

Review

A Bibliometric Analysis of Objective and Subjective Risk

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Abstract: In relation to “objective risk” or “subjective risk”, a bibliometric analysis was performed using documents found in the Scopus database. A search for related documents was narrowed down to 192 documents and these were considered in this study. The results of this study suggest that the use of the ranking method and descriptive statistics is not sufficient in presenting a concise bibliometric analysis. To create a more in-depth bibliometric analysis, the results of this study have to be analyzed together with a visualization map using VOSviewer software. This way, researchers can easily locate a specific gap in the literature, understand the relation between the papers on the same subject, and cite the literature studies based on their effectiveness.

Keywords: objective risk; subjective risk; barometric analysis; Scopus; VOSviewer



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1. Introduction

Risk identification, assessment, and management play a critical role in many fields. Risk can be also categorized into several categories such as pure and speculative risk, fundamental and particular risk, priority and liability risk, operational risk, technical environment risk, information security risk, technical and architectural risk, and objective and subjective risk. Objective risk is the relative variation of actual loss from expected loss, while subjective risk is the uncertainty based on a person's mental condition or state of mind (Rejda and McNamara 2021). In the risk and insurance field, Andersen et al. (2014) define subjective risk probabilities as those probabilities that lead an agent to choose some prospects over others when the outcomes hang on upon random events that are not currently realized. Knight (1921) refers to objective risk as unalterable and subjective risk are alterable and malleable. On the other hand, Pfeffer (1956) argues that objective risk is a combination of hazards measured by probability while subjective risks are uncertainty that measured by a degree of belief, he also argued that risk is a state of the world, but uncertainty is a state of the mind, (An 2020; Houston 1964).

Objective and subjective risks are two opposite types of risks however they are connected by multiple variables. According to Suerdem et al. (2013), risks are possible outcomes of hazardous events. Based on the definition, Health and O'Hair (2009, p. 22) said that “objective risks” are risks that exist in reality whereas “subjective risks” are risks that are purely based on the judgment of other people. In general, the level of risk can be assessed or analyzed objectively or subjectively (BPP Learning Media 2014; Suerdem et al. 2013; Rowe 1981).

In practice, the focus of objective risk appraisal is to measure likelihood or probability including the impact of risk on people (BPP Learning Media 2014). For instance, objective

risk measurement can be computed based on “frequency” or “magnitude” (Harris 2006, p. 129). Using subjective risk scales such as “high”, “medium”, and “low”, subjective risk appraisal is more focused on risk assessors’ knowledge and skills on factors that could influence the level of risk (Ettouney and Alampalli 2017, p. 31; BPP Learning Media 2014).

When applied in business or other real-life social events, risk assessor(s) would compute for estimates or make a forecast on the outcome of objective risk but not subjective risk (Suerdem et al. 2013; Rowe 1981). Therefore, a discrepancy may occur between the “actual risk” and the “expected risk” (Rowe 1981, p. 53). According to Ettouney and Alampalli (2017), risk assessment is useful in guiding risk assessors on how to make optimal decisions. Depending on the risk evaluation outcome, the risk assessor could either accept or create strategies that will prevent or avoid the consequences of risk (Rowe 1981).

The bibliometric analysis is a useful method when it comes to quantifying research outputs and when using the Scopus database. Using the bibliometric analysis method, this study aims to identify documents from the Scopus database that are most cited when doing a research study related to “objective risk” or “subjective risk”. Likewise, this study also adopted the use of the bibliometric analysis method in identifying the top 20 main sources of most cited documents, authors of most cited documents, and countries of most cited documents. Before the end of this study, the most used keywords including the clustering of commonly used keywords were analyzed in this study (Nobanee et al. 2021). Research output related to “objective risk” and “subjective risk” over the past 40 years was evaluated to provide a better understanding of the current situation of global research, current streams, and the direction of future research for this field (Wang et al. 2014). The analyzed characteristics covered not only the quantitative description of publications, such as most influential authors, most cited documents, leading countries, and organizations but also the authors’ and index keywords and their clusters to identify the sub-topics and current streams of “objective risk” and “subjective risk” research output. Even though review articles do not provide or suggest new theories, models, or methodologies, they contribute to the existing knowledge and literature significantly by providing a critical up-to-date overview of the developments in the study field (Amin et al. 2019). Given all of the above, this study presents a review of the literature regarding “objective risk” and “subjective risk” from 1980 to 2020. The main objective of this study is to provide broad insights into the literature on “objective risk” and “subjective risk” using a bibliometric analysis approach. Thus, insights in narrative clusters, research developments, trends, and leading authors, documents, organizations, countries, and journals in the research domain are obtained (Fu et al. 2021)

The scope includes gathering documents straight from the Scopus database, narrowing down the search for related documents using the advance search option found in the Scopus database, listing down documents that are directly related to “objective risk” or “subjective risk”, listing down the top 20 most cited documents on “objective risk” or “subjective risk”, top 20 authors of documents on “objective risk” or “subjective risk”, top 20 countries where researchers could locate the most cited documents on “objective risk” or “subjective risk”, and top 20 commonly used keywords in documents that talks about “objective risk” or “subjective risk”. Likewise, the scope of this study also includes a discussion on how the top 20 commonly used keywords were clustered in different groups. In general, the focus of this study is on “objective risk” or “subjective risk” only. Therefore, the bibliometric result of this study does not apply to other types of risk.

Aside from learning how to maximize the use of the Scopus database, this study will provide the readers with the opportunity to use VOSViewer in completing the bibliometric analysis. Overall, the result of this study will list down documents that are related to “objective risk” or “subjective risk”. Therefore, overall, this study could guide other researchers on the right way to locate documents on “objective risk” or “subjective risk”.

As part of helping future researchers on how to use the Scopus database, this report presented original work on how future researchers could benefit from using VOSViewer.

