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Underwriting Technology Trends: A Systematic Literature Review

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ABSTRACT

This study systematically reviews trends in underwriting technology to enhance the precision and personalization of insurance companies' risk assessment and decision-making processes. Using the Kitchenham method, we conducted a systematic review of scientific publications indexed by Scopus from 2011 to 2021. Our findings reveal the extent of research activity in this field, the leading contributing countries, the methodologies employed, the technologies utilized, and the specific areas investigated. The results indicate significant advancements in the application of machine learning, blockchain, and other technologies in underwriting, providing a comprehensive overview of current trends and future directions. This study offers valuable insights for researchers and practitioners aiming to improve underwriting technology, highlighting potential areas for further research and development. These insights are crucial for advancing the field and enhancing the efficiency and effectiveness of underwriting practices.

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1. Introduction

Underwriting is the process in insurance where the level of risk associated with the insured or anticipated group is evaluated and categorized, and decisions regarding coverage for that risk are made [1]. Historically, insurance companies relied on age and policy history as factors to assess risk, but, technology is now being more commonly utilized for this purpose. The industry has an exceptional opportunity to modify the underwriting process because to the abundance of historical data, sometimes referred to as big data, and the emergence of tools such as machine learning and predictive modeling. In the present day, insurance companies must consider extra factors when they aim to enhance the personalization and accuracy of their risk assessment and underwriting processes[2].

As the volume of client data increases, there are significant opportunities for improvement in the procedures utilized for insurance registration and claim settlement in this sector [3][4]. Artificial intelligence, the prevailing term of the current decade, pertains to the advancement of machines that possess the ability to imitate human intelligence [5][6]. Machine Learning (ML) and predictive analytics are two forms of artificial intelligence (AI) that aid the insurance sector in enhancing its performance. Artificial intelligence has the capability to fulfill nearly all the operational requirements of insurance firms. AI improves risk selection and pricing approaches by expediting underwriting processes [7][8].

In addition, client data has the potential to offer a variety of valuable insights, and the use of speedier underwriting and analytic techniques facilitates the process of customizing policies [9][10]. In order to obtain the latest research positions, further investigation into the use of technology in insurance underwriting processes is necessary. In order to bridge this divide, the author plans to conduct a study to assess the existing level of research in underwriting technology and to pinpoint possible research avenues that can tackle the problem. Specifically, this inquiry pertains to how the direction and function of information technology might enhance underwriting performance or productivity.

Kitchenham [11]introduced a method for doing systematic literature reviews, which has since been widely implemented. Wahono [12]employed a method to implement the Kitchenham approach in his study. The software developed by Wahono is depicted in Figure 1. This study will utilize the Kitchenham technique [11]to conduct literature studies on the topic of underwriting technology. This study aims to analyze the trends in underwriting technology.

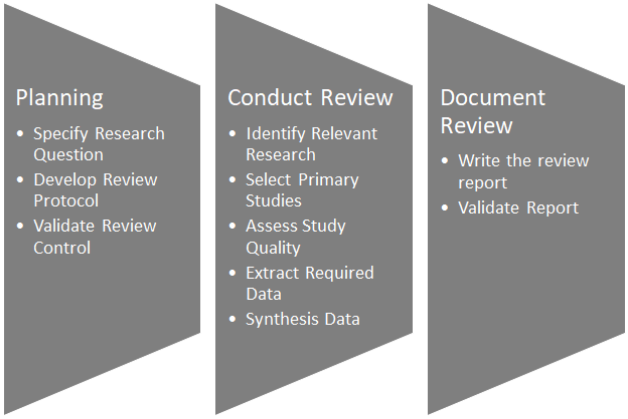

Figure 1. Kitchenham Methodology [12]

Determining the research question (RQ) is very important to maintain the focus of the research. The RQ design was carried out with the help of the PICOC criteria (Population, Intervention, Comparison, Outcomes, and Context)[13]. The (PICOC) structure of the research questions is shown in Table 1**.**

Table 1. Summari of PICOC

Population	Technology in Underwriting
intevention	Machine Learning, Blockchain, and others related to technology
comparation	No comparison intervention in this study
outcomes	List of classifications of technology use in Underwriting
context	Studies in industry and academia, small, and large datasets

The research questions in this research are:
RQ1 : How many research publications on underwriting technology between 2011 and 2021?
RQ2 : Which countries contribute to research related to underwriting technology?
RQ3 : What research methods are used?
RQ4 : What type of technology is used in underwriting?
RQ5 : What research objects are related to underwriting technology?

2. Methode

The A Systematic Literature Review (SLR) is a strategy for finding, evaluating, and analyzing all relevant research data to answer RQ [11]. The three steps of the SLR are shown in Figure 1 which include planning, conduct review, and reporting the literature review.

