scale computational techniques that are directly applicable to insurance analytics.

Expert Systems with Applications (Q1), with a total publication count of 9,435 and 141,273 citations, ranks closely behind. The journal's highly cited work on healthcare fraud detection" A process-mining framework for the detection of healthcare fraud and abuse" (199 citations) reflects its pivotal role in advancing intelligent systems for fraud analysis, which remains a central research theme in insurance-related AI.

The Journal of Biomedical Informatics (Q1) contributes meaningfully through studies integrating AI with health insurance datasets, indicated by its 784 publications and influential articles such as "Analyzing health insurance claims on different timescales to predict days in hospital" (22 citations). This reinforces the journal's relevance to actuarial modelling and risk prediction in health insurance.

Similarly, the Journal of Big Data (Q1), with 644 publications and 14,380 citations, provides substantive research on data-intensive approaches, including telematics-driven risk assessment—evident in its most cited article "A survey on driving behaviour analysis in usage-based insurance using big data" with 97 citations. Accident Analysis and Prevention (Q1) contribute through 1,353 publications, supporting research on vehicle risk behaviour and telematics, including a notable article cited 40 times.

Additional journals listed in Table2 such as Computer Methods and Programs in Biomedicine

(Q1), Decision Support Systems (Q1), and Sustainability (Switzerland) (Q1) further reinforce the interdisciplinary nature of AI-insurance research. Their citation scores (11.1, 13.5, and 7.7, respectively) demonstrate strong research impact, particularly in fraud detection, predictive modelling, and risk assessment.

Collectively, Table 2 highlights that the most influential contributions in this domain originate from technically oriented, high-impact journals, reflecting the methodological rigor and computational depth characteristic of contemporary AI research in insurance. (Ellili et al., 2023).

Table 2: Leading Academic Journals in AI And ML Research for Insurance Industry.

Journal	Quartile	*TP	**TC for journal	Citate score	Most cited article	Time cited	Publisher
IEEE Access	Q1	44988	402859	9	An ensemble random forest algorithm for insurance big data analysis	262	IEEE
Expert Systems with Applications	Q1	9435	141273	15	A process-mining framework for the detection of healthcare fraud and abuse	199	Elsevier
Journal of Biomedical Informatics	Q1	784	7961	10.2	Analyzing health insurance claims on different timescales to predict days in hospital	22	Elsevier
Journal of Big Data	Q1	644	14380	22.3	A survey on driving behaviour analysis in usage-based insurance using big data	97	Springer Nature
Accident Analysis and Prevention	Q1	1353	16948	12.5	Using telematics data to find risky driver behaviour	40	Elsevier
International Journal of Advanced Computer Science and Applications	Q3	5428	14628	2.7	Improving Imbalanced Data Classification in Auto Insurance by the Data Level Approaches	12	Science and Information Organization
Computer Methods and Programs in Biomedicine	Q1	2118	23456	11.1	A prescription fraud detection model	49	Elsevier
Decision Support Systems	Q1	491	6646	13.5	Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud	267	Elsevier
Sustainability (Switzerland)	Q1	58414	450030	7.7	Development of model to predict natural disaster-induced financial losses for construction projects using deep learning techniques	24	Multidisciplinary Digital Publishing Institute (MDPI)
Risks	Q2	876	4399	5	Machine learning approaches for auto insurance big data	69	Multidisciplinary Digital Publishing Institute (MDPI)
***TP = Total publication, **TC= total citation**							

3.3. What Are the Most Significant Countries in Artificial Intelligence and Machine Learning Within in Insurance Industry Research?

Figure 4 clear the distribution of publications across countries reveals a dominance of technologically advanced and research-intensive economies. The United States leads substantially with 237 publications, reflecting its mature digital infrastructure, strong integration of AI within the financial and insurance sectors, and the presence of globally influential research institutions and industry–academia partnerships. (Furman & Seamans, 2019) China follows with 126 publications, driven by its rapid technological expansion, state-backed AI initiatives, and the strategic growth of its insurance and InsurTech sectors. India, with 74 publications, demonstrates increasing momentum attributed to its expanding IT ecosystem, competitive analytics workforce, and the rising adoption of AI-driven solutions by domestic insurers. (Yu et al.,2022)

Asian economies like Taiwan (47) and South Korea (36) show strong research outputs linked to their advanced digital ecosystems, particularly in telematics, IoT, and mobile insurance services. The presence of Australia (32), Canada (30), and Saudi

Arabia (30) indicates growing investments in digital transformation and InsurTech adoption. Collectively, this pattern highlights those countries with robust technological capabilities, mature insurance markets, and strong policy support for AI research are those driving the global scholarly output in this emerging field. (Veerasankararao & Saheb, 2025) (Kim & Kim, 2025).

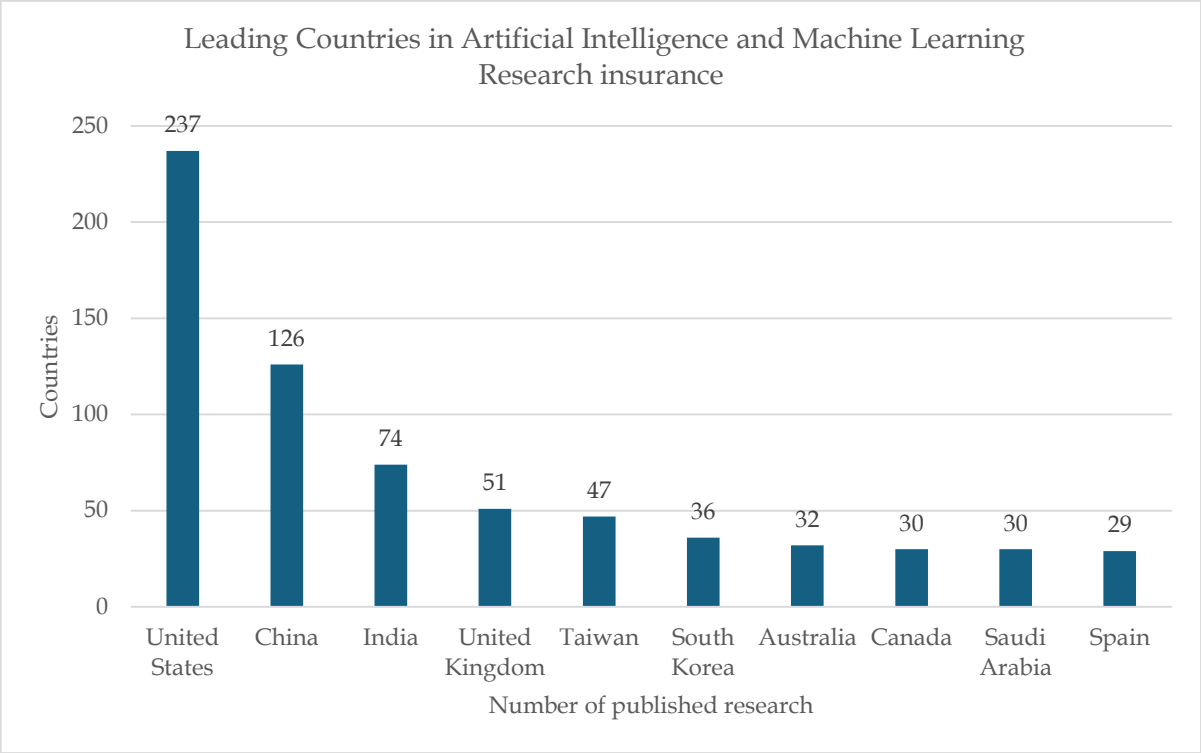

Figure 4: Top 10 Countries by Research Output on Artificial Intelligence and Machine Learning in the Insurance Industry.