Most existing documents on “objective risk” or “subjective risk” do not explain the benefits and limitations of doing bibliometric analysis. As such, the result of this study may contribute new ideas when searching for related literature on “objective risk” or “subjective risk”.

2. Literature Review

Several bibliometric studies on risk assessments and management have been conducted across the disciplines of medicine, engineering, management, social sciences, and other fields.

[Wang et al. \(2014\)](#) used the Web of Science to provide insights into research outputs of the global risk of engineering nanomaterials for the period of 1999–2012 by using the bibliometric method. The results show that number of publications per year has increased steadily since 2006. The most influential countries were the USA followed by China and then by the UK. The most influential journals on these topics are Environmental Science and Technology, Toxicology, and Journal of Nanoparticle Research. The results also show that research on environmental behavior and ecological risk of ENMs is a fast-growing field. [Amin et al. \(2019\)](#) employed the bibliometric methodology to examine the existing literature on process safety and risk analysis for the period 2009 to 2018. The findings of the study show that the USA is the leading contributor, and the collaborative works between industry and academia are rare in the searched topic. The results also showed the field of process safety and risk analysis is of great growth potential with growing numbers of annual publications. [Fu et al. \(2021\)](#) applied the analyzed Arctic shipping risk management using bibliometric analysis and systematic review methods for the years 2000–2019. Most of the papers in this field are focusing on the scenario, methods, data sources, and RIFs. [Nobanee et al. \(2021\)](#) employed a bibliometric method to analyze the existing literature on sustainability and risk management using the VOSviewer software for the period 1990–2020, a reflection of 1233 documents appeared in Scopus on sustainability and risk management. The paper highlighted six major streams, related to topics such as the moral responsibilities and sustainability development, blockchain technology and minimization of risks, social sustainability and supply chain, environmental impacts, safety engineering, and risk identification, optimization and sustainability practices. The paper concluded that sustainability remains an important issue in the global perspective and risk factors were also identified and, everyone must be socially responsible to minimize their negative impact on the economy. [Diez-Herrero and Garrote \(2020\)](#) reviewed the existing literature on flood risk analysis and assessment using bibliometric analysis. They argued that studies that reviewed flood risk analysis and assessment using systematic and symmetric methods are not customary and most of these reviews provide a snapshot of the scientific state of the art of FRA with partial views, and they focused on a limited number of selected methods and approaches. In their study, they employed bibliometric analysis using the Web of Science database. The results show that the US researchers dominated the field, but now they have been overtaken by the Chinese. The results also showed that global warming appears to dominate part of future FRA research production. [Braun et al. \(2019\)](#) employed systematic and bibliometric methods to analyze the literature on sustainable remediation through the risk management perspective and stakeholder involvement using both Scopus and the Web of Science databases. The results showed that sustainable remediation is a recent theme verified by a growing number of research outputs in recent years. The study recommended that the perception of stakeholders and risk management will be better understood within the context of sustainable remediation. [Xu et al. \(2020\)](#) reviewed the literature on disruption risks in supply chain management using bibliometric analysis methodology, they argued that the field of supply chain disruption has received increasing attention on qualifying the risks and enhancing the supply chain performance. A total of 1310 publications were derived from the Web of Science. The paper identified the most influential authors, affiliations, and keywords with the most occurrences, the leading publications, and main clusters are also identified to highlight the key research

topics based on content and citation analysis. [Ganbat et al. \(2018\)](#) used the bibliometric method to review the literature on risk management and building information modeling for international construction for the period 2007–2017. The results show that building information modeling for international construction is not only attracting all stakeholders' interests but also brings some financial risks. [Jiménez and Bjorvatn \(2018\)](#) conducted a bibliometric review on political risk, the paper identified key literature on the sources of political risk, the impacts of political risk on countries, industries, firms, and projects. The paper also highlighted research output on vulnerabilities, capabilities, and responses to political risk. [Tavares et al. \(2017\)](#) used a bibliometric method to review the literature on risk management in scrum projects. The paper relies on Web of Science and Scopus databases to identify the main authors, countries, journals, most cited authors, and the keywords with the most frequencies. The analysis was conducted using CiteSpace[®] software, and despite the importance of the research topic of risk management in scrum projects, the results show that few scientific studies were identified, which brings the need for more research on the topic. [Han et al. \(2020\)](#) applied a bibliometric overview of research trends on heavy metal health risks for the period 1989–2018. The findings showed there was a significant increase in the concern over heavy metal risks and impacts in the past decade, the results also showed that China surpassed the USA and became the most productive country in 2010. [Fuentes Cabrera et al. \(2019\)](#) used the bibliometric review methodology to analyze the literature on bullying among teens, ethnicity, and race risk factors for victimization, in addition to the bibliometric methodology, the study used systematic review, documentary quantification, and data visualization methods to review the related literature. The study discovered 831 documents for the years 2011–2019. the findings showed that bullying has a negative impact both physically and psychologically on the victims. [Nagi et al. \(2017\)](#) conducted a bibliometric analysis of risk management in seaports, co-citation analysis of documents is performed using the organization risk analyzer (ORA) software CoCit-Score method of calculation. The paper suggested directions for future research on risk assessment and management methods based on the findings of the co-citation analysis. [Gómez-Galán et al. \(2020\)](#) employed the bibliometric analysis methods on musculoskeletal risks and RULA method applications in terms of the knowledge, country, year, and journal categories. The documents were collected from the Web of Science database for the period 1993 to April 2019. The analysis discovered 809 publications refined to 226 documents. the results show that the USA stands out for its greater research output. The paper concluded that RULA can be applied to workers in different fields, typically in combination with other methods. [Darabseh and Martins \(2020\)](#) conducted a bibliometric study and content analysis on risks and opportunities for reforming construction with blockchain. the main findings show that while the number of articles about the use of blockchain in construction has grown during the past years, no studies provided ready-to-use solutions. Instead, most of the studies focused on the technical capabilities of the technology. [Da Silva et al. \(2020\)](#) employed a bibliometric method to review research output on data mining and operations research techniques in supply chain risk management. the paper highlighted the gap found in the literature considering data mining techniques in supply chain risk management, identified the current streams, and proposed suggestions for future research.

