International Research Progress on Traffic Accident Based on Bibliometric Analysis Method

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Abstract: It is important to research on the characteristics, distribution rules, and mechanisms of traffic accidents, which are carried out to explore the deep-seated causes of accidents. Based on bibliometric analysis method, this paper conducts a quantitative analysis of 8125 papers in the field of traffic accident research from the past five years. It is concluded that the most important document source in the current traffic accident field is Accident analysis and prevention, the most important research countries are the United States and China, and the most important research institutions are Tsinghua University and Tongji University. The main research hotspots are traffic accident severity analysis, statistical analysis of traffic accidents, short-term prediction of traffic accidents, prediction of traffic accident severity, and analysis of the impact of dynamic factors such as weather on accidents. It has certain reference significance for domestic scholars to intuitively understand the topics that have not been fully researched in our country and the gap between existing research and foreign frontier fields through comparison.

1 INTRODUCTION

According to "The Global Status Report on Road Safety 2018" issued by the World Health Organization (World Health Organization, 2018), road traffic crashes now represent the eighth leading cause of death globally and road traffic injury is now the leading cause of death for children and young adults aged 5–29 years. Deaths from road traffic crashes have increased to 1.35 million a year. That's nearly 3 700 people dying on the world's roads every day. Tens of millions of people are injured or disabled by traffic accidents every year. The property losses, medical expenses and emergency expenses caused by traffic accidents are huge, and they also bring huge trauma to the family and society.

The occurrence of traffic accidents is the result of a combination of factors such as people, vehicles, roads, environment, and management. Through research on the characteristics, distribution rules, and mechanisms of traffic accidents, the deep-seated causes of accidents are explored in order to provide technical support for the prevention of traffic accidents. In recent years, domestic and foreign scholars have carried out a series of studies on traffic accidents and achieved a series of results. Domestic and foreign scholars analyse the impact of human factors on traffic accidents from the perspective of dangerous driving behaviours such as distracted driving, aggressive driving, fatigue driving, and drunk driving (Zhang, 2020; Klauer, 2014; Abegaz, 2014; Almahasneh, 2014), analyse the impact of vehicle factors on traffic accidents from the perspective of vehicle safety technical performance such as active and safety of vehicles, protection of vulnerable road users and vehicle occupants, body collision compatibility (Kahane, 2015; Li, 2016; Badea-Romero, 2013), analyse the impact of road factors on traffic accidents from the perspective of road alignment, road safety facilities and lighting facilities (Wong, 2007; Ma, 2010; Yang, 2017).

At present, there are more and more researches on road traffic accidents, but most of them focus on certain aspects of road traffic accidents such as dangerous driving behaviour, vehicle compatibility design, road alignment optimization, etc. Existing research results lack analysis from macro perspectives such as road traffic accident research trends, cutting-edge technologies, and research hotspots. Based on the document co-occurrence network analysis and visualization tool VOS viewer

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software, this paper conducts a quantitative analysis of 8125 papers in the field of traffic accident research from 2016 to 2020. Through the source of the document, the main research country, the main research institution, the author of the paper, quantitative analysis of key words and cited papers in the paper, the most important sources of literature in the current traffic accident field, the most important research countries, research institutions and scholars, as well as the research trends, research frontiers and research hotspots in the field of traffic accidents are summarized.

2 BIBLIOMETRIC ANALYSIS METHOD

Bibliometrics refers to the cross-science of using mathematical and statistical methods to quantitatively analyse all knowledge carriers. It is a comprehensive knowledge system integrating mathematics, statistics, and philology, focusing on quantification. The measurement objects are mainly: the amount of documents (various publications, especially journal articles and citations), the number of authors (individuals, collectives or groups), the number of words (various document identifications, most of which are thesaurus), document measurement. The most essential feature of learning is that its output must be "quantity".

2.1 Data Sources

The data source of this study is the core database in Web of Science (WOS). In the database, through entering "traffic accident" in the keyword part and "2016-2020" in the age part, a total of 8125 related documents are retrieved. The retrieval information is stored in 17 files in a group of 500 pieces, and the file format is ".txt" file.

2.2 Analysis Tools and Methods

VOS viewer (VOS viewer Manual, 2020) is a software tool used to create maps based on network data and to visualize and browse these maps. The functions of VOS viewer can be summarized as follows.

Create a map based on network data. You can create a map based on an already available network, or you can build the network first. VOS viewer can be used to build a network of scientific publications, scientific journals, researchers, research organizations, countries, keywords or terms. Items in these networks can be connected by co-authors, simultaneous occurrences, citations, bibliographic coupling or citation links.

Visualize and explore the map. VOS viewer provides three kinds of map visualization: network visualization, coverage visualization and density visualization. The zoom and scroll functions allow you to browse the map in detail, which is essential for handling large maps containing thousands of items. The "Create Map" wizard in VOS viewer can be used to create a new map. There are multiple ways to create a new map.