3.4. What Are the Most Significant Educational Institutions in Artificial Intelligence and Machine Learning Within in Insurance Industry Research?

The data clearly indicates Florida Atlantic University's leading role with 20 publications, emphasizing robust institutional focus on AI research specifically targeted toward practical applications in the insurance industry. Universitat de Barcelona ranks second with 15 publications, reflecting Europe's influential academic presence and specialized expertise in insurance-related AI innovations. (Blier-Wong et al.,2020). The presence of institutions from diverse geographical locations including Ireland, Belgium, Egypt, China, Canada, and the U.S. demonstrates the globalized and multidisciplinary nature of AI applications in insurance research. this diverse institutional representation signals a clear trend towards international collaboration, knowledge exchange, and increased adoption of AI-driven solutions across the global insurance landscape. Moving forward, fostering collaborative projects among these institutions could substantially enhance innovation capacity, enabling accelerated implementation of practical AI technologies in the insurance industry worldwide. (Righi et al., 2020)

Table3: Top Educational Institution in Artificial Intelligence and Machine Learning Within Insurance Research.

Educational institution	*TP	country
Florida Atlantic University	20	United States
Universitat de Barcelona	15	Spain
University of Limerick	11	Ireland
KU Leuven	11	Belgium
FAU College of Engineering and Computer Science	11	United States
Assiut University	9	Egypt
University of Florida	9	United States

Zhejiang Gongshang University	8	China
Université du Québec à Montréal	8	Canada
Harvard Medical School	7	United States

***TP: Total Publication**

3.5. Who Are the Most Prolific Authors in the Field of Artificial Intelligence and Insurance Research?

The table 4 presents key insights into the most prolific authors in Artificial Intelligence (AI) and insurance research, highlighting their academic contributions through metrics such as total publications (TP), h-index, and total citations (TC). Taghi M. Khoshgoftaar clearly leads the field with an impressive 776 publications, an h-index of 70, and 42,025 citations. His work at the FAU College of Engineering and Computer Science emphasizes the institution's strategic commitment to advanced AI research within the insurance domain. Veteran scholars like Montserrat Guillen (213 publications, h-index 38, 3,972 citations) from Universitat de Barcelona and Finbarr Murphy (93 publications, h-index 27, 2,204 citations) from the University of Limerick have provided foundational contributions in applying AI techniques to actuarial science and risk management. Additionally, John T. Hancock (55 publications, h-index 18, 2,174 citations) and Joffrey L. Leevy (42 publications, h-index 18, 1,502 citations), both affiliated with FAU College of Engineering and Computer Science. Emerging scholars such as Ruixing Ming (37 publications, h-index 8, 209 citations) from Zhejiang Gongshang University highlight the expanding global diversity and innovative potential of newer researchers. Ultimately, the table illustrates the broad geographic and institutional diversity of influential scholars, confirming the field's robust expansion.

Future research should emphasize collaborative ventures among these top researchers, leveraging their expertise to address complex, multidisciplinary challenges in AI applications within the global insurance sector.

Table 4: Leading Academic Journals in AI And ML Research for Insurance Industry.

Autor	Year of first publication	*TP	h-index	**TC	Current affiliation	country
Khoshgoftaar, Taghi M.	1996	776	70	42,025	FAU College of Engineering and Computer Science	United States
Guillen, Montserrat	1989	213	38	3972	Universitat de Barcelona	Spain
Ming, Ruixing	2007	37	8	209	Zhejiang Gongshang University	China
Murphy, Finbarr	2009	93	27	2,204	Kemmy Business School, University of Limerick	Ireland
Bauder, Richard A.	2016	31	19	1,656	FAU College of Engineering and Computer Science	United States
Mullins, Martin	2006	80	24	1,764	University of Limerick	Ireland
Pérez-Marín, Ana Maria	2003	34	16	777	Universitat de Barcelona	Spain
Sheehan, Barry	2016	35	16	946	Kemmy Business School, University of Limerick	Ireland
Hancock, John T	2020	55	18	2,174	FAU College of Engineering and Computer Science	United States
Leevy, Joffrey L.	2018	42	18	1,502	FAU College of Engineering and Computer Science	United States

***TP = Total Publication, **TC= Total Citation**

3.6. Who Are the Most Cited Articles the Field of Artificial Intelligence and Machine Learning in Insurance Industry Research?

The table 5 presented highlights the Top 10 Most Cited Articles at the intersection of Artificial Intelligence (AI), Machine Learning (ML), and insurance research, ranked by total citations (TC), reflecting their significant impact on the field.

1. **"Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud"** by (Wang and Xu,2018) leads the list with 267 citations (45 citations per year). Published in Decision Support Systems (Q1) by Elsevier, the study proposes an innovative fraud detection model for automobile insurance using deep learning integrated with Latent Dirichlet Allocation (LDA)-based text analytics. Experimental results confirm the model's significant superiority over traditional

machine learning techniques like Random Forest and SVM. The findings highlight the critical value of combining textual data and expert experience to enhance fraud detection accuracy in insurance (Wang & Xu, 2018).

2. "An ensemble random forest algorithm for insurance big data analysis" by (Lin et al.,2017), published by IEEE, with 262 citations (38 per year). This study presents an enhanced ensemble random forest algorithm tailored for analyzing big insurance data, addressing challenges like imbalanced data distributions and missing features. Utilizing Apache Spark for parallel computing, the authors applied heuristic bootstrap sampling techniques to efficiently manage large-scale datasets from China Life Insurance. Experimental results demonstrate that the proposed model significantly outperforms traditional methods (SVM, logistic regression) in precision, recall, and computational efficiency (Lin et al., 2017).
3. "A process-mining framework for the detection of healthcare fraud and abuse" by (Yang and Hwang,2006), appearing in Expert Systems with Applications (Q1) by Elsevier, has accumulated 200 citations This research presents an advanced process-mining framework aimed at detecting fraud and abuse within healthcare insurance systems by systematically analyzing clinical pathway data. Unlike traditional manual approaches, it automates the identification of behavioural patterns, reducing reliance on subjective human judgment. The framework incorporates robust feature selection techniques to enhance both efficiency and detection accuracy. Applied to real-world data from Taiwan's National Health Insurance program, it proved capable of uncovering fraudulent activities that manual review processes had overlooked. These findings underscore its value as a powerful tool for strengthening fraud prevention mechanisms in large-scale health insurance operations (Yang & Hwang, 2006).
4. "Using artificial intelligence to create value in insurance" by (Riikkinen et al.,2018), published in the International Journal of Bank Marketing (Q1), has received 175 citations. This study explores the role of artificial intelligence, particularly chatbots, in creating value within the insurance sector. It proposes a conceptual framework integrating AI, service-dominant logic, and reverse use of customer data to enhance operations and customer experience. Through practical examples, the paper identifies four main roles of chatbots in insurance, ranging from providing basic information to delivering fully personalized customer support. It demonstrates how these technologies can accelerate services, improve interaction, and deliver tailored solutions that boost customer satisfaction and loyalty. The study concludes that future advancements in AI will further strengthen insurers' ability to deliver genuine added value through smart digital tools (Riikkinen et al., 2018).
5. "Insurance Telematics: Opportunities and challenges with the smartphone solution" by (Handel et al.,2014) with 132 citations, featured in IEEE Intelligent Transportation Systems Magazine (Q1), This paper examines the potential and challenges of using smartphones as the basis for Usage-Based Insurance (UBI) programs. It highlights that smartphones offer a low-cost and widely accessible alternative to in-vehicle devices, but face issues with data quality and accuracy. The study proposes advanced data processing techniques to improve the reliability of measurements such as speed and harsh braking, alongside analyzing driving behaviour indicators. It also discusses methods for designing risk assessment systems and providing driver feedback to enhance safety and trust in UBI. The research concludes that smartphones present a transformative opportunity for the insurance industry, provided technical challenges and driving data accuracy are effectively addressed (Handel et al., 2014).
6. "The value of vehicle telematics data in insurance risk selection processes" by (Baecke &Bocca,2017), again in Decision Support Systems (Q1) by Elsevier, cited 117 times, this study investigates how vehicle telematics data, collected via in-vehicle data recorders, can enhance risk selection in motor insurance. By integrating driving behaviour metrics with traditional customer, vehicle, and claims data, predictive accuracy for accident risk improves significantly. The research demonstrates that even three months of telematics data is sufficient to build robust risk models, with Pay-As-You-Drive metrics being especially valuable. Expert-derived telematics variables further refine predictions in regulatory environments requiring transparent models. These findings position telematics as a