The above bibliometric analysis studies of risk management reviewed s research outputs in several fields and disciplines. However, based on the above critical review of the existing literature, we did not find any study that employed the bibliometric method to review existing research output on objective and subjective risk. Based on documents found in the Scopus database, this study will carry out bibliometric analysis using software such as VOSviewer and MS-Excel. While using the Scopus database, the research study objectives of this paper include the following:

- (1) To locate and list down documents related to “objective risk” or “subjective risk”;
- (2) To carry out bibliometric analysis of related literature using VOSViewer;
- (3) To discuss the importance of scientometric when carrying out bibliometric analysis; and

- (4) To evaluate the clustering of keywords found in the most cited documents.

The Research Questions Are:

Research questions that will be addressed in this study include the following:

- (1) What are the top 20 documents that are most cited in research studies related to “objective risk” or “subjective risk”?
- (2) What are the sources of the most cited documents related to “objective risk” and “subjective risk”?
- (3) Who are the top 20 authors of documents related to “objective risk” and “subjective risk”?
- (4) What are the top 20 countries where researchers could have located the most cited documents on “objective risk” or “subjective risk”?
- (5) What are the top 20 commonly used keywords in documents related to “objective risk” and “subjective risk”?
- (6) What is the proper way of analyzing the clustering of keywords?

3. Methodology

We used the Scopus database for our bibliometric analysis on objective and subjective risk, which turns in with Elsevier. We explored the Scopus database on 25 October 2020, to obtain the journals and articles related to objective and subjective risk. The bibliographic archive in Scopus had a wide range of subjects (Md Khudzari et al. 2018), which we employed to support the bibliometric analysis centered on the coupling and visualization of bibliometric and scientometric methods (Nobanee et al. 2021). Several similar studies in many disciplines including risk management have been conducted using the Scopus database such as the studies of (Md Khudzari et al. 2018; Yahaya et al. 2020; Moreira et al. 2019; and Khatib et al. 2021). There are three major databases are available for collecting bibliographic information: Scopus® by Elsevier, Google Scholar, and the Web of Science (WoS) by Thomson Reuters (Delafenestre 2019). Each of the above databases has several advantages and disadvantages (Adriaanse and Rensleigh 2013; Delafenestre 2019). Mongeon and Paul-Hus (2016) argue that both Scopus and the Web of Science are valid for bibliometric studies and social sciences disciplines are better represented in the Scopus database, Scopus database includes several conference proceedings and book chapters (Delafenestre 2019). Scopus database has millions of publications online. To locate related documents, main keywords such as “objective risk” or “subjective risk” will be applied in the search engine box of the Scopus database. In general, narrowing down the search for related documents is possible using inclusion/exclusion criteria (Hattingh et al. 2020). As such, Table 1 summarizes the inclusion/exclusion criteria applied in this study (Nobanee 2021). (See Table 1—Inclusion/Exclusion Criteria below)

Table 1. Inclusion/exclusion criteria.

Inclusion	Exclusion
<ul style="list-style-type: none"> ➤ All types of documents with title or keyword “objective risk” or “subjective risk”; and ➤ Related documents are written in the English language. 	<ul style="list-style-type: none"> ➤ All types of documents without “objective risk” or “subjective risk” in title or keyword; and ➤ All related documents are not written in the English language.

According to Korom (2019), the use of top-tier related journals or documents is best when it comes to conducting the bibliometric analysis. Therefore, only the top 20 most cited documents, top 20 authors, top 20 countries, and top 20 author-supplied keywords were analyzed in this study. To quantify and analyze the list of related documents, top-tier ranking and descriptive statistics were purposely applied in this study (i.e., frequency/percentage) (Bisdorff 2008).

In the bibliometric analysis, the object of interest is considered as items (Nobanee 2020). To create a visual representation of items, the VOSViewer software was used to create a map that represents the relatedness of each item (<https://www.vosviewer.com/>, accessed on 25 October 2020). Using distance-based maps, the relatedness of each item is also known as the visualization of two similar items (Delafenestre 2019; Eck and Waltman 2010; Borg and Groenen 2005).

This paper analyzed the bibliographic information of objective and subjective risks obtained from the Scopus database. The network mapping and visualization of the authors, countries, documents, affiliations, and occurrence of words were achieved with the use of the VOSviewer software, (Visualizing Scientific Landscapes), developed by the Leiden University Centre for Science base and Technology Studies in the Netherlands. The VOSviewer software is based on an algorithm called “visualization of similarities” or VOS (Lulewicz-Sas 2017; Sarkar and Searcy 2016) The software can also present the thematic flow of knowledge and identifying information clusters of the analyzed bibliographic data (Moed 2010; Zhu et al. 2009; Khatib et al. 2021). Clustering of bibliographic data aims at conjoining sets of concepts and items possessing common characteristics of authors, countries, documents, affiliations, and occurrence of words (Radicchi et al. 2004; Li et al. 2020). These methods enable us to provide a comprehensive evaluation of the development of objective and subjective risk research from an international perspective and across all disciplines.

4. Results

To locate documents on “objective risk” or “subjective risk”, the researcher had to use the Scopus database. Using keywords such as “objective risk” or “subjective risk” in both “title” and “keywords”, the researcher was able to locate 215 document results. To narrow down the search for related documents, advanced search options like “LIMIT-TO” were used in this study. Since only 215 related documents were found during the initial search for related documents, no limit was set on the year of publication.

In general, researchers can use an online search engine to limit the retrieval of documents to a specific language (Bates 2012). To increase the validity and reliability of the list of related documents, duplicates found in the Scopus database were removed from the dataset. After limiting the search to the English language only and removing all duplicates, 192 related documents were left for the final assessment. (See Table 2—Basic and advance search results).