3 ANALYSIS AND VISUALIZATION OF CO-OCCURRENCE NETWORK OF TRAFFIC ACCIDENT LITERATURE

3.1 Literature Sources

According to the number of documents from each source not less than ten papers, the top ten document sources selected are shown in the following table.

According to the search results listed in Table 1, the top ten document sources with the highest total link strength have a total of 975 articles, accounting for 12% of the total number of documents retrieved. Among them, Accident analysis and prevention is the journal that publishes the largest number of papers in the field of traffic accidents. There are 333 articles in total, accounting for 4.10% of the total number of retrieved documents. The number of citations and total link strength of articles are much higher than other journals. The second to tenth places are Transportation research part-f-traffic psychology and behaviour, Traffic injury prevention, International journal of environmental research and public health, Analytic methods in accident research, Sustainability, Safety science, Journal of safety research, Plos one, Journal of advanced transportation.

Table 1: Literature sources.

Serial number	Source	Number of articles	Cited times	Total connection strength
1	Accident analysis and prevention	333	2723	683
2	Transportation research part-F: traffic psychology and behavior	139	661	201
3	Traffic injury prevention	144	550	176
4	International journal of environmental research and public health	57	292	141
5	Analytic methods in accident research	18	675	136
6	Sustainability	56	85	120
7	Safety science	66	509	116
8	Journal of safety research	40	246	105
9	Plos one	74	319	103
10	Journal of advanced transportation	48	129	91

3.2 Research Countries

According to the number of published papers in each country not less than five papers, and the number of citations not less than five papers, the information of the top ten countries selected is shown in the figure below.

According to the search results listed in Figure 1, the top ten countries with the highest total link strength have a total of 4376 articles, accounting for 53.86% of the total number of documents retrieved. Among them, China is the country with the largest number of published papers, with a total of 1514 articles, accounting for 18.63% of the total number of retrieved documents, and the United States has a total of 971 papers, accounting for 11.95% of the total number of retrieved documents, but the number of citations and total links of Chinese articles both are lower than the United States, which is about 90% and 80% of the United States respectively. The above data indicates that the quality of Chinese articles needs to be further improved. The third to tenth places are the United Kingdom, Australia, Germany, Sweden, Canada, Italy, Spain, and the Netherlands. These countries are all economically developed countries that have higher requirements for traffic safety and more funding.

3.3 Research Organizations

According to the fact that each organization has published no less than nine papers, and the number of citations no less than four papers, the selected top ten organization information is shown in the following table.

Table 2: Research organizations.

Serial number	Organization	Number of articles	Cited times	Total connection strength
1	tsinghua univ	74	414	76
2	tongji univ	84	546	63
3	shahid beheshti univ med sci	53	108	57
4	univ tehran med sci	37	124	51
5	cent s univ	34	385	47
6	southeast univ	67	256	40
7	wuhan univ technol	74	148	39
8	beijing jiaotong univ	60	156	34
9	univ hong kong	21	221	33
10	changan univ	70	199	31

According to the search results listed in Table 2, the top ten research institutions with the highest total link strength have a total of 574 articles, accounting for 7.06% of the total number of documents retrieved. Among them, Tongji University is the university with the largest number of published papers, with a total of 84 articles, accounting for 1.03% of the total number of retrieved documents, and Tsinghua University has 74 papers, accounting for 0.91% of the total number of retrieved documents, but the total link strength of Tsinghua University's papers is higher than Tongji University. The third to tenth places are Shahid Behshidi Medical University, Tehran Medical University, Central South University, Southeast University, Wuhan University of Technology, Beijing Jiaotong University, Hong Kong University and Chang' an University.

3.4 Research Authors

According to each author's publication of no less than five papers and no less than three citations, the information of the top ten authors is selected, and the co-author network among prolific authors is shown below.

According to the search results listed in Figure 2, the top ten authors with the highest total link strength have a total of 114 articles, accounting for 1.40% of the total number of documents retrieved. Among them, Huang Helai of Central South University is the author with the largest number of papers published in the field of traffic accidents in the past five years. There are 21 articles in total, accounting for 0.26% of the total number of retrieved documents. The number of citations and total connection strength of the article are much higher than other authors.

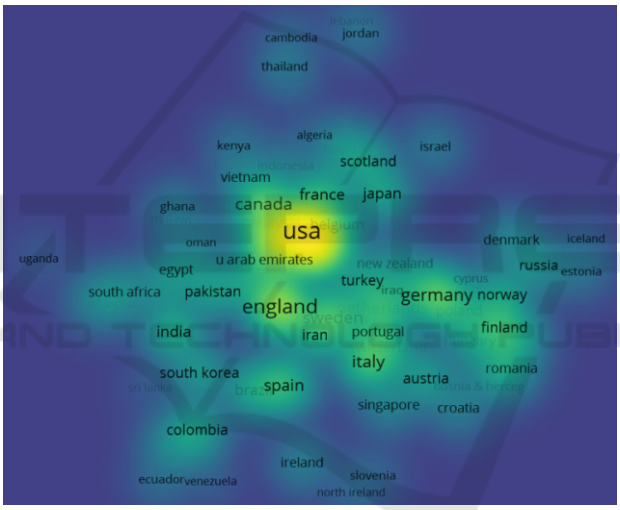

Figure 1: Density maps of major research countries.

