

A Bibliometric Analysis of Auto Insurance: Current Status, Development, and Future Research Directions

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Abstract. Auto insurance has been an essential complimentary service to owning a vehicle due to the accident rates' history on a global scale. We aim in this study to analyze the existing literature on auto insurance. We applied bibliometric analysis and cluster analysis to the selected database's data. From the conducted investigations, we concluded that auto insurance researchers focus on detecting fraudulent activity, identifying accident-causing behavior, monitoring clients' driving behavior for premium discounts and society's safety, and innovating models for auto insurance development. It has been illustrated from the reviewed papers that insurers' data collection methods require improvement and the restructuring of suggested models in either assessing drivers or setting premiums. Moreover, the insurers are recommended to improve society's overall driving behavior, update the insurance policy, predict the loss factors, and create more auto insurance programs that benefit all interlinked parties. This study has contributed theoretically to the knowledge community by displaying the trend of auto insurance research and development during the 21st century. It provides scholars with a baseline for future research that could reduce the knowledge gap between researchers and insurers or policymakers.

Keywords: Auto Insurance; Car Insurance; Motor Insurance; Vehicle Insurance; Wheel Insurance; Collision Insurance; Bibliometric analysis.

1. Introduction

Individuals pick protection or Insurance as a shield against the unfavorable impacts and misfortunes brought about by extreme and erratic mishaps and calamities. Insurance advantages in different fields, respectively, are, for example, life coverage, mishap protection, medical coverage, travel protection, and accident protection. Protection is likewise the route for individuals to regain control of their lives, diminish pressure, and move towards genuine feelings of serenity. Safety net providers know this and utilize it during training (Clarke, 2015). Accident insurance is identified with the protection of the vehicle that individuals wish to safeguard. This assurance is given to the client in return for a regularly scheduled installment, known as a premium, to the insurer.

The idea of car insurance was popularized after the first world war. The people recognize that these vehicles are dangerous and relatively fast; therefore, every car is a hefty liability without insurance. As stated by the Massachusetts Government (n.d.), it was also decided that the injured driver would get compensation for his endurance of significant difficulties and vehicle damage. Most countries made it compulsory that drivers should ensure their publicly used vehicles. The most critical factors for coverage in any car insurance are damage coverage and other minimum liability. Additionally, the insurance policies provide various coverage options, such as roadside assistance, minor violation forgiveness, accident forgiveness, custom equipment, OEM endorsement, rental insurance, and gap insurance (Clark, 2001).

Insurance is a legitimate agreement known as a strategy, tying the client to the insurance agency for the arrangement's period duration (Policy Bazar, n.d.). Accident coverage is significant, and there is a kind of inclusion alluded to asking for clinical installments' inclusion. Even though protection costs many clients' disposable income, and if a mishap occurs, the insurer's client compensations and indemnification over the long haul will be highly beneficial if the clients can't forestall cases of accidents in day-to-day existence (Policy Bazar, n.d.).

The main benefits of automobile insurance, also known as car, automobile, motor, or vehicle insurance, are the protection of clients from financial liability, indemnification for the damage from the third-party property, protection against unlimited liability from third-party injury or death claims, and protection from the damage or loss of the car or vehicle (Massachusetts government, n.d.).

Numerous fantasies encompass the issue of accident coverage. Furthermore, the components, for example, the driver's age group, driving record, and the record of loan repayment, influence the collision protection rate. Examination of the protection rates will generally differ contingently upon the insurance agencies in the sense of specialist or representative, the inclusion, and the sort of vehicles the user claims (Clarke, 1977).

Research output related to auto insurance during the past 100 years was analyzed and investigated to provide a basis for a better understanding of the global research current and past situations and future trends, establishing long-term strategies for the auto insurance field. Hence, this study aims to investigate the auto insurance literature to identify, analyze, and visualize certain trends or themes in the study over several aspects. The analyzed factors covered not only the quantitative description of publications, including leading sources, countries, authors, research sponsors, and institutions but also the cluster analysis that describes and analyzes the current trends, content analysis, and hotspots obtained from the synthesized analysis by words in both author and indexed keywords (Wang et al. 2014). Therefore, results will highlight the main findings and flow of the research area to emphasize possible literature gaps for future scholars to address. As such, this paper lays a baseline for future researchers to use in their investigations and benefit policymakers with critical information in bettering the auto insurance industry and their offered services.

The paper is organized as follows. In Section 2, we review the existing literature. In Section 3, we describe our methodology. In Section 4, we present the results and discussions. Lastly, section 5 concludes the paper.

2. Literature Review

As explained, auto insurance is an agreement where the insuring party bears the risk of misfortunes incurred by a vehicle's owner due to an accident by requiring clients to subscribe to various premiums. According to Kagan (2020), different auto insurance premiums are determined by factors such as gender, driving experience, age, accident history, and violation of traffic rules history. Therefore, an improper driving record attracts high premiums. Although it is mandatory in every state or country to have insurance coverage, most demand vehicle owners to have a minimum auto insurance amount (Kagan, 2020).

The genesis of auto insurance is traced back to when automobiles were invented. Bogardus (2004) provides that auto insurance was born in America in 1897 when the Travelers insurance company issued the first third-party automobile policy. In 1898, the traveler's policy provided cover against damages to property and persons caused by the car (Bogardus, 2004). Until 1902, auto theft and fire insurance did not exist, and even insurance against collisions was introduced later (Bogardus, 2004). Nevertheless, Matley et al. (2016) argued that despite the initial automobile insurance guideline being noted over a century back, the fundamental insurance framework had not experienced any significant changes.

However, the future of mobility is likely to change the model and every aspect concerning automobile insurance, including the consumers, the demanded products, and the product marketing strategy (Matley et al., 2016). Similarly, Agather (2018) emphasizes that technological advancement and its use in vehicles are the main reasons behind car insurance changing forever. The change in this insurance policy is due to innovations like car-sharing, ridesharing, and autonomous cars.

For example, recent innovative technology is the Vehicle Ad-hoc Network (VANET), where the unit becomes a mobile node for communication with other vehicles that support several services, including road safety, to mitigate road accident risks (Um, 2022). Additionally, electric cars, with over 10 million units available in the global market in 2020 (Jones, 2021), are observed to reduce the road accident rate and are indeed environmentally friendly. Still, they are also built-in with technologies that protect the driver's safety, such as a crash detection system (Razak et al., 2022). Yet, few built-in technologies are still unreliable for driver and pedestrian safety, such as the self-driving mode in some electric cars (Cho & Chun, 2022).

Another example is full automation, which is expected to be fully integrated into automobiles by 2025 (Wee et al., 2022). And so, autonomous vehicles using an operating system and software may require unique insurance covers to protect against damages resulting from accidents. In addition, Read (2015) provides that manufacturers of autonomous cars, such as Volvo and Mercedes, have begun taking responsibility for any accident that occurs when their vehicles are in autonomous mode. These innovations are forcing insurers to rethink their relationship with car owners, drivers, and automobiles.

A milestone achievement in the auto insurance evolution was the development of telematics. According to Hapon (2018), telematics insurance uses smart tags, smartphone apps, onboard diagnostic devices, and cigarette-lighter plugs. The back boxes are the most common technology in this Insurance, which is equipped with a motion sensor to give information about the impact of a vehicle, a GPS, a SIM card for data transmission, and software that controls how the data is analyzed and transmitted (Hapon, 2018). A telematics box measures the customers' driving aspects, sends the information to the insurer, analyzes it, and adjusts the premiums accordingly.

Telematics has also undergone significant evolution to be improved. In 2012, this technology improved from a black box to mobile-based telematics that helped the driving data collect from mobile phone sensors (Cambridge Mobile Telematics, 2019). Subsequently, telematics was further improved to be an engagement

tool promoting customer behavior change. Although the auto insurance model has experienced some changes, insurance companies still cover almost similar customers or cars in the present day. According to the Heritage Insurance Company (2020), insurance covers are provided to every vehicle category, including third-party property and bodily damage, third-party fire and theft, and comprehensive for any accidental damage to the vehicles.

For the insured to own an insurance contract and keep that ownership, they must pay an insurance premium; otherwise, the coverage contract will be dismissed. This insurance premium charge is applied in automobile insurance as well as in most insurance contracts. However, some insurance firms tend to overprice their premium or discriminate that charge between clients. Furthermore, the payment must be set based on the risk level associated, not the exterior looks and characteristics of a client; this will result in questionable ethical tactics and impede clients' intrinsic rights (Li et al. 2010). Additionally, to control or regulate premium charges, regulators interfere with making the insurance contracts and their premiums affordable for all current and potential clients (Weiss et al. 2010). If insurers charge a high premium fee, they may yield higher returns but might experience clients' sensitivity to their services. In turn, the clients might pass on contract renewals, indirectly affecting the insurers' possible operation yield (Verschuren, 2021). Still, insurers are currently moving towards a "demand-based" pricing approach to account for such sensitivities for return maximization (Verschuren, 2021). However, suppose the insurance firm reduces its premium charge. In that case, more clients will be willing to become policyholders at their firm, as more than 70% of global road accidents are caused by other drivers' careless driving or negligence (Wee et al., 2022). However, such high demand for the insurance product might increase the risk of fraudulent insurance claims.