The databases were indexed by Scopus and searched by title, keyword and abstract. The searching keyword was presented as below:

TITLE-ABS-KEY ((underwriting) OR (insurance AND premium)) AND (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "p")) AND (PUBYEAR > 2010) AND (PUBYEAR < 2022) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "COMP"))

A total of 356 works related to underwriting technology have been found in this literature review, employing abstracts, titles, and keywords, since 2011. By implementing inclusion and exclusion filters, we narrowed down the initial set of documents to 50. After further analyzing these documents using keyword and research question matching, we identified 24 studies that satisfied our criteria.

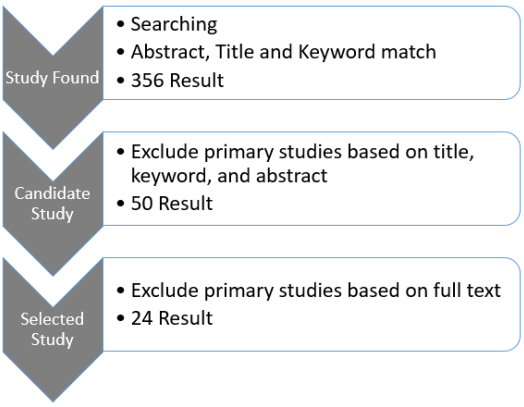

Figure 2. Searching Strategy

Inclusion (IC) and exclusion (EC) criteria are used to identify conformity in answering the RQ. If it does not meet the criteria, then the data will be removed from the review.
IC1. The paper discusses how technology can be used to provide underwriting solutions (architecture, model, tool, etc.) AND
IC2. All of the papers have been written in English AND
IC3. The articles are presented in conferences or peer-reviewed journals AND
IC4. The subject of the paper is about computer science AND
IC5. Publication of papers between 2011 and 2021

The exclusion criteria are derived from the inclusion criteria as their opposite.

EC1. The utilization of technology for underwriting solutions is not mentioned in the article (architecture, model, tool, etc.) OR
EC2. The papers aren't in English OR
EC3. The articles are not presented in conferences or peer-reviewed journals OR
EC4. The subject of the paper is not about computer science OR
EC5. Paper publication not between 2011 and 2021

3. Result

3.1 Document Publication

The distribution through time is provided to answer RQ1 and to demonstrate how people's enthusiasm for this issue has changed over time. There are 24 key studies in this literature review that look at underwriting technology. The distribution through time is shown to demonstrate how interest in underwriting technology has varied over time. Figure 3 shows a summary of the distribution studies that have been undertaken over the years. Figure 3 further demonstrates that underwriting technology research is still very significant.

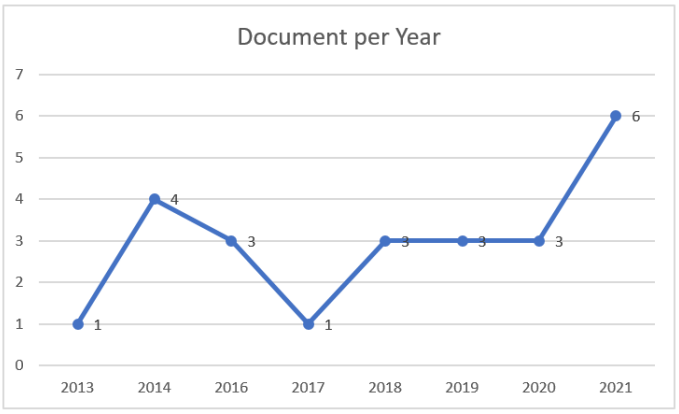

Figure 3. Searching Strategy

The 24 selected papers consisted of 8 journals and 16 conferences. The most relevant of the underwriting technology prediction journals' Scimago Journal Rank (SJR) rating and Q categories (Q1-Q4) are shown in Table 2. The SJR value of journal publications is used to sort them.

Table 2. Scimago Journal Rank (SJR) of Selected Journals

No	Journal Pubications	SJR	Q Category
1	Transportation Research Part C: Emerging Technologies	3.211	Q1 in Computer Science: Computer Science Applications
2	Expert Systems with Applications	2.07	Q1 in Computer Science: Computer Science Application
3	IEEE Systems Journal	1.359	Q1 in Computer Science: Computer Science Applications
4	IEEE Intelligent Transportation Systems Magazine	0.993	Q1 in Computer Science
5	AI Magazine	0.577	Q2 in Computer Science: Artificial Intelligent
6	International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives	0.305	Q4 in Computer Science: Information Systems
7	International Journal of Advanced Computer Science and Applications	0.284	Q3 in Computer Science
8	International Journal of Information Management Data Insights	0.148	Q4 in Computer Science : Information Systems and Management

3.2 Country of Publication

In response to RQ2, we find the distribution of countries contributing to the paper as shown in Figure 4. It was found that the country of India contributed the most to papers on underwriting technology.