powerful tool for insurers to personalize pricing, reduce risk, and deliver fairer, data-driven premiums (Baecke & Bocca, 2017).

7. "A Secure AI-Driven Architecture for Automated Insurance Systems: Fraud Detection and Risk Measurement" by (Dhieb, et al.,2020) with 115 citations, published by IEEE, this study presents an integrated framework leveraging artificial intelligence and blockchain to develop an automated insurance system focused on fraud detection and risk measurement. It employs the XGBoost algorithm for batch learning and the VFDT algorithm for real-time incremental learning, enhancing detection accuracy and responsiveness. The integration of blockchain ensures secure data sharing between insurers while protecting customer privacy and preventing claim manipulation. Experimental results demonstrate the framework's effectiveness in detecting fraud and reducing losses compared to traditional methods. This approach represents a significant step toward improving the efficiency and reliability of the insurance industry through secure, intelligent technologies (Dhieb, et al., 2020).
8. "Smartphone-based measurement systems for road vehicle traffic monitoring and usage-based insurance" by (Händel et al.,2013), published in IEEE Systems Journal (Q1), with 110 citations, this paper presents a smartphone-based measurement framework designed for both road traffic monitoring and Usage-Based Insurance (UBI). The system operates on two data streams: one supporting societal benefit such as reducing congestion and environmental impact, and another powering the UBI business model. A ten-month pilot study collected 4,500 driving hours and 250,000 km of data, demonstrating feasibility and sustainability. The results highlight smartphones as a cost-effective, scalable tool for advancing intelligent mobility and personalized insurance pricing (Händel et al., 2013)
9. "Unravelling the predictive power of telematics data in car insurance pricing" by (Verbelen et al.,2018) with 108 citations, appearing in the Journal of the Royal Statistical Society:(Q2), This study explores how telematics data from black-box devices can improve car insurance pricing, particularly for young drivers. By analysing driving behaviour metrics such as distance, time of travel, and road type, the authors develop statistical models that significantly enhance accident risk prediction compared to traditional self-reported data. The research demonstrates that integrating telematics can replace outdated rating variables like gender while enabling fairer, usage-based pricing. Advanced modelling techniques, including generalized additive models and compositional data analysis, allow for nuanced interpretation of telematics information. The findings confirm that telematics-driven risk classification offers insurers greater accuracy, reduces cross-subsidization, and promotes safer driving behaviours (Verbelen et al.,2018).
10. "An interactive machine-learning-based electronic fraud and abuse detection system in healthcare insurance" by (Kose et al.,2015), published in Applied Soft Computing (Q1) by Elsevier, cited 106 times, this study introduces an interactive machine learning (IML)-based framework for detecting fraud and abuse in healthcare insurance, overcoming the limitations of traditional rule-based and static models. The framework integrates expert knowledge throughout the process, using clustering, risk scoring, and visualization tools to analyze fragmented claim patterns across multiple actors and commodities. It supports both proactive and retrospective detection, enabling faster identification of suspicious cases and reducing manual review burdens. Tested on real-world insurance data, the system successfully identified multiple fraud scenarios with strong detection performance. This approach offers insurers a flexible, adaptive, and data-driven tool to reduce losses and improve claim integrity (Kose et al.,2015).

Collectively, these highly cited articles underscore the transformative impact of AI and ML across various aspects of insurance, including fraud detection, telematics, risk management, cybersecurity, and predictive analytics.

They reflect the increasing integration of sophisticated AI techniques into insurance practices, setting foundational pathways for future research and industry advancements.

Table 5: Top 10 Most Cited Articles in Artificial Intelligence and Machine Learning in Insurance Industry Research?

Paper title	(Authors)/Year	TC	Citations per year	Journal	Publisher	Rank
Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud	(Wang & Xu,2018).	267	45	Decision Support Systems	Elsevier	Q1
An ensemble random forest algorithm for insurance big data analysis	(Lin et al.,2017)	262	38	IEEE	Institute of Electrical and Electronics Engineers Inc	Q1
A process-mining framework for the detection of healthcare fraud and abuse	(Yang & Hwang,2006)	200	11	Expert Systems with Applications	Elsevier	Q1
Using artificial intelligence to create value in insurance	(Riikkinen et al.,2018)	175		International Journal of Bank Marketing	Emerald	Q1
Insurance Telematics: Opportunities and challenges with the smartphone solution	(Handel, et al.,2014).	132		IEEE Intelligent Transportation Systems Magazine	Institute of Electrical and Electronics Engineers Inc	Q1
The value of vehicle telematics data in insurance risk selection processes	(Baecke & Bocca, 2017)	117		Decision Support Systems	Elsevier	Q1
A Secure AI-Driven Architecture for Automated Insurance Systems: Fraud Detection and Risk Measurement	(Dhieb, et al., 2020)	115		IEEE	Institute of Electrical and Electronics Engineers Inc	Q1
Smartphone-based measurement systems for road vehicle traffic monitoring and usage-based insurance	(Händel, et al.,2013).	110		IEEE Systems Journal	Institute of Electrical and Electronics Engineers Inc	Q1
Unravelling the predictive power of telematics data in car insurance pricing	(Verbelen et al.,2018)	108		Journal of the Royal Statistical Society. Series C: Applied Statistics	Oxford University Press	Q2
An interactive machine-learning-based electronic fraud and abuse detection system in healthcare insurance	(Kose et al.,2015).	106		Applied Soft Computing	Elsevier	Q1

3.7. What Are the Patterns of International Research Collaboration in the Field of Artificial Intelligence and Machine Learning Applications in the Insurance Sector?

illustrates Figure 5 The co-authorship network maps the global collaborative structure in research on Artificial Intelligence (AI) and Machine Learning (ML) within the insurance sector.