As indicated previously, if insurance premiums increase, the client churn rate will increase as an indirect effect of trying to improve the return rate. Song & Qiuhong (2018) highlighted that the reasons behind the rise in the insurance client churn rate might be due to "service quality, price issues, auto insurance product issues, and the problem of employee turnover" in addition to premium discounts and total insurance cost discounts. In such a case, the insurers won't be gaining much profit if they lose clients due to their raised premium fee or non-satisfying performed services. Therefore, insurance firms must effectively manage their churn rate by incorporating systems that maximize their profits while reducing their client retention rate. Client retention management consists of the following steps: identify churn clients, detect reasons for churn, and decide on strategies for churn rate reduction (Soeini & Rodpysh, 2012).

On the other hand, if the premiums charge decreases, clients will be more tempted to become policyholders, and thus, the chances of receiving fraudulent claims will probably increase. Fraudulent claims have become increasingly common in the automobile insurance sector. Motor insurance fraud is when the insured deceives the insurer to collect the reimbursement amount for financial gain. Posey (2021) highlighted that automobile insurance fraudulent claims accounted for approximately 14% of the total premiums. Fraud detection in insurance claims significantly depends on inspection and audit, and a great tool used to combat fraudulent claims is "data mining" (Kowshalya & Nandhini, 2018). The previous fraud discussion is based on the insured's actions. However, the insurer can also engage in fraudulent activity by, for example, "premium diversion, fee churning, asset diversion, and workers compensation fraud" (Ghorbani & Farzai, 2018). The increase in fraudulent claims is associated with high accident rates in the auto insurance sector, consequently endangering fellow civilians that account for 1.17 million global deaths (Wee et al., 2022). In addition, fraud increases the premium fee to fulfill the high coverage expenditures. To reduce fraudulent claims in the motor insurance sector, Insurance companies offer coverage contracts that include deductibles, which act as a funding resource for a more efficient coverage system (Dionne & Gagné, 2001). Another benefit of deductibles is that they ensure the policyholders' interests are aligned with the insurer's, as they share in the coverage cost (Investopedia, 2021).

All in all, this paper’s purpose is to analyze the contributed articles on auto insurance to the literature. Therefore, further analysis of the subject is explored in the following sections to identify what topics or aspects of auto insurance are yet to be investigated.

3. Methodology

A bibliometric study focused on the visualization of similarity techniques followed by a systematic literature review has been applied to provide an accurate analysis of the new advances and determine the trend and direction of auto insurance literature (Nobanee, 2020; Afriliana & Ramadhan, 2022). We went for one of the significant bibliographic databases, Scopus, a versatile database including millions of records with several concerning the topic of interest. The keywords and filtration entered for the Scopus search on auto insurance, shown in table 1, include synonyms or familiar words used to refer to auto insurance, where a (*) has been placed next to terms that could be limited to its current presentation in the search query but could have an extension. For example, the words “auto” or “automobile” could be searched for using only “auto*” in the search query. It is worth noting that the keywords used to search for documents were limited to either of the searched synonyms included in the documents’ titles. Filters were applied to the search query to limit the results to only a few types of papers published in English. The search keywords and filters entered on the Scopus database search showed 650 documents available for analysis. The collected data on the retrieved 650 papers from Scopus was downloaded in two comma-separated value (CSV) files for the analysis software’s compatibility purpose. One file includes the documents’ publication year, country, authors, affiliation, source, type, funding sponsor, & subject type. The second consists of the documents’ citation count, abstract, authors and index keywords, page numbers, publication year, volume, issue, DOI, source, & title.

Table 1. Scopus search query for auto insurance documents.

Search keywords	Search filters (limit-to)
(TITLE (“Auto*Insurance”) OR (“Car Insurance”) OR (“Motor* Insurance”) OR (“Vehicle Insurance”) OR (“Wheel* Insurance”) OR (“Collision Insurance”))	English, conference paper (cp), article (ar), letter (le), short survey (sh), review (re), or note (no)

Software tools are vital in bibliometric mapping. VOS viewer is a versatile and open license tool; therefore, it was utilized in our study to generate bibliometric maps. This method is much easier to identify trends in research than the top-down traditional expert approach. We applied two bibliographic analyses via VOS viewer after uploading the documents’ dataset (650 papers) into the software: bibliographic coupling to investigate the documents, authors, countries, sources, and affiliations associated with this topic and co-occurrences to identify the top-ranked keywords linked to auto insurance (Shukla et al. 2020). The software assisted in visualizing the bibliographic coupling and co-occurrence results into maps consisting of several color-coded clusters to differentiate each group (Leu & Ashoka, 2019). The co-occurrence analysis allowed us to conclude seven main streams shown in table 11: Insurance, business research, fraud detection, accident insurance, risk assessment, insurance claims, and insurance companies.

In addition to bibliometric analysis, a traditional cluster analysis of critical studies on auto insurance was conducted under each stream (Nobanee et al., 2021). The cluster analysis involved a careful review of keyword clusters to ensure that the clustered studies were from a qualitative perspective, genuinely exploring the topics that could be accumulated within a particular study stream. Reports were read and reviewed qualitatively, consistent with the systematic literature review process. In addition, the research assessed all the article titles and abstracts to exclude irrelevant articles. These steps allowed the researchers

to understand past contributions on a topic of interest. Following the data collection, the results & discussion are presented in the following section.

4. Results and Discussions

As mentioned, we employed cluster analysis and bibliometric analysis to investigate the contributed studies to the literature on automobile insurance thus far. This section is divided into two based on the two analyzing strategies. The bibliometric analysis will analyze the data retrieved from the Scopus database based on authors, keyword occurrences, publishing country, affiliation, source, and other subfactors such as publishing year, studies' types, source types, etc. Furthermore, the cluster analysis is constructed based on the predetermined keyword streams. It will investigate 2-3 significant studies published between 2015-2021 per stream to identify the remaining gaps for further examination.

4.1. Bibliographic Analysis

4.1.1. Sources

The results reported in table 2 showed that the “Astin Bulletin” is the source that provided the highest number of documents on auto insurance and has scored the second highest citation rate. Additionally, it is shown that the journal of risk and insurance is the highest-ranked journal for being cited the most on auto insurance-related articles and is the second highest in total publications' rate. The main reason that Astin Bulletin produces the highest number of documents is that it's a reliable source that publishes different papers relevant to any branch of insurance mathematics and actuarial science (Astin Bulletin, 2020). Auto insurance falls under the actuarial science branch that helps financial and Insurance fields' financial risks using statistical and mathematical techniques (Astin Bulletin, 2020). The journal of risk and insurance was ranked highest per the number of citations because it is a premier outlet for empirical and theoretical research on insurance and risk management topics (Journal of Risk and Insurance, 2020). Figure 1 illustrates a VOS-generated map that shows the interconnections between the inputted sources regarding auto insurance. Figure 2 highlights the top 10 ranked sources based on the highest published number of documents on the said topic (Zou et al., 2020).

Table 2. Top 20 ranked sources with the highest citation score.

Rank	Source	Documents	Citations
1	Journal of Risk and Insurance	23	485
2	Astin Bulletin	31	345
3	Accident Analysis and Prevention	11	296
4	Insurance: Mathematics and Economics	14	234
5	Expert Systems with Applications	6	196
6	Journal of Law and Economics	3	131
7	Scandinavian Actuarial Journal	7	129
8	Review of Economics and Statistics	3	126
9	Journal of Risk and Uncertainty	3	125
10	Transportation Research Part A: Policy and Practice	5	80
11	Transportation Research Record	4	72
12	Decision Support Systems	2	62
13	Geneva Papers on Risk and Insurance: Issues and Practice	15	57
14	European Journal of Operational Research	4	54
15	Transportation Research Part C: Emerging Technologies	3	47
16	Geneva Papers on Risk and Insurance Theory	3	42
17	Insurance Mathematics and Economics	7	42
18	Marketing Science	2	38