Table 2. Basic and advanced search results.

Scopus Database Search Strategy	Description	Result
Basic Search	(TITLE (“objective risk” OR “subjective risk”) OR KEY (“objective risk” OR “subjective risk”))	215 Documents
Advanced Search	(TITLE (“objective risk” OR “subjective risk”) OR KEY (“objective risk” OR “subjective risk”)) AND (LIMIT-TO (LANGUAGE, “English”))	192 Documents

4.1. Top 20 Most Cited Documents

The top three (3) most cited document related to “objective risk” or “subjective risk” includes documents written by Acerbi, C. ($n = 399$, 20.2%) followed by Rozendaal, L. ($n = 193$, 9.8%), and Botzen, W.J.W. ($n = 178$, 9.0%). Table 3 summarizes the top 20 most cited documents on “objective risk” or “subjective risk” These papers are highly cited given that their citations exceed the average citations per document. (See Table 3—Top 20 Most Cited Documents on “objective risk” or “subjective risk”).

Table 3. Top 20 most cited documents on “objective risk” or “subjective risk”.

Rank	Author	h-Index	Citations	Percentage (%)
1	Acerbi (2002)	5	399	20.2
2	Rozendaal et al. (1996)	41	193	9.8
3	Botzen et al. (2009)	14	178	9.0
4	Summala (1988)	101	153	7.7
5	Mackersie (1989)	109	108	5.5
6	Sjöberg and Drottz-Sjöberg (1991)	173	83	4.2
7	Aiken et al. (1995)	95	82	4.1
8	Gerend et al. (2004)	26	78	3.9
9	Frewer et al. (1998)	66	68	3.4
10	Schiebener and Brand (2015)	11	67	3.4
11	Hansson (2010)	33	67	3.4
12	Li et al. (2014)	4	66	3.3
13	Lipkus et al. (1996)	49	65	3.3
14	Cameron (2005)	25	64	3.2
15	Holinagel and Malterud (1995)	22	62	3.1
16	Hanna and Chen (1998)	18	59	3.0
17	Brewer and Hallman (2006)	52	51	2.6
18	Knuth et al. (2014)	6	48	2.4
19	Constans and Mathews (1993)	19	45	2.3
20	Haight (1986)	8	40	2.0
Total			1976	100.0

4.2. Top 20 Sources of Most Cited Document

The top three (3) sources of most cited document related to “objective risk” or “subjective risk” include Journal of Banking and Finance ($n = 399$, 18.0%), Risk Analysis ($n = 252$, 11.4%), and Ergonomics ($n = 211$, 9.5%). Table 4 summarizes the top 20 sources of most cited documents on “objective risk” or “subjective risk”. The topic of objective and subjective risk has been published by 160 sources, of which only 9.3 present more than one document on objective and subjective risk, relieving that very few sources are specialized at dealing with this field (Izzo and Camminatiello 2020), (See Table 4—Top 20 Sources of Most Cited Document on “objective risk” or “subjective risk” below).

Table 4. Top 20 sources of most cited document on “objective risk” or “subjective risk”.

Rank	Source	CiteScore 2020	Citations	Percentage (%)
1	Journal of Banking and Finance	4.4	399	18.0
2	Risk Analysis	6	252	11.4
3	Ergonomics	4.7	211	9.5
4	International Journal of Cancer	10.1	193	8.7
5	Water Resources Research	7.5	178	8.0
6	Archives of Surgery	N.A.	108	4.9
7	Journal of Risk Research	4.3	94	4.2
8	Women’s Health (Hillsdale, N.J.)	N.A.	82	3.7
9	Health Psychology	6.4	78	3.5
10	Neuropsychology Review	10.6	67	3.0
11	Ecological Economics	9.1	66	3.0
12	Cancer Epidemiology Biomarkers and Prevention	6.8	65	2.9
13	Accident Analysis and Prevention	7.8	64	2.9
14	Journal of Risk and Uncertainty	3	64	2.9

Table 4. Cont.

Rank	Source	CiteScore 2020	Citations	Percentage (%)
15	Family Practice	3.8	62	2.8
16	Journal of Financial Counseling and Planning	2.1	59	2.7
17	Clinical Infectious Diseases	13.2	51	2.3
18	Cognition and Emotion	4.8	45	2.0
19	Frontiers in Psychology	3.5	42	1.9
20	Energy	11.5	35	1.6
Total			2215	100.0

4.3. Top 20 Authors of Related Documents

The top three (3) authors of related documents include: Acerbi, C. ($n = 399$, 11.4%), Helmerhorst, Th.J.M. ($n = 192$, 5.5%), and Kenemans, P. ($n = 192$, 5.5%). Table 5 summarizes the top 20 authors of related documents. Older documents have more citations than new documents, this will reduce the chance of newer articles being considered and this will affect the order of the top authors in the list (Luther et al. 2020; Van Oorschot et al. 2018). (See Table 5—Top 20 Authors of Related Documents below).

Table 5. Top 20 authors of related documents.

Rank	Author	h-Index	Frequency	Percentage (%)
1	Acerbi C.	5	399	11.4
2	Helmerhorst Th.J.M.	51	193	5.5
3	Kenemans P.	60	193	5.5
4	Meijer C.J.L.M.	133	193	5.5
5	Rozendaal L.	41	193	5.5
6	Van Ballegooijen M.	53	193	5.5
7	Van Der Linden J.C.	32	193	5.5
8	Voorhorst F.J.	50	193	5.5
9	Walboomers J.M.M.	60	193	5.5
10	Aerts J.C.J.H.	53	178	5.1
11	Botzen W.J.W.	14	178	5.1
12	Van Den Bergh J.C.J.M.	54	178	5.1
13	Aiken L.S.	95	160	4.6
14	West S.G.	58	160	4.6
15	Summala H.	40	153	4.4
16	Brand M.	90	112	3.2
17	Schiebener J.	11	111	3.2
18	Hoyt D.B.	89	108	3.1
19	Mackersie R.C.	109	108	3.1
20	Shackford S.R.		108	3.1
Total			3497	100.0

4.4. Top 20 Countries of Related Documents

The top three (3) countries of related documents include: United States ($n = 1009$, 26.4%), Italy ($n = 493$, 12.9%), and Netherlands ($n = 464$, 12.2%). Table 6 summarizes the top 20 countries where the researcher can find related documents when using the Scopus database. (See Table 6—Top 20 Countries of Related Documents below).