The node size reflects each country's publication volume, while the link thickness indicates the strength of collaborative ties. The United States, China, and India emerge as dominant contributors, with the United States occupying the most central and connected position, highlighting its leadership in both research volume and international engagement. China maintains a strong cluster in collaboration with the United States, India, and several Asian partners, while India serves as a bridge between developed and emerging economies.

European countries such as the United Kingdom, Spain, France, and Belgium form dense regional clusters, often collaborating closely with North American partners. The map also reveals the rising role of countries like Saudi Arabia, Egypt, and Taiwan, which are building stronger ties within global research networks.

Overall, the visualisation underscores an

increasingly interconnected international landscape in AI-insurance research, where both established and emerging players contribute to advancing knowledge and fostering innovation through cross-border collaboration.

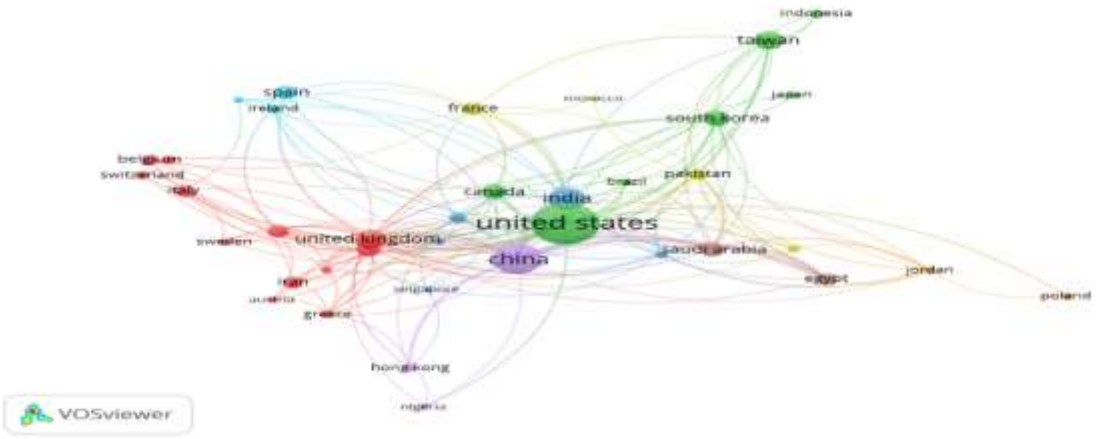

Figure 5: Country Collaboration Map Based on Co-Authorship in AI And ML Applications in the Insurance Publications.

3.8. What Are the Main Research Themes in AI And ML Applications in the Insurance Sector Based on Keyword Co-Occurrence Analysis?

Figure 6 illustrates A keyword co-occurrence map the relationships between research terms, where connecting lines represent their joint appearance and the size of each circle reflects their frequency of occurrence. Using VOSviewer, a map was generated from 796 publications, focusing on keywords appearing in at least five articles. This visualization reveals five main thematic clusters, each assigned a distinct colour based on co-occurrence patterns. The thickness of connecting lines denotes the strength of keyword association, while node size highlights the frequency of term usage.

Green Cluster – Advanced AI Techniques for Insurance Applications

Key Terms: machine learning, deep learning, explainable AI, natural language processing, prediction, decision making. This cluster reflects the core technological stream driving modern insurance analytics. It emphasizes advanced AI techniques for predictive modelling, policyholder risk assessment, and operational decision-making. The prominence of deep learning and NLP signals a shift towards modelling complex, high-dimensional, and unstructured data to improve claims handling, risk profiling, and service personalization.

Blue Cluster –Technological Innovation and Domain-Specific AI Applications in Insurance

Key Terms: insurance, life insurance, InsurTech, internet of things, risk, support vector machine. This cluster represents insurance-specific applications of AI, highlighting the adoption of technologies such as IoT and SVM in various insurance lines. The frequent mention of InsurTech reflects the digital transformation of the industry, particularly in customer engagement, operational efficiency, and new risk evaluation paradigms.

Orange Cluster – Big Data and Feature Engineering in Insurance Analytics

Key Terms: big data, feature selection, class imbalance, ensemble learning, blockchain. This cluster captures the role of large-scale data analytics and feature engineering in developing robust AI models. Addressing class imbalance and leveraging ensemble methods like gradient boosting enhances fraud detection, pricing accuracy, and customer behaviour prediction. The inclusion of blockchain reflects growing interest in secure, transparent insurance transactions.

Red Cluster – Fraud Detection and Claims Optimization

Key Terms: fraud detection, automobile insurance, supervised learning, unsupervised learning, healthcare. This cluster focuses on applying AI to detect fraudulent claims, optimize claims management, and enhance underwriting. The integration of supervised and unsupervised learning approaches allows insurers to identify anomalies in structured and unstructured claims data efficiently.

Yellow Cluster – Usage-Based Insurance and

Telematics

Key Terms: usage-based insurance, telematics, pricing, driving behaviour, auto insurance. This emerging cluster revolves around behaviour-based risk assessment, leveraging telematics and driving data to personalize premiums. Such models align pricing with actual driving patterns, promoting fairness and incentivizing safer driving.

Overall, the network highlights a research landscape where core AI technologies intersect with domain-specific insurance applications, underpinned by big data, behavioural analytics, and emerging digital infrastructures. These thematic clusters reflect both the maturity of foundational AI methods in insurance and the rapid growth of innovative, data-driven practices shaping the sector's future.

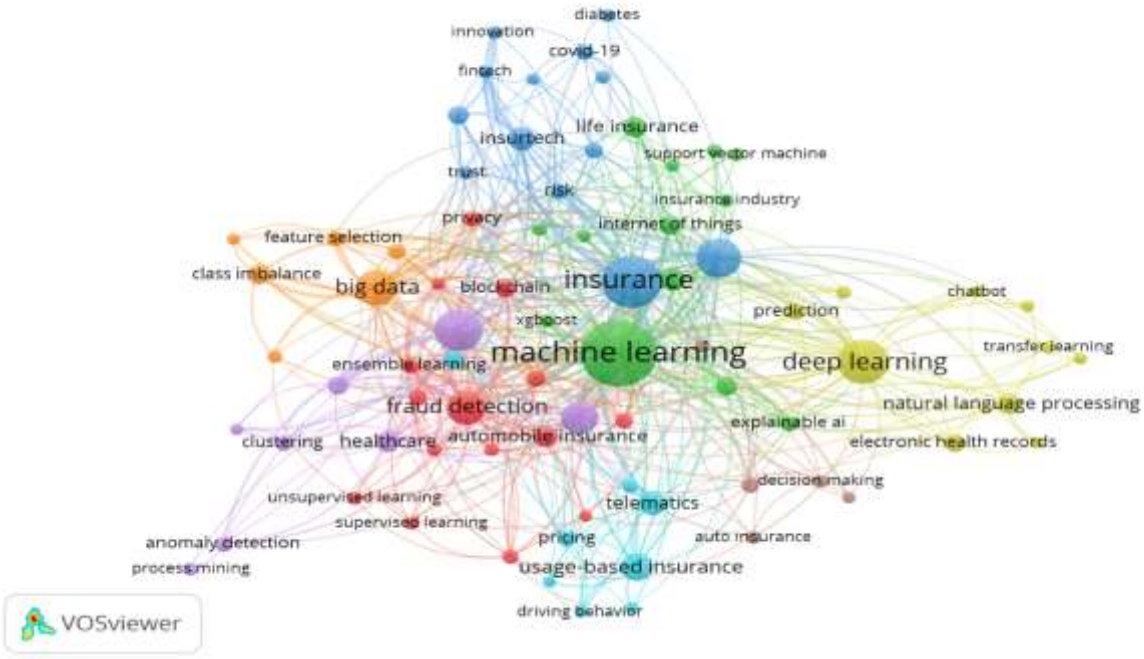

Figure 6: Keyword Co-Occurrence Network in AI And ML Applications in the Insurance Research (2006–2025).