19	Transportation Quarterly	2	34
20	Applied Stochastic Models in Business and Industry	2	33

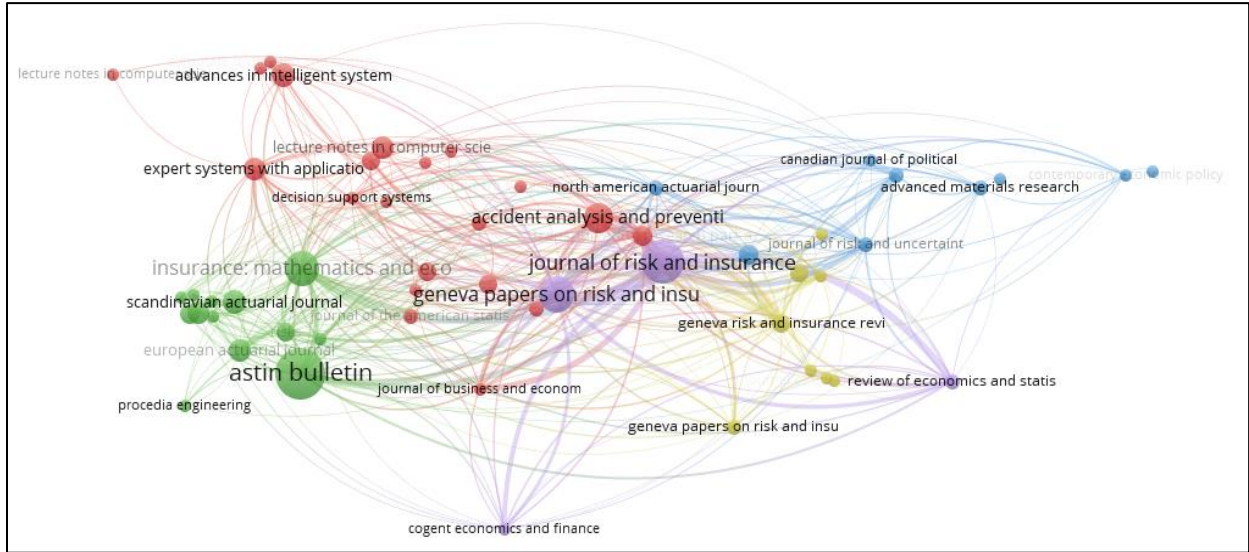


Fig. 1: VOS viewer-generated map of leading sources

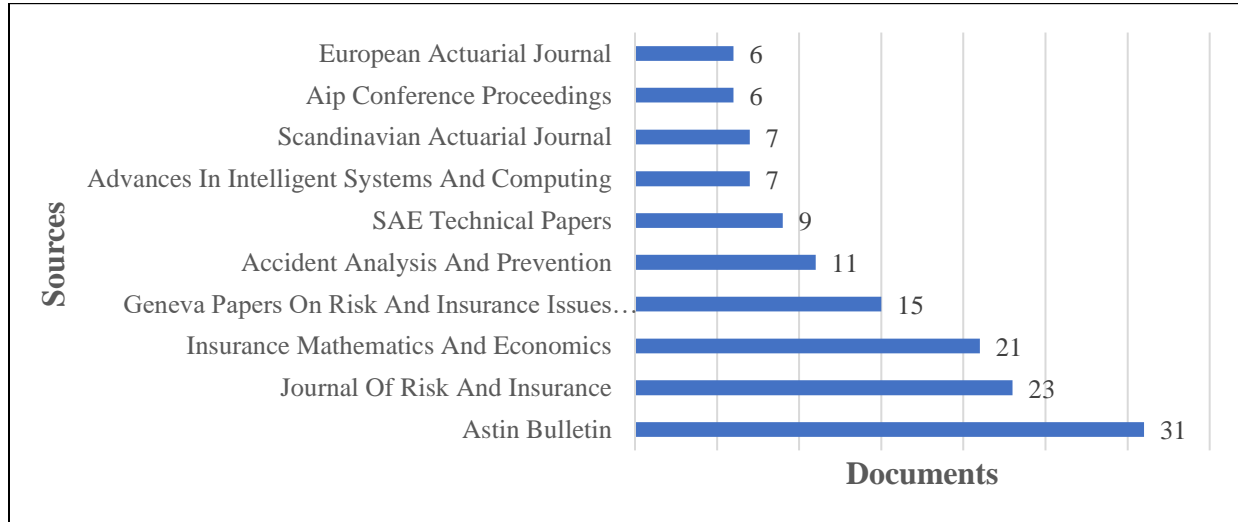


Fig. 2: Highest-ranked 10 sources.

4.1.2. Affiliation

As shown in table 3, the results indicate that “Universitat de Barcelona” is affiliated with the highest number of published documents on car insurance. They are followed by “Feng Chia University” and “Wharton School of the University of Pennsylvania”. Universitat de Barcelona’s primary reason for its leading affiliation is its extensive research and publication about auto insurance. For example, Montserrat Guillén, a University of Barcelona’s professor of Quantitative Methods for Economics and Business, was awarded for the best work presented at the international congress of insurance experts in 2018 that was titled “The transition towards semi-autonomous vehicle insurance” (Reial Academia Europea de Doctors,

2019). Figure 3 highlights the top 10 ranked affiliations based on the most published documents on said topic.

Table 3. Top 20 ranked affiliations with the highest number of published documents.

Rank	Affiliation	Documents
1	Universitat de Barcelona	25
2	Feng Chia University	12
3	Wharton School of the University of Pennsylvania	10
4	Shandong University of Science and Technology	9
5	Universiti Kebangsaan Malaysia	9
6	University of Pennsylvania	9
7	KU Leuven	8
8	VSS University of Technology	8
9	Universidad de Las Palmas de Gran Canaria	7
10	Renmin University of China	7
11	Athens University of Economics and Business	7
12	Shenyang Aerospace University	6
13	University of Melbourne	6
14	Université libre de Bruxelles ULB	5
15	Ministry of Education China	5
16	Universiteit van Amsterdam	5
17	University of Montreal	5
18	University of Limerick	5
19	City University of London, Cass Business School	5
20	GE Global Research	5

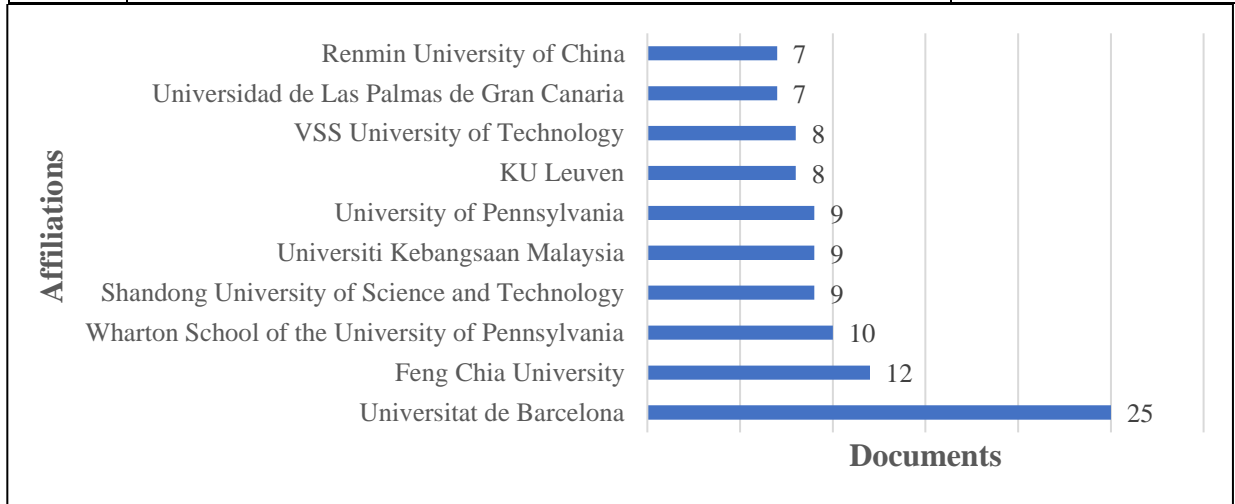


Fig. 3: Highest-ranked 10 affiliations on publication rate.

4.1.3. Documents

The results, presented in table 4, indicate that Desyllas & Sako (2013) is the highest-cited auto insurance document with 154 citations, followed by Bonissone et al. (2006), while Viaene et al. (2005) is the least cited document from our top 20 selection. Desyllas & Sako's (2013) document is highly cited because it focuses on the auto insurance industry. The author uses the Pay-As-You-Drive (PAYD) automobile insurance case, an innovative technique of setting insurance fees based on how and when the vehicle is

being driven (Desyllas & Sako, 2013). Figure 4 illustrates a VOS-generated map that shows the interconnections between the inputted auto insurance-related documents by authors instead of the document title.

Table 4. Top 20 ranked Documents with the highest citation score.