Table 6. Top 20 countries of related documents.

Rank	Country	Frequency	Percentage (%)
1	United States	1009	26.4
2	Italy	493	1.9
3	Netherlands	464	12.2
4	United Kingdom	338	8.9
5	Germany	273	7.2
6	Sweden	216	5.7
7	Spain	182	4.8
8	China	167	4.4
9	Finland	165	4.3
10	Denmark	119	3.1
11	Norway	95	2.5
12	Australia	81	2.1
13	Iran	40	1.0
14	Greece	33	0.9
15	New Zealand	32	0.8
16	Switzerland	31	0.8
17	Canada	20	0.5
18	Israel	20	0.5
19	France	19	0.5
20	Kenya	19	0.5
Total		3816	100.0

4.5. Top 20 Author-Supplied Keywords

Author-supplied keywords are keywords identified by the author of documents related to this topic (i.e., “objective risk” or “subjective risk”) (Gordon 2019). As such, the Top 20 author-supplied keywords include: human ($n = 62$, 11.6%), article ($n = 46$, 8.6%), and humans ($n = 45$, 8.4%). Table 7 summarizes the top 20 author-supplied keywords in this study. (See Table 7—Top 20 Author-Supplied Keywords below).

Table 7. Top 20 author-supplied keywords.

Rank	Keyword	Occurrences	Percentage (%)
1	Human	62	11.6
2	Article	46	8.6
3	Humans	45	8.4
4	Female	42	7.9
5	Male	32	6.0
6	Adult	31	5.8
7	Decision making	31	5.8
8	Priority journal	29	5.4
9	Middle-aged	27	5.0
10	Major clinical study	25	4.7
11	Aged	23	4.3
12	Risk	23	4.3
13	Controlled study	22	4.1
14	Objective risk	21	3.9
15	Risk analysis	20	3.7
16	Psychological aspect	12	2.2
17	Attitude to health	11	2.1
18	Multiobjective optimization	11	2.1
19	Probability	11	2.1
20	Perception	11	2.1
Total		535	100.0

4.6. Cluster of Author-Supplied Keywords

The most influential papers in objective and subjective risk were categorized into clusters based on the common topics and keywords. clustering of popular keywords is all about the grouping of keywords based on their inter-relatedness or interconnection with one another (Konchady 2006). As such, the author-supplied keywords were clustered into eight (8) groups. Content analysis and future research questions are presented in Table 8. We created the cluster table mainly with eight main streams that include risk and socioeconomic variables, attitude to health, risk factors, decision making, risk optimization, risk analysis, assessments, and management, physiological aspects, and safety, we summarized the purpose of the study, the study findings and we converted the suggestions of future research in each article into research questions (Bahoo 2020).

Table 8. Cluster analysis.

Stream	Author	Purpose	Findings	Suggestions for Future Research (in the Form of Research Questions)
Risk and socioeconomic variables	Stülpnagel and Lucas (2020)	The importance of risk perception when driving in urban areas is sometimes overlooked by urban planners. The majority of results suggest that the probability of an event as well as the subjective perception of this risk are dynamic.	the correlation between objective danger in a moderate German city (caused by cyclical crashes) and personal risk (caused by people report in a crowdsourcing project)	Where do bike riders over-evaluate or under-estimate the specific consequences of crashes as a justification for the construction and promotion of healthy biking infrastructure and services?
			These sets of data lead to multiple infrastructures including traffic features considered to be important for cycling protection.	Why will cyclists exaggerate or overlook the real crash risk, which can provide the foundation for developing healthy cycling facilities and for encouraging biking as a convenient means of transport?
Attitude to health	Chen et al. (2020)	The model considers the cumulative impact of reservoir inflow, side flow, and flood protection uncertainty.	The submodel for risk optimization takes advantage of uncertainties and creates an operational model that takes account of two conflicting objectives for reducing downstream and upstream flood threats.	What is the solution planned in the middle reaches of the Huaihe River Basin in China for an actual flood management system?
			The sub-model for a risk calculation measures the risk using the stochastic method (SDE)	Do these findings suggest that the MOR established will provide plans which fulfill flood management goals while simultaneously reducing total risk?
			The sub-model for final improvement integrating a risk management model with an unregulated scanning genetic algorithm III into the risk optimizing operating model (NSGA-III)	

Table 8. Cont.