In Figure 7, the word cloud illustrates the most frequently occurring keywords in the literature on Artificial Intelligence (AI) and Machine Learning (ML) within the insurance sector. The dominance of terms such as "insurance," "machine learning," and "health insurance" reflects the central focus of scholarly work on leveraging intelligent systems to optimize insurance operations and healthcare-related services. Keywords like "data mining," "deep learning," "fraud detection," and "risk assessment" highlight the methodological emphasis on predictive analytics, anomaly detection, and decision-making support.

Figure 7: Word Cloud of AI And ML Applications in the Insurance Industry.

3.9. What Are the Intellectual Linkages Between Dominant Research Topics, Leading

Authors, And Contributing Academic Institutions in AI Applications Within the Insurance Industry?

In Figure 8, the Three-Field Plot Diagram provides an integrated view of the intricate research interconnections between core research topics, leading authors, and academic institutions in the field of Artificial Intelligence (AI) applications in insurance. Key themes such as Big Data, Fraud Detection, Machine Learning, and Usage-Based Insurance dominate the landscape, serving as foundational pillars for transforming data into predictive tools and effective operational decisions. These themes are strongly linked to prominent authors such as Khoshgoftaar T.M. (Florida Atlantic University), whose work spans big data, machine learning, and fraud detection; (Guillen et al.,2024) (Universitat de Barcelona), who integrates health insurance with advanced statistical models; and Murphy F. (University of Limerick), who focuses on telematics and usage-based insurance. Leading academic institutions such as Florida Atlantic University, University of Limerick, and Universitat de Barcelona act as multidisciplinary research hubs, connecting scholars with diverse interests and creating bridges between seemingly distinct research topics.

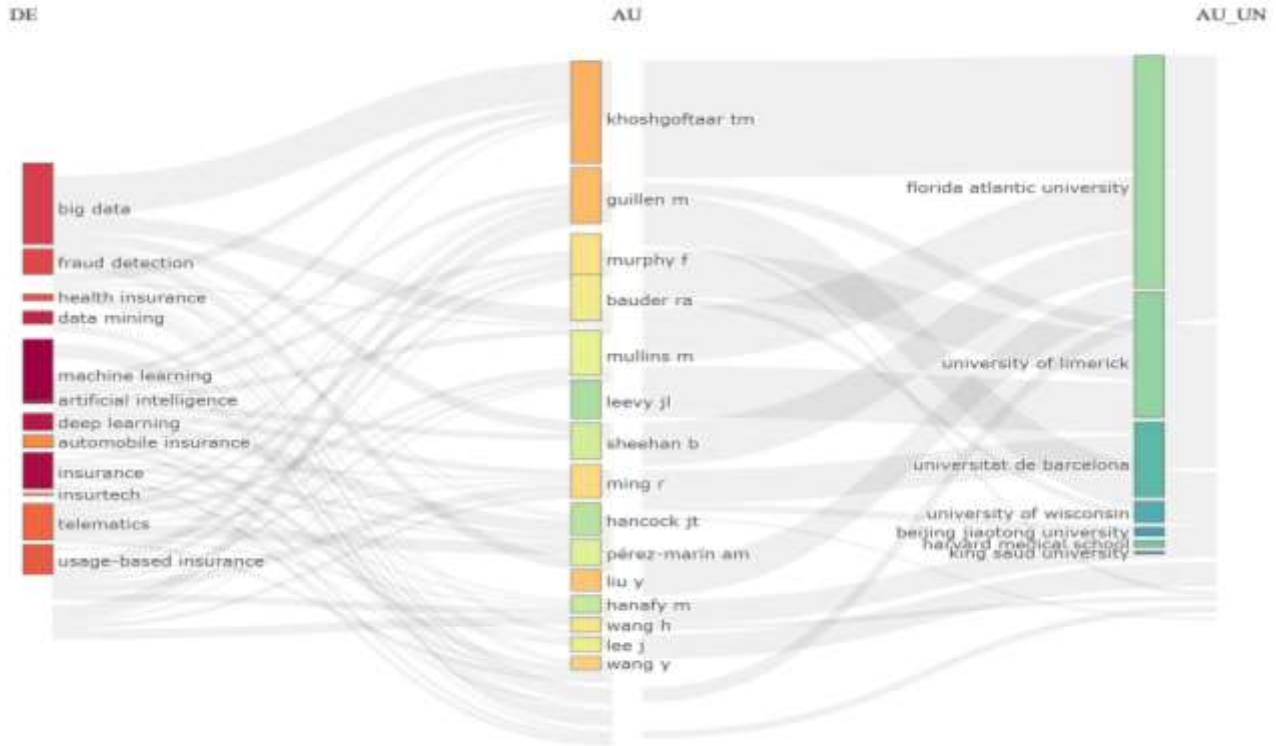

Figure 8: Three-Field Plot of Topics, Authors, And Institutions in AI And Insurance Research.

3.10. What Is the Distribution of Corresponding Authors Across Countries in AI And Insurance?

Figure 9 illustrates the distribution of publications by corresponding authors' countries, distinguishing between Single Country Publications (SCP) and Multiple Country Publications (MCP). The United States clearly dominates the field, contributing the highest volume of publications, with a notable balance between domestic research output and international collaborations. This leadership reflects the country's advanced research infrastructure and deep integration of AI into insurance studies. (Ellili et al., 2023) China ranks second, with a substantial research volume and a relatively higher share of international co-authorships, underscoring its strategic engagement with global research networks to strengthen its expertise (Wang, 2021). India follows in third place, demonstrating growing research capacity and a strong domestic output, indicating the development of local expertise in AI-driven insurance solutions. Other significant contributors include South Korea and the United Kingdom, both showing a healthy mix of national and international collaboration. European countries such as France, Italy, and Spain appear in the mid-tier, often participating in cross-border projects. Emerging contributors like Saudi Arabia, Egypt, and Pakistan are entering the field, signalling expanding

interest and capacity building in developing and transitional economies.