Rank	Document	Citations
1	Desyllas & Sako (2013)	154
2	Bonissone et al. (2006)	116
3	Viaene et al. (2002)	107
4	Cohen (2005)	92
5	Bolderdijk et al. (2011)	89
6	Smyth & Jørgensen (2002)	89
7	Jørgensen & de Souza (1994)	85
8	Cohen & Dehejia (2004)	76
9	Artís et al. (2002)	75
10	Cummins & Tennyson (1996)	69
11	Dionne & Vanasse (1992)	66
12	Guelman (2012)	65
13	Antón et al. (2007)	62
14	Šubelj et al. (2011)	59
15	Wang & Xu (2018)	58
16	Sorock et al. (1996)	55
17	Tennyson & Salsas-Forn (2002)	54
18	Troncoso et al. (2011)	53
19	Artís et al. (1999)	53
20	Viaene et al. (2005)	50

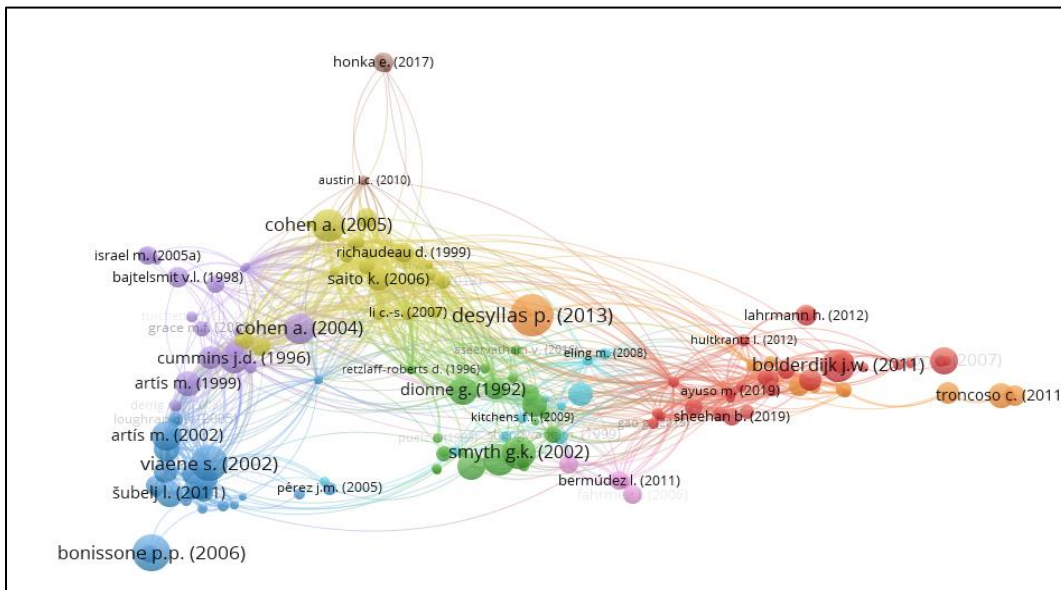


Fig. 4: VOS viewer generated network map of the most cited documents.

4.1.4 Key Words

The results in table 5 indicate that “Insurance” is the keyword with the highest occurrences of 236, followed by “automobile insurance” with an occurrence rate of 128. The keyword “insurance” has the highest occurrences because of its use in various documents and websites on different insurance types (Nowspeed, 2018). There are several insurance types, including health insurance, life insurance, assets insurance, animal insurance, business insurance, and other coverages sharing a similar term. Figure 5 highlights the top 10 ranked keywords based on the highest reoccurring keyword concerning the said topic; figure 6 illustrates a VOS-generated map that shows the interconnections between the inputted auto insurance-related keywords and their occurrence number.

Table 5. Top 20 ranked keywords with the highest number of occurrences.

Rank	Keyword	Occurrences
1	Insurance	236
2	Automobile Insurance	128
3	Automobiles	69
4	Car Insurance	57
5	Insurance Companies	55
6	Article	41
7	Human	39
8	Motor Insurance	39
9	Accidents	37
10	Vehicles	35
11	Crime	34
12	Decision Trees	31
13	Health Insurance	30
14	Risk Assessment	30
15	Costs	26
16	Data Mining	25
17	Traffic Accident	25
18	Economics	24
19	United States	24
20	Auto Insurance	23

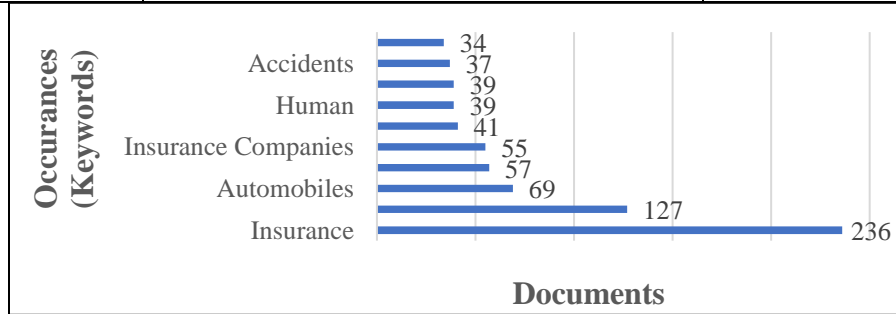


Fig. 5: Highest-ranked 10 occurrences on publication rate.

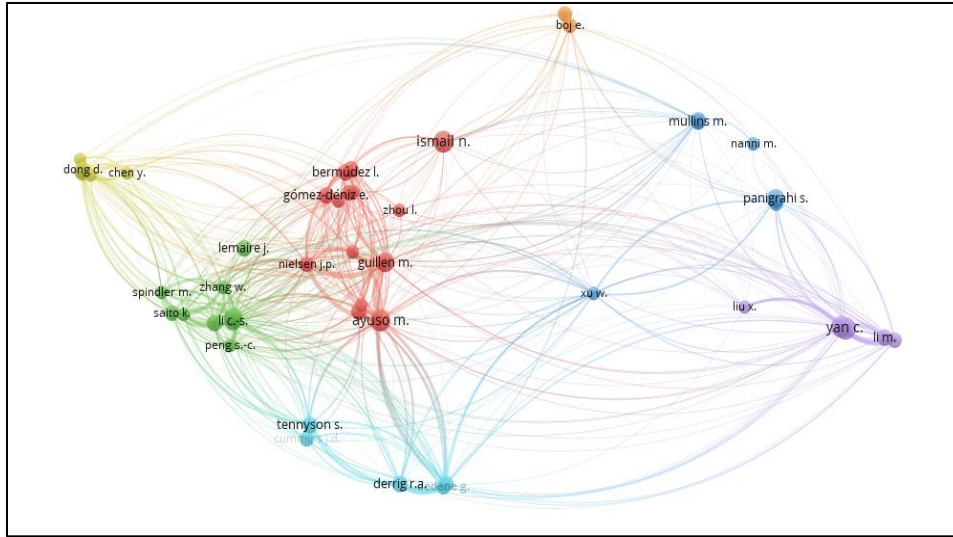


Fig. 7: VOS viewer-generated map of leading authors

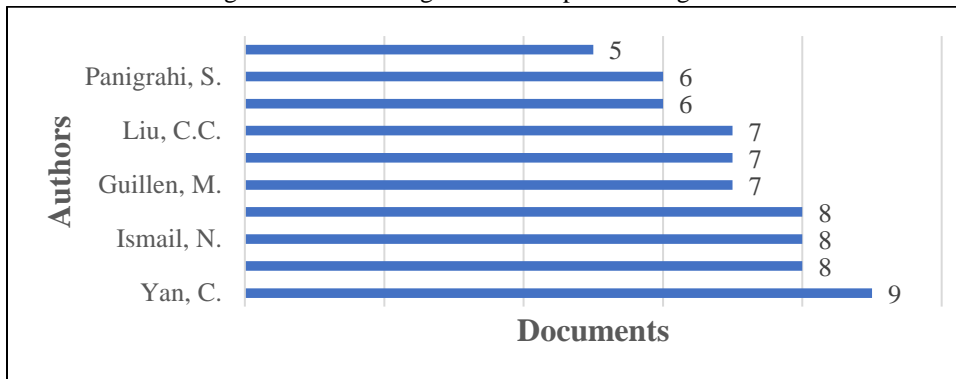


Fig. 8: Highest 10 ranked authors on publication rate.

4.1.6. Countries

The country with the highest publications number and citations associated with auto insurance is the United States. At the same time, Iran has the least number of publications, and Ireland has the least number of citations, as shown in Table 7. The United States has the most published documents on auto insurance because it is among the first countries that produced cars over a century ago; they developed the first auto insurance policy (History, 2018). Moreover, the United States is a developed country with advanced technologies incorporated in vehicles, thus, leading to extensive research on how auto insurance will accommodate the changes (Akiko, 2019). For instance, autonomous cars are positively linked to accident frequency than human-driven automobiles, although their mishaps are often less severe (Akiko, 2019). Figure 9 illustrates a VOS-generated map that shows the interconnections between the inputted countries concerning auto insurance. Figure 10 highlights the top 10 ranked countries based on the most published documents on said topic.

Table 7. Top 20 ranked countries with the highest citation score.