Stream	Author	Purpose	Findings	Suggestions for Future Research (in the Form of Research Questions)
Risk factors	Groves and Varley (2020)	In current outdoor activity settings, we built awareness, preparation and technologies to keep us better or secure.	The soil of Avalanche is such a dynamic ecosystem where the confusion is central	Have semi-structured interviews studied the impact of equipment on participant understanding of danger and action risk?
			The Glenmore Lodge, National SportsScotland Outdoor Training Centre, undertook a pilot analysis on a limited group during a 3-Year Transceiver Evaluation.	Did there vary considerably between views of avalanche and safety equipment as well as the comparison between dangerous conduct and proclaimed behaviour, proof of positive prejudice and protective disapproval?
Decision Making	Mol et al. (2020)	Assess possible flood risk misunderstandings in the Netherlands and offer insight into the factors linked to underestimation or over-estimation of the perceived risk of flooding	Many Dutch inhabitants overestimate the likelihood, but they underestimate the predicted flood level of the peak water level. Heuristic accessibility refers to different persons	What if the risk was massively underestimated by a great many Dutch people on the floodplain yet overstated the maximum predicted flood level?
Risk optimization	Wang et al. (2019)	The proposed algorithm provides great carriers landing efficiency as well as enhancement of flight efficiency.	Objective danger but subjective risk principles are used in the recovery of transport aircraft	What is the rule developed by the Automated Conveyor Downward Control Act?
			To build a statistical model for objective danger taking into account the variations in art from the present and future decline, the concept of future states dependent on current states was advocated. The related model is taken from the pilot's personal experience of flight simulation studies	Have all these ever-changing target weights modified over time for monitoring variations in condition and removing the danger in the process of roll optimization, while the contextual risk is handled by additional risk conditions?
Risk analysis, assessments, and management	Farah et al. (2020)	Creation of a system for the assessment of the area of the operational architecture of lane carriers	The system of research consists of the quantitative driving risk scale focused on the PDRF and a psychological risk scale focused on driver behavior, trust, and circumstances understanding.	Why are conditions beyond the Unusual (i.e., in-hill/off-hill signs) commonly found in an ODD?
			The approach can be used with the Automatic Lane Keeping Device of Tesla Model S.	Are participants primarily accurately identified by the locations inside the Unusual (i.e., tunnel and curve)?
Physiological aspects	Liebherr et al. (2018)	Review the results of objective danger decision-making when meeting extra engine criteria	72 players, aged 18 to 30 years, either sitting or standing on one knee, played games of Dice Task In the sense of decision-making and motor demand, the participants were required to make comparable attempts. A significant big effect of "option" and an effective relationship between "choice" x "gang"	Those who stand on each leg and select the most disadvantaged (Number 1) option?

Table 8. Cont.

Stream	Author	Purpose	Findings	Suggestions for Future Research (in the Form of Research Questions)
			In the sense of decision-making and motor demand, the participants were required to make comparable attempts. A significant big effect of “option” and an effective relationship between “choice” x “gang”	Is the “seating party” chosen more frequently as a valuable four-number combination?
Safety	Thiene et al. (2017)	Mountain slides have happened frequently in places including Italy throughout history, sometimes contributing to casualties. Policies must also be cautiously formulated that eliminate the potential of death related to landslides.	A survey of tourists and inhabitants from a region of Italy, vulnerable to landslide, decides the personal risk of others who might have been dying in a landslide and also the subjective chance of dying. One part of the study provides scientific knowledge and, if you so chose, helps you to update your risk evaluation while checking the function of this information.	Are there then subjective probabilities used to create attributes relevant to risk in the main architecture variant of the conventional model of selection? Does the largest risk shift when anomalies are necessary to clarify options?

4.7. Cluster Analysis

The analysis carried out on the main eight clusters is based on studying the most powerful stream in the eight clusters and finding the most influential paper in that stream. Then analysis will discuss the mainstream, author name, the purpose of the study, and the finding of the study. This analysis will give us a clear insight into the way the clusters are formulated and how they are divided. (See Table 8—Stream Analysis below).

The stream analysis (See Table 8—Stream Analysis Above) helps us to identify the most influential papers per stream and by analyzing these papers we can see that some of the terms are dominant in each cluster such as risk and socioeconomic variables, attitude to health, risk factors, decision making, risk optimization, physiological aspects, and safety.

Each stream discusses our research subject “objective and subjective risk” and analyzes it from the researcher point of view, for example, stream 1 “risk and socioeconomic variables” indicates a complex relationship between the risk of involvement in an accident and the subjective expectation of that risk as written Stülpnagel and Lucas (2020).

Stream 2 “attitude to health”, as Chen et al. (2020) explained in their paper, is the risk optimization process sub-model that takes into account uncertainties and develops an operating model that takes into account two competing goals to reduce flood risk upstream and downstream flood risk.

Stream 3 was “risk factors”, and according to Groves and Varley (2020), risk perceptions and the relationship to safety equipment differ significantly between levels of expertise, along with the contrast between risky behavior and declared action, evidence of optimistic bias and defensive disapproval.

Decision Making and Risk optimization were the number 4 and 5 streams and “Decision Making” explains the relation between the decision and the type of the risk, called “Risk optimization”. The principle of predicting future states based on current states was put forward so that a mathematical model for objective risks was created, taking into account the deviations of the current and future downturn in art as written by Wang et al. (2019).

Stream 6 was “Risk analysis, assessments, and management”. In this cluster, the most dominant keyword was “Risk analysis” and the papers related analyzed the objective and subjective risk.

Stream 7 was “Physiological aspects”. This stream relates the psychological aspects to the risk as written by Liebherr et al. (2018) to implications of decision making under objective risks while performing additional engine requirements.

Stream 8 was “Safety” and the relationship between safety and the objective and subjective risk was studied. Larger risk changes as departures from the baseline risk are found to be significant in explaining choices, according to Thiene et al. (2017).

5. Discussion of Results

Using the ranking method and descriptive statistics, the act of analyzing the results of the top 20 most cited documents, top 20 authors, top 20 countries, and top 20 author-supplied keywords is straightforward. However, the use of the ranking method and descriptive statistics does not provide the researcher a complete insight with regards to how the most cited documents, authors of most cited documents, the country where researchers can find the most cited documents, and author-supplied keywords are interrelated and connected. To better analyze bibliometric results, it is best to carry out a scientometric analysis using the VOSviewer software.