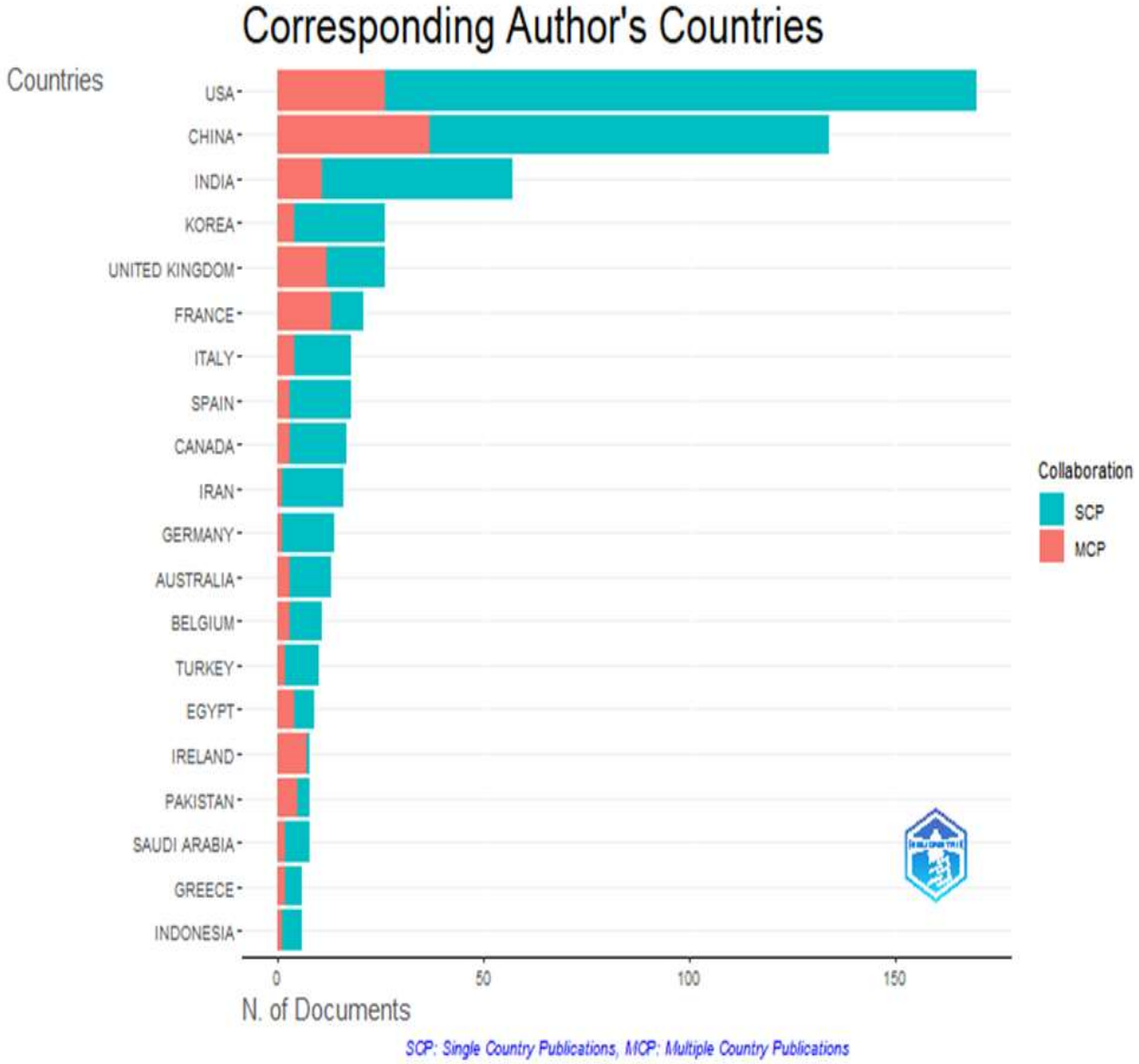

Figure 9: Distribution Of Corresponding Authors by Country and Type of Collaboration in AI And Insurance Research.

3.11. What Are the Evolving Research Trends in the Application of Artificial Intelligence in the Insurance Industry Over Time?

In Figure 10, The trend topics visualization provides a chronological perspective on the evolution of key research themes in Artificial Intelligence (AI) applications in insurance, highlighting both their emergence and sustained relevance over time. The prominence of machine learning demonstrates its central role as the methodological backbone of AI-driven insurance research, particularly in recent years. Closely associated with this rise is fraud detection, which shows strong research momentum.

The inclusion of big data and algorithms as recurring themes points to the continued convergence of advanced computational methods with vast insurance datasets, enabling more granular risk assessment, personalized pricing, and operational efficiency.

the concentration of high-frequency terms in recent years indicates that AI-insurance research is transitioning from exploratory adoption to targeted, domain-specific implementation. This shift signals maturity in the research field, with a focus on scalable, explainable, and regulatory-compliant AI applications that directly address pressing industry needs such as fraud mitigation, claims optimization, and enhanced customer experience (Klein & Walther,

2024).

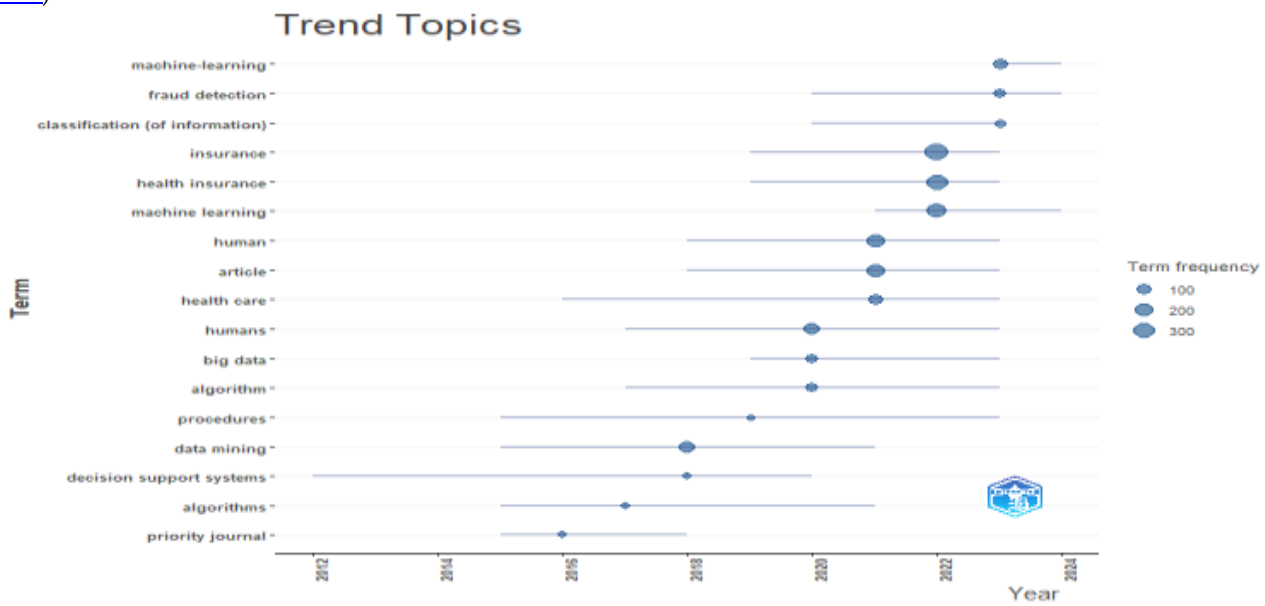

Figure 10: Temporal Evolution of Key Research Topics in AI Applications in the Insurance Sector.

3.12. How Are Research Themes In AI-Insurance Studies Positioned in Terms of Relevance and Maturity Based on Thematic Mapping?