Rank	Country	Documents	Citations
1	United States	137	1523
2	Canada	40	588
3	Spain	42	552
4	United Kingdom	49	483
5	Belgium	15	373
6	China	60	281
7	Netherlands	9	226
8	Germany	26	179
9	Australia	23	156
10	Denmark	7	155
11	Greece	11	155
12	Italy	16	111
13	Brazil	10	105
14	South Korea	17	76
15	Sweden	13	75
16	Japan	9	74
17	Taiwan	19	71
18	France	6	69
19	India	29	56
20	Ireland	7	46

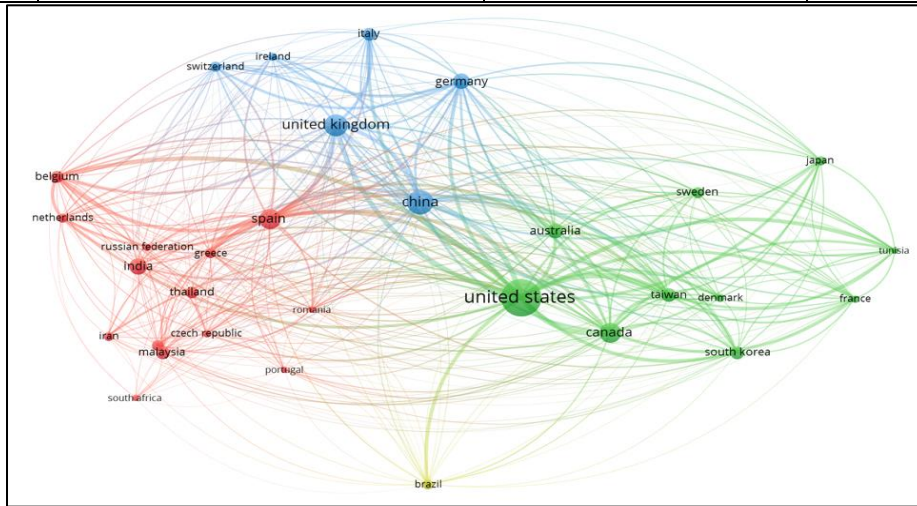


Fig. 9: VOS viewer generated network map of leading countries

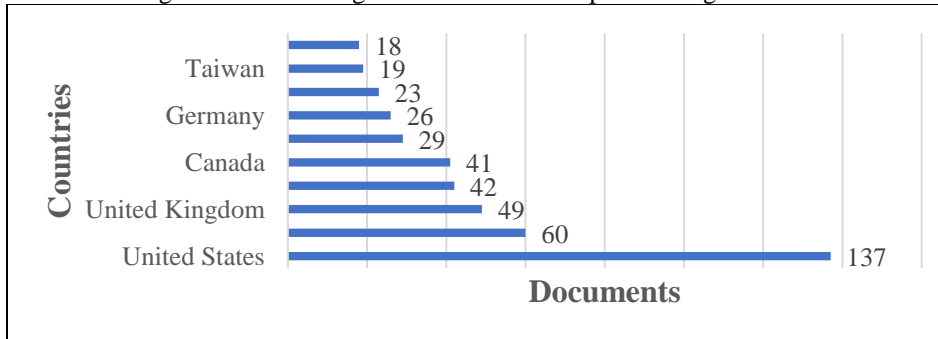


Fig. 10: Highest-ranked 10 countries on publication rate.

4.1.7. Sponsors, publication years, subject areas, and document types

Figure 11 shows that the highest document type was articles at 436 papers. Additionally, figure 12 indicates that the subject area with more significant concern for auto insurance is Economics, Econometrics, and Finance for producing 202 documents. The results in figure 13 further exhibit that China's national natural science foundation is the sponsor of the highest number of papers on auto insurance, signifying great concern regarding this topic associated with the insurers' auto insurance clients, society, or economy. Finally, figure 14 illustrates the number of document publications peaking in 2019 and reaches 76 documents published across multiple sources, but the initial publication was released in 1921.

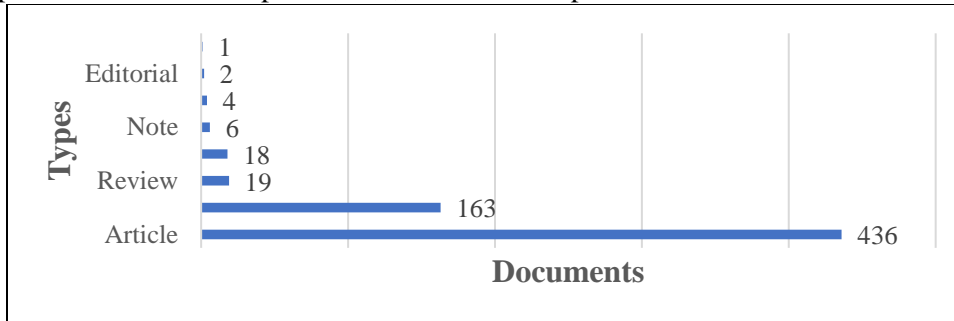


Fig. 11: Illustration of published document rate per type.

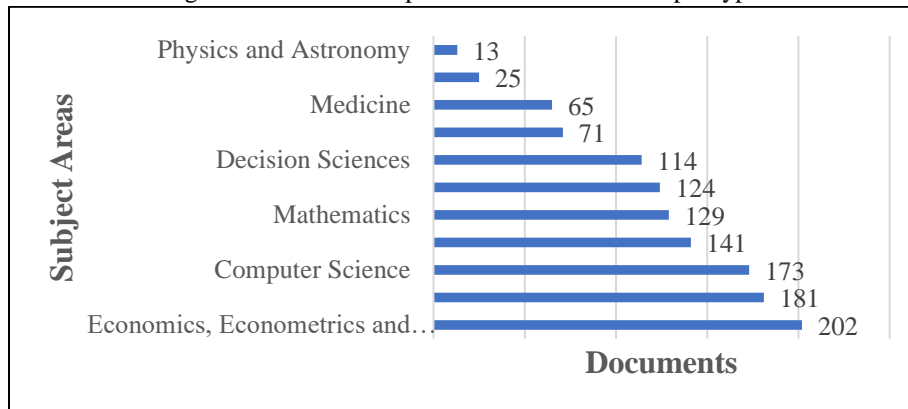


Fig. 12: Presentation of published document rate per subject areas

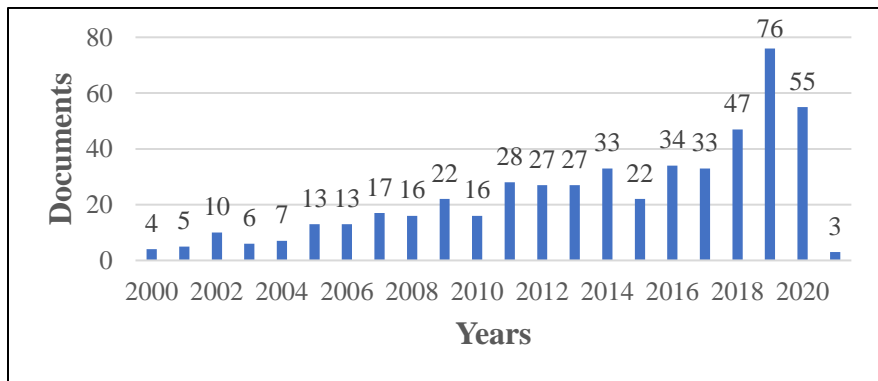


Fig. 13: Illustration of the number of documents published per year.

4.2. Cluster Analysis: Summary of critical papers

Based on the co-citation mapping generated from VOS viewer, we identified seven significant streams interlinked to auto insurance: Insurance, business research, fraud detection, accident insurance, risk assessment, insurance claims, & insurance companies. Additionally, there are sub-occurrences for a few of the streams, and they're listed in table 8 under the streams' titles. All of the reoccurring keywords mentioned are connected. Insurance companies are insurance providers; they apply business research methods to monitor and assess their clients' driving behavior to set premiums individually. Moreover, the providers consider the risk rate associated with clients' behaviors and accident rates and apply fraud detection systems to project possible fraudulent insurance claims. This section focuses on conducting a traditional content analysis of crucial articles regarding auto insurance and the occurrences.

Table 8. Cluster analysis of crucial auto insurance papers

Stream	Author	Purpose	Findings	Future research agendas
Insurance (car, auto, motor, automobile)	Sarker et al. (2020)	Illustrate a time-based pattern of brake waves gathered from an automobile.	The suggested brake-based location tracking system insurers use anticipates an accurate route projection for the gathered steering information with acknowledgment of traffic movement's false details, but the clients' whereabouts privacy is unsecure.	<ul style="list-style-type: none"> - How to counteract the BBLT model's setbacks? - How can the gathering process & tools of insurance users' data collection & accuracy be improved?
	Spiteri & Azzopardi (2018)	Identify risk elements linked to churn, determine consumers' churning, and perfect the time till churn.	Clients with a great chance of churn, best forecasted accurately by the random forest tool, demand recurrently, thus proving unprofitable to insurance firms.	How to incorporate broader consumer aspects in the produced profiles for an assessment?
Business Research (Data mining, Decision trees, Regression analysis, Behavioral research)	Cheng et al. (2018)	Explore the discrepancy of pricing issues of vehicle insurance premiums.	<ul style="list-style-type: none"> - All the study's independent variables greatly influence accident numbers and insurance claims. - The vehicle insurance premium was inconsistent with the examined driving performance. 	<p>What is the ideal sample data of driving performance & claim amount collected from insurers?</p> <ul style="list-style-type: none"> - How can the vehicle insurance rate-making model be further investigated?
	Soleymanian et al. (2019)	Utilize driving performance and further data on Usage-Based Insurance (UBI) acquirers to assess the UBI driver's relation to auto insurance policies and to driving performance modifications post-enrollment in the UBI plan.	UBI plan is socially productive, benefiting the clients by gaining permanent premium discounts, the insurers by increasing profit yield, and the community by decreasing accidents and improving driving performance, thereby increasing the renewal ratio against non-UBI contributors.	<ul style="list-style-type: none"> - How to determine if driving behavior changes are temporary or permanent? - How to determine if a client will enroll in the UBI program and if it will be for the short or long term?
Fraud Detection	Liu et al. (2020)	Establish an exclusive evidential reasoning (ER) directive incorporating autonomous proof of practice-based factors and fraud likelihoods.	The evidential reasoning management tool decreases the benefactor's time & efforts in the assessment phase and advances the decision-making attribute in addition to permitting researchers in determining client behavior.	<ul style="list-style-type: none"> - How the addition of rule-based belief procedure to evidential reasoning will improve fraud detection efforts? - How can the evidential reasoning's determine the connection between automobile insurance fraudulent