In general, VOSviewer is a useful tool when illustrating the distance between items. As such, Eck and Waltman (2010) explained that a longer distance between items means that the items are not so related to one another whereas a shorter distance between items means that the items are related to one another. For example, Figure 1 presents the visualization map of the top 20 most cited documents on “objective risk” or “subjective risk”. In Figure 1, it was noted with a large blue bubble that the document written by Acerbi, C. is the most cited document on topics related to “objective risk” or “subjective risk”. However, the distance between the documents written by Acerbi, C. and other authors that were clustered into groups is quite far from one another. This strongly suggests that not many research studies have been made with regard to creating a spectral measurement for subjective risk aversion. To address the gap in research, future researchers who are interested in doing a research study on “objective risk” or “subjective risk” should conduct a similar study. This way, the research finding that was presented by Acerbi, C. can be validated by other researchers. (See Figure 1—Top 20 most cited documents on “objective risk” or “subjective risk”).

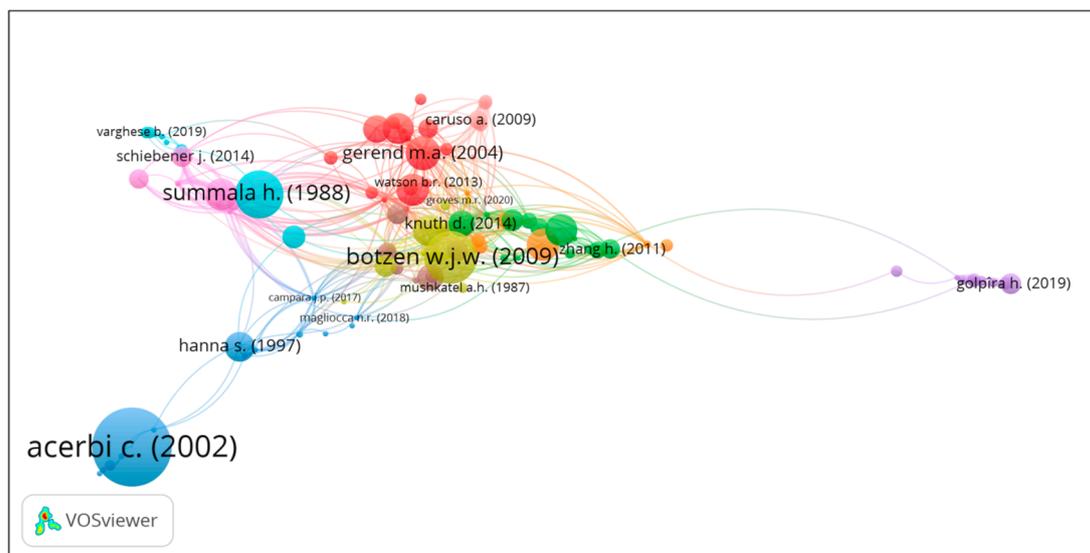


Figure 1. Visualisation map of top 20 most cited documents on “objective risk” and “subjective risk”.

The same is true with regards to the document written by Golpira, H. The document written by Golpira, H. is about creating an objective risk-based decision-making framework for smart building energy management. The fact that the size of the purple bubble is quite small means that this document has not been cited so much in other studies related to “objective risk” or “subjective risk”. Compared to the document written by Acerbi, C., the document written by Golpira, H. was set further away from the clustering of other documents as shown in this visual map. Therefore, another way to address the gap in the literature is to encourage more researchers to conduct a research study on objective risk related to smart building energy management.

Figure 2 presents the visualization map of the top 20 sources of most cited documents on “objective risk” or “subjective risk”. In Figure 2, Eck and Waltman (2010) explained that the lines that connect two separate bubbles point out a relationship in each source of most cited documents. Complexity in the lines as shown in Figure 2 somehow suggests that there is a connection in each source of most cited documents. It could be that the line that binds two or more sources of most cited documents represents the frequency in co-citation or two documents being cited by a third-party author whereas differences in the color of bubbles symbolize the temporal pattern in the top 20 sources of most cited documents (Zhou et al. 2015). (See Figure 2—Visualisation map of Top 20 Sources of Most Cited Documents on “objective risk” or “subjective risk” below).

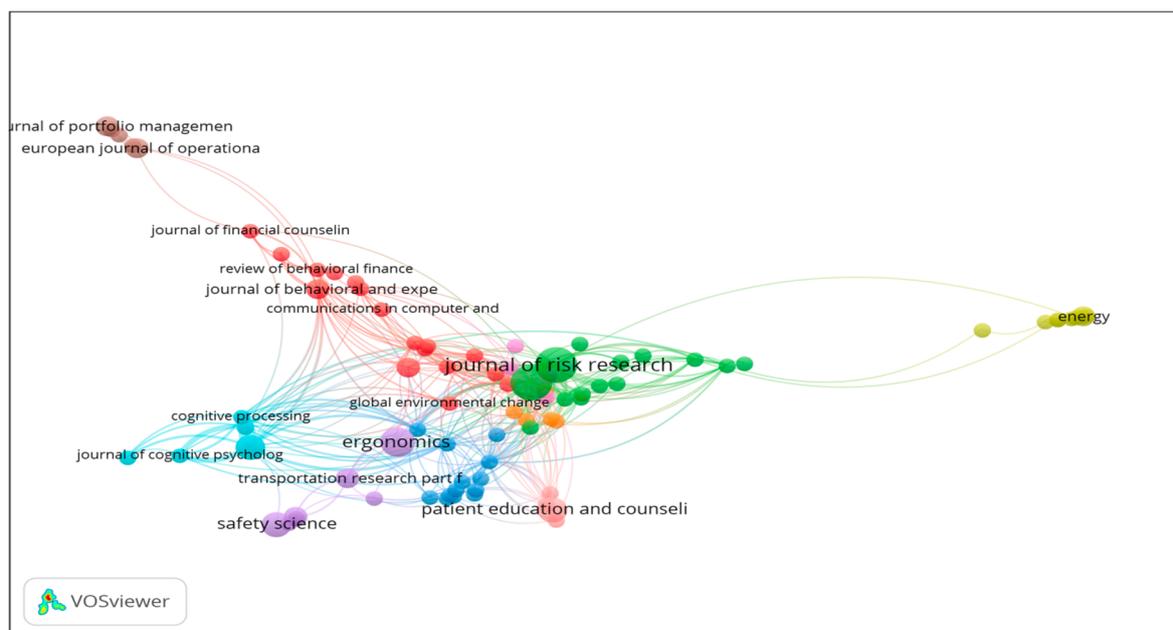


Figure 2. Visualisation map of top 20 sources of most cited documents on “objective risk” and “subjective risk”.