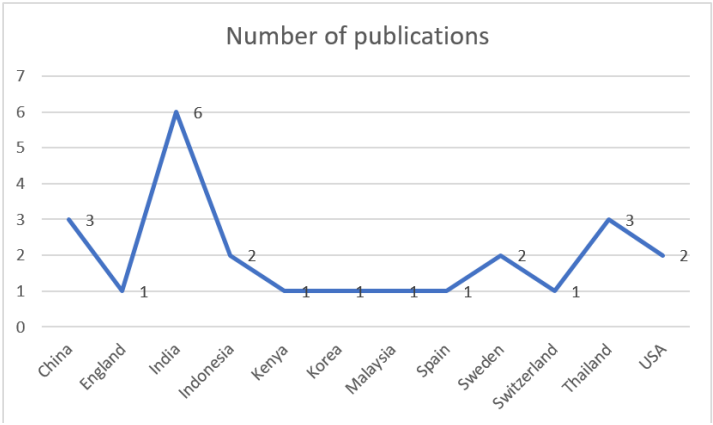

Figure 4. Document Publication Per Country for Selected Study

3.3 Research Methode

In response to RQ3, we found the distribution of the research methods used in the paper as shown in Table 3. It was found that quantitative methods using data mining techniques were the most widely used in this study.

Table 3. List of Research Methode

Methode	Technique	Reference
Quantitative	Survey	[14]
	Data Mining	[15] [16] [17] [18][19] [20][21] [22][23] [24]
Qualitative	Case Study	[25] [26]
	Grounded Theory	[27] [19] [28] [29] [30] [31] [32][33], [34] [35] [36]

3.4 Type of Technology Is Used In Underwriting

As a result of this research for RQ 4, we found technology related to underwriting as shown in Table 4. It was found that Artificial Intelligent technology was the most explored in this study. From the results of the literature review, it was found that Machine Learning technology, as a branch of Artificial Intelligent, is the technology most widely used in research related to underwriting technology. The machine learning methods used are the classification method [15] [17] [37] [28] [20] [21] [22] [24], regression method [16], prediction method [38], and rule base method [27]. In addition to machine learning technology, as a result of the literature review, research on other technologies was also found, such as natural language processing (chatbot) technology [25][19] and recommender systems [19].

Table 4. Type of Technology in Underwriting

Technology	Explanation	Purpose	Object	Reference
Artificial Intelligent	involves the process of analyzing (big) data (using machine learning methods, for example) and generating automated decisions based on the data.	assisting underwriters in risk assessment and determining premium rates based on data and knowledge	Loan, Insurance (Medical, Vehicle, Credit, Flight Delay, Life, Marine Cargo, Health, Travel)	[15][16][25][17][27][18] [38][19][26][20][21][22] [23][24]
Internet of things	Every element in the connected world broadcasts and receives data via sensors.	Can determine premium dynamically based on IoT sensor data	Insurance (Vehicle, Life, Fire)	[29][34][35]
Blockchain	A cryptographic digital data storage system that consists of interconnected records.	A distributed data storage system that securely, transparently, and efficiently stores transaction details.	Vehicle Insurance	[32][33]
Geographic Information System	computer-based risk mapping information system	build the premium rate map	Storm, Flood Insurance	[26]
Mobile devices with apps	Smartphones and tablets, together with their apps, have mostly replaced desktop computers.	Can calculate risk and set insurance premiums in real-time using data collected from smartphone applications.	Vehicle Insurance	[30][31][36]

Global Positioning System	satellite based navigation system	Examining driving risk trends as a basis for assessing risk and setting insurance prices	Vehicle Insurance	[14]

3.5 Research Object In Underwriting Technology

As a result of this research for RQ 5, we found research object as shown in Table 5 It was found that vehicle insurance was the most explored in this study [16][28][29][21][30][31][32][33][14][34][36].

4. Conclusion

Regarding The underwriting process employs a wide range of diverse technologies. The technologies mentioned are Artificial Intelligence, Internet of Things, Blockchain, Geographic Information System, Mobile devices with applications, and Global Positioning System. Motorcycle insurance is the primary focus of technological research. In the future, it is anticipated that further investigation would be required on subjects beyond motorcycle insurance, such as in the realm of marine cargo. Further comprehensive investigation is required on the utilization of Global Positioning System technology in maritime navigation. This data can definitely facilitate the dynamic determination of premiums. Blockchain technology can be utilized for recording purposes. The recommender system function can also serve as a tool to offer suggestions for other insurance packages. These are potential research opportunities that have the potential for further development.

The limitation of this research is the scope of the journal which still only takes the Scopus database. In the future, it is necessary to add a scope such as the Web of Science (WoS) database, IEEE Xplore or Springer. So it is hoped that the literature review will be richer and more complete with insight.

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