				activities' independent & dependent factors?
	Kalwihura & Logeswaran. (2020)	Propose fraud behavior, featuring an engineering approach, that pre-processes information to enhance fraud projection paradigms.	<ul style="list-style-type: none"> - The homogeneity-oriented behavior analysis method has efficiently enhanced the fraud projection model's functioning. - The policy cessation contribution performance analysis influenced the creation of substantial factors explaining fraudulent claims. 	What behavioral analyses, of concern to homogeneity-oriented behavior analysis method, be further investigated and utilized in the insurance sector?
Accidents Insurance (Traffic accidents, Accidents, Car, Vehicle, & Driving behavior)	Ayuso et al. (2019)	Demonstrate how GPS devices can help estimate and predict accidents from driver behavior.	Driver behaviors impact the expected number of accidents and insurance claim as opposed to their age and gender.	How to understand different drivers' age behaviors?
	Pütz et al. (2019)	Analyze the effects of inventive car mechanization and its interrelation with the risks fulfilled by third-party motor and complete insurance guidelines.	<ul style="list-style-type: none"> - Vehicles with advanced driving assistance procedures of stage 1 mechanization increases roadway safety. - Connected Automated Vehicles must be monitored due to doubt and uncertainty of their ability, and they will influence the ingrained risk feature of the car insurance business. 	How to improve and make Connected Automated Vehicles?
Risk Assessment (Artificial intelligence, Machine Learning, Leering system)	Guidotti & Nanni. (2020)	Explore the issues of building a data-driven model to estimate accidents risk level by using Individual Mobility Networks and analyzing driver behavior	<ul style="list-style-type: none"> - Individual Mobility Network-based and mutual qualities are essential in predicting accidents. - An increased Jaccard of developments between varied Individual Mobility Network and the frequency of using speed and breaks increases the chance of a crash. 	<ul style="list-style-type: none"> - How to explain locations by understanding driving behavior to improve Individual Mobility Networks? - How to improve predictions demonstration and explore driving behaviors to avoid risk?
	Qianqian et al. (2020)	Present the purpose of the intelligent damage assessment system and how to implement each functional module	The system achieved quick mishap revelation, cost assessment, & instant indemnification, which helps insurers accomplish fast & precise fee valuation.	How to develop and use an intelligent damage determination system?

Insurance Claims	Boj et al. (2019)	Identify features influencing claim occurrence while controlling legislative and demographic factors	<ul style="list-style-type: none"> - Fraud strongly effects claim frequency rates when self-damage is insured. - Liability, theft, and legal defense react in contradictory ways to enhance the general economy. 	How to identify factors affecting small insurance companies?
	Singh et al. (2019)	Propose an automated end-to-end system to improve the insurance claim process	<ul style="list-style-type: none"> - The system visualizes and predict the cost of repair after the damaged images are uploaded. - The system operates with different models like Mask R-CNN, PANet, and VGG16 network. 	<ul style="list-style-type: none"> - How to develop system performance by examining other previous failure cases? - How to upgrade the system to include all car models in the market?
Insurance Companies	Gatzert & Osterrieder. (2020)	Identify and assess how new mobility is affecting car insurers.	Demand is growing for insurers to modify current underwriting frameworks strategies to adapt to the new mobility risk.	How will automobile insurers be affected when human-automated and self-driven motor vehicles are considered niche target markets?
	Shaikh et al. (2020)	Utilize telematics frameworks in determining the price of insurance.	<ul style="list-style-type: none"> - Monitoring driver's performance through sensors and processing collected data is helpful when pricing insurance, but the data is difficult to store for privacy concerns. - The framework can also assist in minimizing fraudulent claims and accident investigations. 	<ul style="list-style-type: none"> - How to integrate LoRa Modules in the current insurance system? - How to activate emergency alerts using the framework to inform drivers of unsafe situations?

As suggested from the above cluster/content analysis table, most of the published documents on auto insurance state that insurance companies who offer auto insurance are extensively monitoring the market and changes in the automobile industry that would, in turn, affect them. Specifically, the insurers monitor clients' driving behavior to determine the risk rate associated with insuring their vehicle and monitor current sector trends to update their insurance policies. Recently, auto insurance companies introduced the UBI system that benefits them, the consumers, and society. Additionally, by monitoring the clients, they can assess the premium fee to charge the insured on an individual basis and accident predictors through modern technologies and models based on their evaluated driving behavior. Lastly, insurers direct efforts towards identifying the clients' insurance claims and fraud detection projection to preserve their market status and service returns.

Nevertheless, it is clear from the above table that further research in this field is still demanded due to the lack of some suggested models and technologies' ability to capture the whole picture a study should capture. The leading suggestions are the improvement of data collection on fraud, client claims, and driving behavior. Additional recommendations are improving model setbacks, possible restructuring, insurance policy latency, premium setting model improvements, and creating new insurance programs that are socially productive and benefit the stakeholders. Further, the last suggestion set is improving client claim, fraud, accident, or company loss factor predictors.

5. Conclusion

People pick Insurance as a shield against the troublesome effects and hardships of extraordinary and inconsistent incidents and cataclysms. Security is more over the course for people to recuperate control of their lives, decrease loss's weight, and move towards certified sentiments of serenity. Assurance is like the course for people to recover possession of their lives, reduce weight, and move towards authentic feelings of peacefulness. Security net suppliers know this and use this in, for example, assessing premiums to charge clients. Most nations made auto insurance mandatory for vehicles utilized on open streets (Clark, 2001). The most fundamental variables for inclusion in any vehicle protection are harm inclusion and other least obligation. Mishap inclusion is vast, and there is, in like manner, a sort of consideration insinuated ask clinical portions incorporation.

Accident coverage is otherwise called vehicle, auto, motor, or wheel protection. Its fundamental advantages are the customers being shielded from monetary risk, indemnified for the harm of third-party's property, covered against limitless obligation from the outsider injury or demise asserts, and protected from the damage or loss of the vehicle. An efficient writing audit guided by a bibliometric study focusing on the representation of uniform procedures was upheld to give a detailed investigation of the new advances in bibliographic examination (Campbell, n.d.). The analysis evaluated key article titles and abstracts to bar immaterial articles and observed a heavy concentration on monitoring clients' driving behavior, fraud detections, and increasing premiums for insurers' profits. The study utilized bibliometric coupling, co-occurrence analysis, and cluster analysis on the filtered significant articles.

Further exploration in this insurance type is demanded because of the absence of some proposed models and innovations. Additionally, an investigation is required in the auto insurance area to catch the complete picture an examination should record, such as accident detection technologies, data collection model, premiums setter model, fraud detection models, etc. The primary motivation behind why the watchword "protection or insurance" has the most elevated events is its utilization in different reports and sites on various insurances. By observing the customers, insurers can impose the superior expense to charge the safeguarded individual premise and mishap indicators through present-day advances and models dependent

on their assessed driving conduct. Moreover, these research studies and models allow insurers to predict clients' possible false claims or fraudulent behaviors.