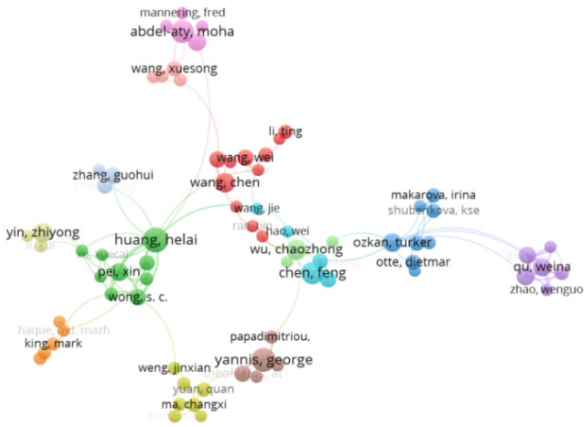

Figure 2: Co-author network among prolific authors.

3.5 Key Words

According to the number of occurrences of each key word not less than twenty times, the top twenty key word information is filtered out, and the visualization view of keyword coverage in the field of traffic accidents is shown in the following table.

The visualized view of the coverage of keywords in the field of traffic accidents is shown in the figure below.

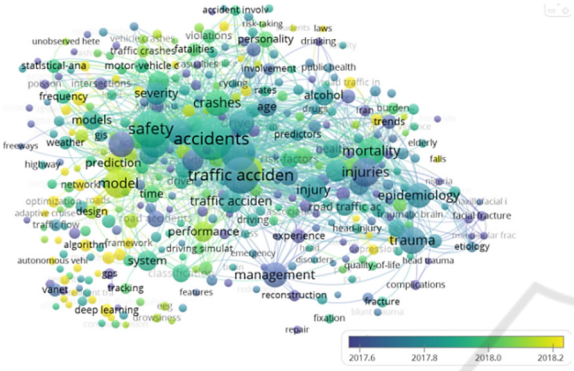

Figure 3: Key word coverage visualization view.

According to the search results listed in Figure 3, the top twenty key words with the highest total connection strength are accidents, risk, safety, traffic accidents, injuries, mortality, crashes, drivers, model, road safety, impact, trauma, injury, epidemiology, behavior, severity, injury severity, traffic safety, age, alcohol. Indicating that the main research direction of traffic accidents is the severity of the accident, the main research objects are drivers' driving behavior, age, blood alcohol content, etc. The main indicators for judging the severity of the accident are injury rate, fatality rate, etc.

3.6 Cited Literature

According to the number of citations of each article not less than ten times, the top fifty literature information is screened out. The density map of the citations in the field of traffic accidents is shown in the following table.

The density map of citations in the field of traffic accidents is shown in the figure below.

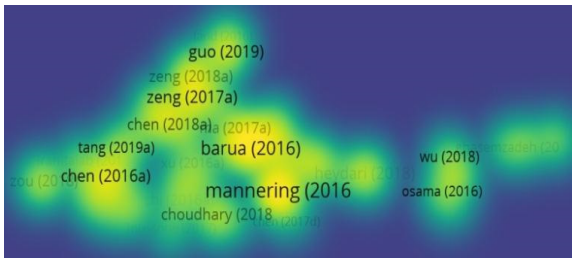

Figure 4: Citation density map.

Among the top fifty cited papers, they mainly focus on the following seven research directions:

- Analysis of the severity of injuries to drivers, occupants, and cyclists in traffic accidents.
- Statistical analysis of traffic accident data.
- Short-term prediction of traffic accidents.
- Prediction of the severity of traffic accident damage.
- Analysis of intersection accidents.
- Analysis of the causes of accidents such as fog and rain.
- Analysis of the impact of dynamic factors and vehicle speed on the accident.

4 CONCLUSION

Based on the document co-occurrence network analysis and visualization tool VOS viewer software, this paper conducts a quantitative analysis of 8125 papers in the field of traffic accident research from 2016 to 2020. Through the source of the document, the main research country, the main research institution, the author of the paper, quantitative analysis of key words and cited papers in the paper, it is concluded that the most important document source in the current traffic accident field is Accident analysis and prevention, the most important research countries are the United States and China, and the most important research institutions are Tsinghua University and Tongji University. The main research hotspots are traffic accident severity analysis, statistical analysis of traffic accidents, short-term prediction of traffic accidents, prediction of traffic accident severity, and analysis of the impact of dynamic factors such as weather on accidents. The research results of this article provide domestic scholars with an intuitive understanding of the topics that have not been fully studied in my country and existing the gap between research and foreign frontier fields has certain reference significance.

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