In Figure 11 The thematic map presents a strategic landscape of research themes in Artificial Intelligence (AI) applications for insurance, organized by development degree (density) and relevance degree (centrality). The four quadrants offer a framework to interpret the maturity, integration, and strategic importance of each theme.

3.12.1. Motor Themes (High Density, High Centrality)

This quadrant contains well-developed and highly relevant topics driving the field. Usage-based insurance, telematics, and pricing stand out as transformative forces, reflecting the shift toward behaviour-based risk assessment and personalized premium structures. Random forest models, life insurance, and prediction also occupy this space, demonstrating the operational application of advanced machine learning algorithms in underwriting, claims forecasting, and customer segmentation.

3.12.2. Basic Themes (Low Density, High Centrality)

Themes such as machine learning, data mining, fraud detection, insurance, deep learning, and artificial intelligence represent the conceptual and methodological foundation of AI-insurance research. These topics are central to the field's knowledge network but still show room for further methodological refinement and domain-specific specialization. Their position highlights their role as entry points for both applied and theoretical advancements.

3.12.3. Niche Themes (High Density, Low Centrality):

Topics like chatbots, recurrent neural networks, and support vector machines represent specialized, mature areas that are highly developed but serve narrower research purposes. These may target specific operational challenges, such as automated customer interaction or specialized classification tasks, rather than functioning as broad, cross-domain enablers.

3.12.4. Emerging Or Declining Themes (Low Density, Low Centrality)

Themes such as big data analytics, natural language processing, electronic health records, and de-identification appear here. Some, like NLP and EHR analysis, may represent emerging areas poised for growth as insurers adopt more advanced text and document analytics. Others may be in relative decline or in transition, depending on data availability, and industry adoption trends.

From a strategic industry perspective, the thematic map suggests a dual-track research environment: on one hand, core AI methods like machine learning and deep learning continue to anchor applied research; on the other, application-

driven motor themes such as telematics and usage-based insurance are shaping the commercial transformation of insurance services. The interplay between these quadrants reveals that future advancements will likely hinge on integrating foundational AI techniques with domain-specific, high-relevance applications that directly impact risk management, pricing strategies, and fraud prevention. (Li et al., 2023).

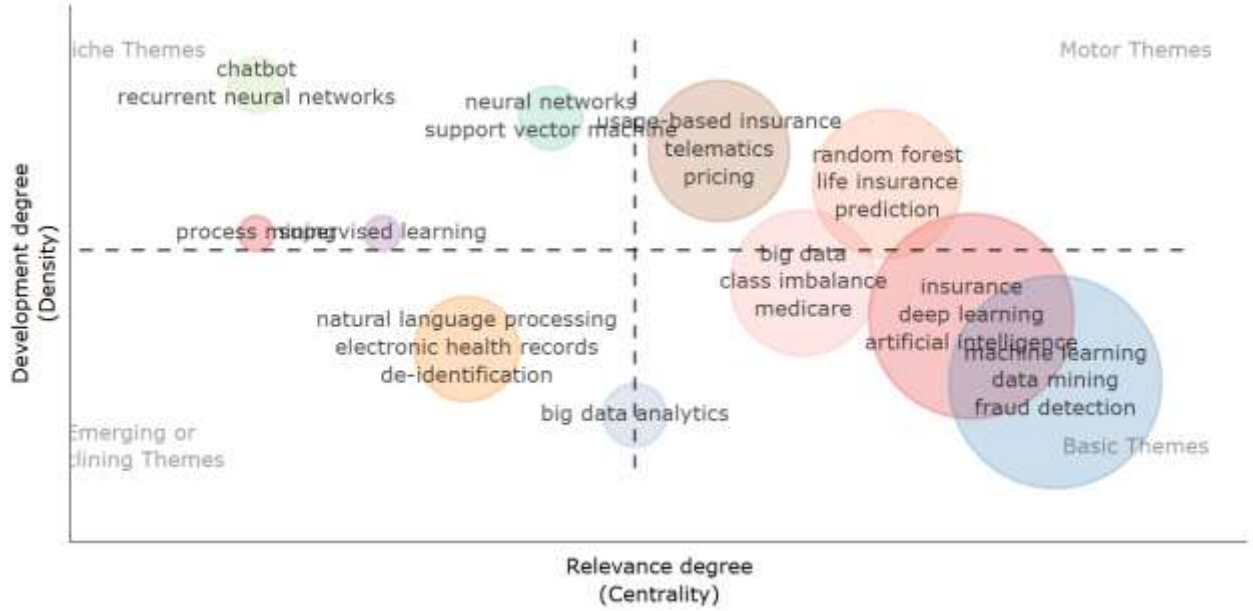

Figure 11: Thematic Map of Artificial Intelligence Research in the Insurance Industry: Based on Centrality and Density.

3.13. How Have the Research Themes in Artificial Intelligence Applications Within the Insurance Industry Evolved Between 2006–2025.

Thematic Evolution Analysis (2006–2025):

Figure 12 shows how the themes of research keywords in the field of AI applications in the insurance industry have changed over time, comparing the years 2006–2020 and 2021–2025. This shows how quickly technology and analysis are changing in the insurance industry.

3.13.1. Sustained Core Themes:

Throughout both eras, fundamental ideas like data mining, electronic health records (EHRs), life insurance, and natural language processing (NLP) have remained crucial. This constancy illustrates data-driven analytics' ongoing value in risk modelling, claims handling, and customized insurance solutions, especially in the fields of health and life insurance.

3.13.2. Transition To Advanced Techniques:

In the recent years (2021–2025), more complex and scalable technologies like machine learning, deep learning, and support vector machines have replaced earlier methodological topics like artificial neural networks, prediction modelling, and process mining. This change denotes a methodological maturity and an increasing reliance on predictive capabilities powered by AI in operational decision-making and actuarial modelling (Pandiri & Chitta, 2024; Laub et al.,2025).

3.13.3. Emerging And Strategic Themes:

New themes such as:

- **Climate change:** Highlight the increasing focus on environmental risk analytics within insurance pricing and portfolio management.
- **Medicare fraud:** Emphasizes the rise of fraud detection systems utilizing AI, particularly in public and private healthcare insurance.
- **Usage-based insurance (UBI):** Indicates a paradigm shift in pricing models driven by real-time behavioural data (e.g., via telematics), leading to hyper-personalized products. These emergent themes are aligned with strategic transformation trends in the global insurance ecosystem, indicating a transition from traditional risk pooling to individualized, behaviour-based underwriting (Guillen et al., 2024).

3.13.4. Declining Or Merged Topics:

Certain keywords like auto insurance and

computer vision were prominent in the early period but did not explicitly appear in the latter phase. This may indicate either a reduced standalone focus or their integration into broader categories such as "insurance claims" or "machine learning" within modern research trends.

3.13.5. Implications From an Actuarial And Insurance Perspective:

The thematic evolution verifies the transformative impact of AI and big data in redefining the principles of actuarial science and insurance methodologies. Actuaries now need to have both traditional statistical modelling skills and AI-based tools to find fraud, predict underwriting, and model customer behaviour. (Pattnaik et al.,2024).