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References

- Afriliana N. & Ramadhan A. (2022). The Trends and Roles of Robotic Process Automation Technology in Digital Transformation: A Literature Review, *Journal of System and Management Sciences*, 12(3), 51-73. DOI:10.33168/JSMS.2022.0303
- Agather M. (2018). *Four Reasons Car Insurance Has Changed Forever*. Retrieved from Agency Nation: <https://www.agencynation.com/4-reasons-car-insurance-changed/>
- Akiko (2019). *15 Unbelievable Self-Driving Car Statistics & Facts*. Retrieved from Future Insights: <https://www.futureinsights.com/15-unbelievable-self-driving-car-statistics-facts-2019/#:~:text=Vehicles%20with%20an%20autopilot%20currently,autonomous%20cars%20having%209.1.>
- Antón C., Camarero C., & Carrero M. (2007). Analyzing Firms' Failures as Determinants of Consumer Switching Intentions: The Effect of Moderating Factors. *European Journal of Marketing*, 41, 135-158. DOI: 10.1108/03090560710718157
- Artís M., Ayuso M., & Guillén M. (2002). Detection of Automobile Insurance Fraud with Discrete Choice Models and Misclassified Claims. *Journal of Risk and Insurance*, 69(3), 325-340. DOI: 10.1111/1539-6975.00022
- Artís M., Ayuso M., & Guillén M. (1999). Modelling Different Types of Automobile Insurance Fraud Behaviour in the Spanish Market. *Insurance: Mathematics and Economics*, 24, 67-81. DOI: 10.1016/S0167-6687(98)00038-9
- Astin Bulletin. (2020). *Astin Bulletin: The Journal of the IAA*. Retrieved from: <https://www.cambridge.org/core/journals/astin-bulletin-journal-of-the-iaa>
- Ayuso M., Guillen M., & Nielsen J.P. (2019). Improving Automobile Insurance Ratemaking Using Telematics: Incorporating Mileage and Driver Behavior Data. *Transportation*, 46(3), 735-752. DOI: 10.1007/s11116-018-9890-7
- Bogardus J.A. (2004). *A Gasoline Can on Wheels'—Spreading the Risks: Insuring the American Experience*. Retrieved from IRIM: <https://www.irmi.com/articles/expert-commentary/spreading-the-risks-insuring-the-american-experience>
- Boj E., Castañer A., Claramunt M.M., Costa T., & Roch O. (2019). Economic Indicators for Automobile Claim Frequencies. *Estudios de Economía*, 46(2), 245-271. DOI: 10.4067/s0718-52862019000200245
- Bolderdijk J.W., Knockaert J., Steg E.M., & Verhoef E.T. (2011). Effects of Pay-As-You-Drive Vehicle Insurance on Young Drivers' Speed Choice: Results of a Dutch Field Experiment. *Accident Analysis and Prevention*, 43(3), 1181-1186. DOI: 10.1016/j.aap.2010.12.032

- Bonissone P.P., Subbu R., Eklund N., & Kiehl T.R. (2006). Evolutionary Algorithms + Domain Knowledge = Real-World Evolutionary Computation. *IEEE Transactions on Evolutionary Computation*, 10(3), 256-280. DOI: 10.1109/TEVC.2005.857695
- Cambridge Mobile Telematics. (2019). *The Tech Evolution that Transformed Auto Insurance*. Retrieved from Cambridge Mobile Telematics: <https://www.cmtelematics.com/blog/connected-insurance-to-ubi/>
- Campbell H. (n.d.), *Motor Vehicle Insurance*. Retrieved from Britannica: <https://www.britannica.com/topic/motor-vehicle-insurance>. Accessed on April 25th, 2021.
- Cheng R., Wang C., Lv G., Liu Z., & Wang T. (2018). Research on Safe Driving Scoring System and Personalized Ratemaking of Vehicle Insurance Based on OBD Data. *ACM International Conference Proceeding Series*. DOI: 10.1145/3265689.3265696
- Cho M.K. & Chun Y.H. (2022). High-Precision Position Protocol for Vehicles to Pedestrian using 5G Networks. *Journal of System and Management Sciences*, 12(1), 241-253. DOI: 10.33168/JSMS.2022.0117
- Clark M. (2001). *Suggestions Help Consumers Save on Auto Insurance*. Retrieved from The Florida Times Union: <https://www.questia.com/newspaper/1G1-75180667/suggestions-help-consumers-save-on-auto-insurance>
- Clarke, M.A. 1997. *Policies and Perceptions of Insurance: An Introduction to Insurance Law*. New York, United States: OUP Oxford.
- Cohen A. (2005). Asymmetric information and learning: Evidence from the automobile insurance market. *Review of Economics and Statistics*, 87(2), 197-207. DOI: 10.1162/0034653053970294
- Cohen A. & Dehejia R. (2004). The Effect of Automobile Insurance and Accident Liability Laws on Traffic Fatalities. *Journal of Law and Economics*, 47(2), 357-393. DOI: 10.1086/422978
- Cummins J.D. & Tennyson S. (1996). Moral Hazard in Insurance Claiming: Evidence from Automobile Insurance. *Journal of Risk and Uncertainty*, 12(1), 29-50. DOI: 10.1007/BF00353329
- Desyllas P. & Sako M. (2013). Profiting from Business Model Innovation: Evidence from Pay-As-You-Drive Auto Insurance. *Research Policy*, 42(1), 101-116. DOI: 10.1016/j.respol.2012.05.008
- Dionne G. & Gagné R. (2001). Deductible contracts against fraudulent claims: evidence from automobile insurance. *Review of Economics and Statistics*, 83(2), 290-301. DOI: 10.1162/00346530151143824
- Dionne G. & Vanasse C. (1992). Automobile Insurance Ratemaking in the Presence of Asymmetrical Information. *Journal of Applied Econometrics*, 7(2), 149-165. DOI:10.1002/jae.3950070204
- Gatzert N. & Osterrieder K. (2020). The Future of Mobility and Its Impact on The Automobile Insurance Industry. *Risk Management and Insurance Review*, 23(1), 31-51. DOI:10.1111/rmir.12140
- Ghorbani A. & Farzai S. (2018). Fraud detection in automobile insurance using a data mining-based approach. *International Journal of Mechatronics, Electrical and Computer Technology (IJMEC)*, 8(27), 3764-3771.
- Guelman L. (2012). Gradient Boosting Trees for Auto Insurance Loss Cost Modeling and Prediction. *Expert Systems with Applications*, 39(3), 3659-3667. DOI: 10.1016/j.eswa.2011.09.058

Guidotti R. & Nanni M. (2020). Crash Prediction and Risk Assessment with Individual Mobility Networks. *21st IEEE International Conference on Mobile Data Management (MDM)*, 89-98. DOI:10.1109/MDM48529.2020.00030

Hapon M. (2018). *How Insurance Companies Leverage telematics to adjust insurance premiums*. Retrieved from Netguru: <https://www.netguru.com/blog/telematics-insurance>

Heritage Insurance. (2020). *Motor Insurance*. Retrieved from Heritage Insurance: <https://www.heritageinsurance.co.ke/content/motor-insurance>

History. (2010). *Automobile History*. Retrieved from history: <https://www.history.com/topics/inventions/automobiles>

Investopedia. (2021). *Why Do Insurance Policies Have Deductibles?* Retrieved from Investopedia website: <https://www.investopedia.com/ask/answers/071515/why-do-insurance-policies-have-deductibles.asp>

Jones J. (2021). *Electric vehicle outlook 2021 – on a strong growth curve*. Retrieved from Smart Energy International: <https://www.smart-energy.com/industry-sectors/electric-vehicles/electric-vehicle-outlook-2021-on-a-strong-growth-curve/>

Jørgensen B. & de Souza M.C. (1994). Fitting Tweedie's Compound Poisson Model to Insurance Claims Data. *Scandinavian Actuarial Journal*, 1994(1), 69-93. DOI: 10.1080/03461238.1994.10413930

Journal of Risk and Insurance. (2020). *About the Journal*. Retrieved from: <https://onlinelibrary.wiley.com/journal/15396975>

Kagan J. (2020). *Introduction to Auto insurance*. Retrieved from Investopedia: <https://www.investopedia.com/terms/a/auto-insurance.asp>

Kalwihura J.S. & Logeswaran R. (2020). Auto-Insurance Fraud Detection: a Behavioral Feature Engineering Approach. *Journal of Critical Reviews*, 7(3), 125-129. DOI: 10.31838/jcr.07.03.23

Kowshalya G. & Nandhini M. (2018), Predicting fraudulent claims in automobile insurance. *The 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018)*, 1338-1343. DOI: 10.1109/ICICCT.2018.8473034

Leu X. & Ashoka K. (2019). Supply chain management in prefabricated construction: An overview of a developed conceptual framework. *Journal of System and Management Sciences*, 9(2), 43-80.