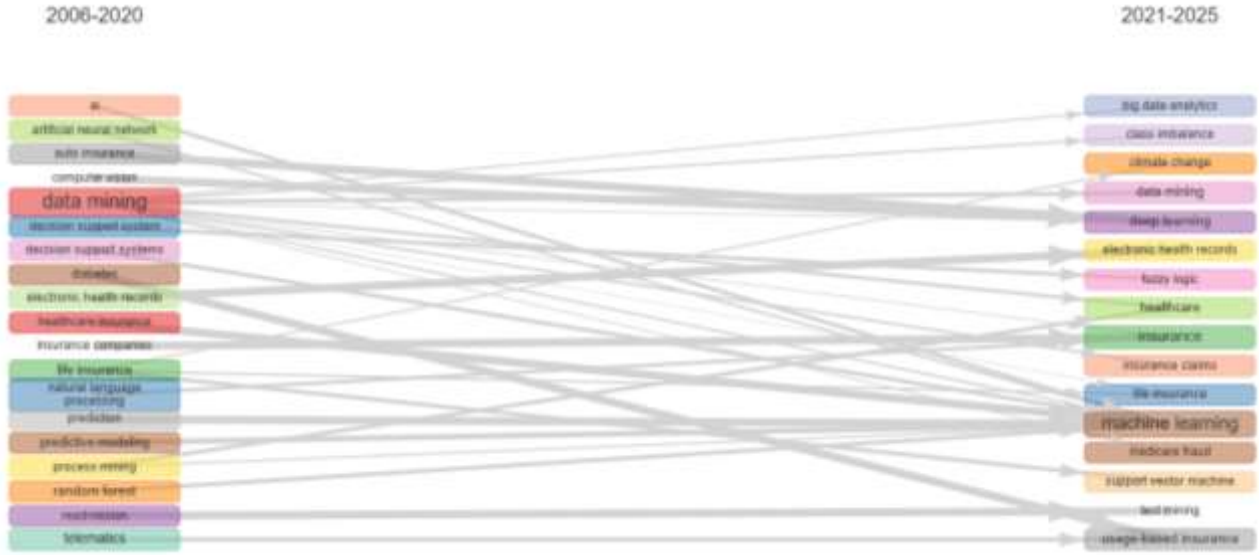

Figure 12: Evolution Of Research Keywords in Insurance and Data Analytics (2006–2025).

4. SUMARY

4.1. Publication Trends

The bibliometric analysis showed that the number of publications about AI applications in the insurance industry grew a lot from 2006 to 2025. From 2006 to 2015, the number of publications was low and stayed about the same. A sharp rise began in 2016, with the biggest growth happening between 2020 and 2024. This shows that scholars are becoming more interested in the digital transformation of the insurance industry.

4.2. Leading Countries and Institutions

The United States was the country with the largest geographic distribution of publications, followed by China and India. These nations showed a high level of collaborative output and research productivity. Florida Atlantic University (USA) and Universitat de Barcelona (Spain) were recognized as leading contributors at the institutional level. The National University of Singapore and the Chinese Academy of Sciences were two other noteworthy establishments.

4.3. Journal Distribution

According to the analysis, most AI applications in insurance were published in interdisciplinary and technical journals. Among the most popular publication venues were IEEE Access, Expert Systems with Applications, and the Journal of Risk and Insurance.

4.4. Keyword Co-Occurrence and Thematic Clusters

Using VOSviewer, keyword co-occurrence analysis revealed five major thematic clusters:

- **Cluster 1:** Focused on core AI techniques including machine learning, deep learning, and neural networks.
- **Cluster 2:** cantered on insurance-related terms such as underwriting, claims, fraud detection, and risk management.
- **Cluster 3:** Addressed data-centric topics including big data, predictive analytics, and telematics.
- **Cluster 4:** Highlighted emerging areas like blockchain, usage-based insurance, and climate risk.
- **Cluster 5:** Included methodological keywords such as feature selection, support vector machines, and optimization.

"Artificial intelligence," "machine learning,"

"insurance," "risk," and "fraud detection" were the most commonly occurring keywords.

4.5. Thematic Evolution

Thematic evolution mapping over two time periods (2006–2020 and 2021–2025) demonstrated a move away from conventional modelling techniques and toward data-driven, real-time applications. While more recent studies have incorporated cutting-edge technologies like blockchain, Medicare fraud detection, and usage-based insurance, earlier research focused on artificial neural networks and data mining (Sun & Wang,2025). The development showed that the range and level of sophistication of AI tools utilized in insurance research had increased.

4.6. Co-Authorship and Collaboration Networks

Analysis of co-authorship revealed rising degrees of scholarly cooperation. Well-known writers like Guillen and Khoshgoftaar had close co-authorship relationships in several different nations. Maps of institutional collaboration revealed close ties between American and European institutions, with new contributions coming from Asia.

5. CONCLUSIONS

This bibliometric study offers a thorough and methodical examination of artificial intelligence (AI) and machine learning (ML) research in the insurance sector from 2006 to 2025. Using a strict PRISMA-based method and a dataset of 796 papers taken from the Scopus database, the study charts the intellectual landscape, thematic evolution, and collaborative networks in this quickly changing field.

The results show that research activity has picked up speed since 2015, with a big jump in publications between 2020 and 2024. This suggests that both academics and businesses are becoming more interested in AI-driven insurance solutions. Core research themes have transitioned from fundamental AI methodologies (e.g., machine learning, deep learning, predictive modelling) to more practical domains such as telematics, usage-based insurance (UBI), fraud detection, and personalized pricing. New ideas are coming up, like blockchain integration and climate risk analytics. These show how the industry is changing and adapting to global problems.

The United States, China, and India are the top countries for research output. Florida Atlantic University and Universitat de Barcelona are two of the most important academic contributors. The fact that technically oriented journals are more popular than insurance-specialized ones shows that there is a gap between AI research and how it is shared in traditional insurance forums.

6. RECOMMENDATIONS

Based on what we learned from thematic trends, institutional contributions, and knowledge gaps, we suggest the following for future research, industry practice, and policy development:

1. **Bridging the Gap Between AI Research and Insurance Practice:** Future research should focus on real-world validation of AI tools in underwriting, claims management, fraud detection, and customer personalization, as practical adoption of these advanced AI techniques in the insurance sector remains limited despite significant technological progress.
2. **Expanding Research into Emerging Themes:** Future research should intensify efforts in emerging areas such as climate risk analytics, Medicare fraud detection, and usage-based insurance (UBI), as these rapidly expanding themes offer significant opportunities for impactful innovation despite their current limited exploration in insurance research.
3. **Fostering Interdisciplinary and International Collaborations:** Future research should strengthen interdisciplinary and international collaborations, especially with emerging regions such as the Middle East, Africa, and Southeast Asia, as global research activity remains uneven and is still dominated by the US, China, and India. Broader collaboration will diversify datasets and enhance the contextual relevance of AI applications in insurance.
4. **Promoting Explainable and Ethical AI in Insurance:** Future research should prioritize explainable and ethical AI frameworks that strengthen regulatory compliance and consumer trust, as the growing reliance on AI-driven decision-making heightens the need for transparency, fairness, and accountability—particularly in sensitive areas such as pricing, claims adjudication, and fraud detection.
5. **Strengthening Actuarial and Data Science Convergence:** Future efforts should strengthen the integration between actuarial science and data science through interdisciplinary training programs that combine actuarial methods, computer science, and ethical AI, as the insurance industry increasingly shifts toward advanced, data-driven risk modelling that

requires blended analytical competencies.

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