Li C., Lin C., Liu C., & Venezian E. (2010). Pricing Effectiveness and Regulation: An Examination of Premium Rating in Taiwan Automobile Insurance. *The Geneva Papers*, 35, S68-S81. DOI: 10.1057/gpp.2010.28

Liu X., Yang J. B., Xu D. L., Derrick K., Stubbs C., & Stockdale M. (2020). Automobile Insurance Fraud Detection using the Evidential Reasoning Approach and Data-Driven Inferential Modelling. *2020 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 1-7. DOI: 10.1109/FUZZ48607.2020.9177589

Massachusetts government. (n.d.), *Basics of Auto Insurance*. Retrieved from Mass, Gov: <https://www.mass.gov/info-details/basics-of-auto-insurance>

Matley J., Gandhi M., Yoo E., Jarmuz B., & Peterson S. (2016). *Insuring the Future of Mobility: The Insurance Industry's Role in the Evolving Transportation Ecosystem*. Retrieved from Deloitte Insights:

<https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/mobility-ecosystem-future-of-auto-insurance.html>

Nobanee H., Dilshad M.N., Abu Lamdi O., Ballool B., Al Dhaheri S., AlMheiri N., Alyammahi A. and Alhemeiri S.S. (2022). Insurance for climate change and environmental risk: a bibliometric review. *International Journal of Climate Change Strategies and Management*. <https://doi.org/10.1108/IJCCSM-08-2021-0097>

Nobanee H. (2020). Big Data in Business: A Bibliometric Analysis of Relevant Literature. *Big Data*, 8(6), 459-463. <http://doi.org/10.1089/big.2020.29042.edi>

Nobanee H., Al Hamadi F.Y., Abdulaziz F.A., Abukarsh L.S., Alqahtani A.F., AlSubaey S.K., Alqahtani S.M. and Almansoori H.A. (2021). A bibliometric analysis of sustainability and risk management. *Sustainability*, 13(6), 3277. <https://doi.org/10.3390/su13063277>

Newspeed. (2018), *Top Keywords Used to Drive Traffic & Leads for Insurance Companies*. Retrieved from Newspeed: <https://newspeed.com/top-adwords-keywords-insurance-companies/>

Policy Bazar. (n.d.), *Car Insurance*. Retrieved from Policy Bazaar: <https://www.policybazaar.ae/car-insurance/#:~:text=As%20per%20UAE%20laws%2C%20it,parties%20along%20with%20own%20damages.>

Posey M. (2021), *6 Types of car insurance fraud*. Retrieved from Bankrate website: <https://www.bankrate.com/insurance/car/fraud/>

Pütz F., Murphy F., & Mullins M. (2019). Driving to a Future Without Accidents? Connected Automated Vehicles' Impact on Accident Frequency and Motor Insurance Risk. *Environment Systems and Decisions*, 39(4), 383-395. DOI: 10.1007/s10669-019-09739-x

Qianqian Z., Weiming G., Ying S., & Zihao Z. (2020). Research on Intelligent Vehicle Damage Assessment System Based on Computer Vision. *Journal of Physics: Conference Series*, 1518(1), 1-6. DOI: 10.1088/1742-6596/1518/1/012050

Razak S., Suhaimi F., Yogarayan S., & Abdullah M. (2022). 2-Phase Crash Detection and Notification System. *Journal of Logistics, Informatics and Service Science*, 9(3), 258-270. DOI: 10.33168/LISS.2022.0318

Read R. (2015), *Who's at Fault When a Self-Driving Car Crashes? 'Us,' Says Mercedes and Volvo*. Retrieved from The Christian Science Monitor: <https://www.csmonitor.com/Business/In-Gear/2015/1013/Who-s-at-fault-when-a-self-driving-car-crashes-Us-say-Mercedes-and-Volvo>

Reial Academia Europea de Doctors. (2019), *Research Award*. Retrieved from Reial Academia Europea de Doctors: <https://raed.academy/en/montserrat-guillen-receives-icrea-academy-award/#:~:text=Montserrat%20Guill%C3%A9n%20professor%20of%20Quantitative,Catalan%20Research%20and%20Advanced%20Studies>

Sarker A., Qiu C., Shen H., Uehara H., & Zheng K. (2020). Brake Data-Based Location Tracking in Usage-Based Automotive Insurance Programs. *2020 19th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN)*, 229-240. DOI: 10.1109/IPSN48710.2020.00-32.

Shaikh M. K., Palaniappan S., Khodadadi T., Khurram M., Khan M. H., & Juzer H. (2020). Insurematic: Generalized Framework for Insurance Company to Automate Insurance Process. *International Conference on Information Science and Communication Technology (ICISCT)*. DOI:10.1109/icisct49550.2020.9080038

- Shukla N., Merigó J.M., Lammers T. and Miranda L. (2020). Half a century of computer methods and programs in biomedicine: A bibliometric analysis from 1970 to 2017. *Computer methods and programs in biomedicine*, 183, DOI: 10.1016/j.cmpb.2019.105075
- Singh R., Ayyar M. P., Sri Pavan T., Gosain S., & Shah R. R. (2019). Automating Car Insurance Claims Using Deep Learning Techniques. *IEEE Fifth International Conference on Multimedia Big Data (BigMM)*, 199-207. DOI: 10.1109/bigmm.2019.00-25
- Smyth G.K. & Jørgensen B. (2002). Fitting Tweedie's Compound Poisson Model to Insurance Claims Data: Dispersion Modelling. *Astin Bulletin*, 32(1), 143-157. DOI: 10.2143/AST.32.1.1020
- Soeini R.A. & Rodpysh K.V. (2012). Applying data mining to insurance customer churn management. *International Proceedings of Computer Science and Information Technology*, 30, 82-92. DOI: 10.1.1.1045.4033
- Soleymanian M., Weinberg C. B., & Zhu T. (2019). Sensor Data and Behavioral Tracking: Does Usage-Based Auto Insurance Benefit Drivers? *Marketing Science*, 1-23. DOI: 10.1287/mksc.2018.1126
- Song H. & Qihong H. (2018). Application of Data Mining Technology in the Loss of Customers in Automobile Insurance Enterprises. *International Journal of Data Science and Analysis*, 4(1), 1-5. DOI: 10.11648/j.ijdsa.20180401.11
- Sorock G.S., Ranney T.A., & Lehto M.R. (1996). Motor Vehicle Crashes in Roadway Construction Work zones: An Analysis Using Narrative Text from Insurance Claims. *Accident Analysis and Prevention*, 28(1), 131-138. DOI: 10.1016/0001-4575(95)00055-0
- Spiteri M. & Azzopardi G. (2018). Customer Churn Prediction for a Motor Insurance Company. *13th International Conference on Digital Information Management (ICDIM)*, 173-178. DOI: 10.1109/ICDIM.2018.8847066
- Šubelj L., Furlan S., & Bajec M. (2011). An Expert System for Detecting Automobile Insurance Fraud Using Social Network Analysis. *Expert Systems with Applications*, 38(1), 1039-1052. DOI: 10.1016/j.eswa.2010.07.143
- Tennyson S. & Salsas-Forn P. (2002). Claims Auditing in Automobile Insurance: Fraud Detection and Deterrence Objectives. *Journal of Risk and Insurance*, 69(3), 289-308. DOI: 10.1111/1539-6975.00024
- Troncoso C., Danezis G., Kosta E., Balasch J., & Preneel B. (2011). PriPAYD: Privacy-Friendly Pay-As-You-Drive Insurance. *IEEE Transactions on Dependable and Secure Computing*, 8(5), 742- 755. DOI: 10.1109/TDSC.2010.71
- Um J.Y. (2020). Performance Evaluation according to RSU Range in Vehicle-to-Vehicle Communications. *Journal of System and Management Sciences*, 10(3), 35-44. DOI: 10.33168/JSMS.2020.0303
- Verschuren R.M. (2021). Customer Price Sensitivities in Competitive Automobile Insurance Markets. *arXivLabs*, 1-30. Retrieved from: <https://arxiv.org/pdf/2101.08551.pdf>
- Viaene S., Dedene G., & Derrig R.A. (2005). Auto Claim Fraud Detection Using Bayesian Learning Neural Networks. *Expert Systems with Applications*, 29(3), 653-666. DOI: 10.1016/j.eswa.2005.04.030

Viaene S., Derrig R.A. Baesens B., & Dedene G. (2002). A Comparison of State-of-the-Art Classification Techniques for Expert Automobile Insurance Claim Fraud Detection. *Journal of Risk and Insurance*, 69(3), 373- 421. DOI: 10.1111/1539-6975.00023

Wang Y. & Xu W. (2018). Leveraging Deep Learning with LDA-Based Text Analytics to Detect Automobile Insurance Fraud. *Decision Support Systems*, 105, 87-95. DOI: 10.1016/j.dss.2017.11.001

Wang Q., Yang Z., Yang Y., Long C. & Li H. (2014). A bibliometric analysis of research on the risk of engineering nanomaterials during 1999–2012. *Science of the Total Environment*, 473, 483-489. <https://doi.org/10.1016/j.scitotenv.2013.12.066>

Wee J., Tee C., & Goh M. (2022). Forward Collision Warning for Autonomous Driving. *Journal of Logistics, Informatics and Service Science*, 9(3), 208-225 DOI: 10.33168/LISS.2022.0315

Weiss M.A., Tennyson S., & Regan L. (2010). The Effects of Regulated Premium Subsidies on Insurance Costs: An Empirical Analysis of Automobile Insurance. *The Journal of Risk and Insurance*, 77(3), 597-624. DOI: 10.1111/j.1539-6975.2010.01360.x

Zou X., Vu H. L., & Huang H. (2020). Fifty Years of Accident Analysis & Prevention: A Bibliometric and Scientometric Overview. *Accident Analysis & Prevention*, 144. DOI:10.1016/j.aap.2020.105568