With regards to the visual map on the top 20 authors of related documents, the explanation of Eck and Waltman (2010) with regards to the distance between items suggests that the documents written by Kendel, F. are somehow connected to the document written by Leventhal, H. However, documents written by Kendel, F. have no relationship with the documents written by Dislich et al. (2010). (See Figure 3—Visualisation map of top 20 authors of related documents).

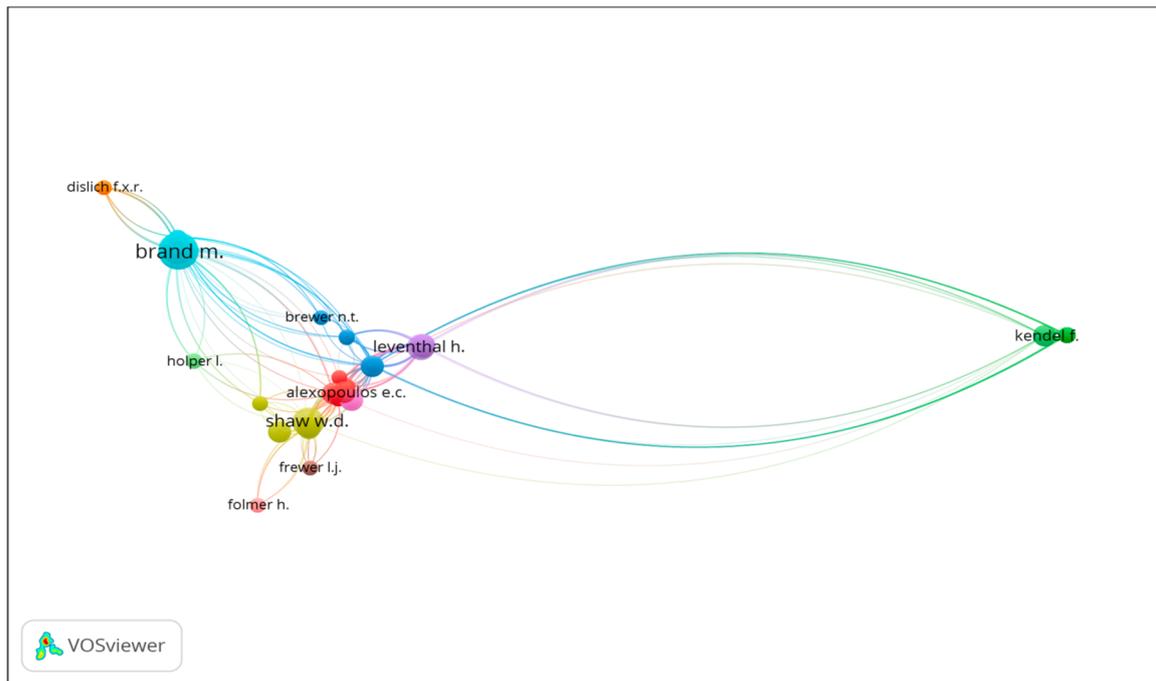


Figure 3. Visualisation map of top 20 authors of related documents.

According to [Eck and Waltman \(2010\)](#), bubbles in each visualization map stand for the object of interest, and that a bigger bubble means a higher frequency than the other items. With this in mind, the huge green bubble in Figure 4 suggests that the majority of related documents can be found in the United States and not in other countries such as Chile or Greece. (See Figure 4—Visualisation map of top 20 countries of related documents).

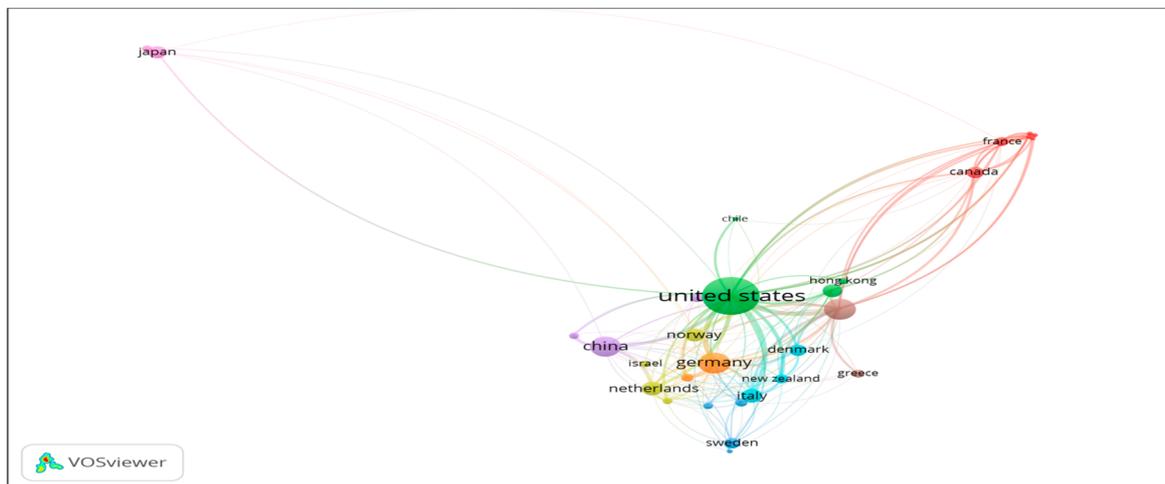


Figure 4. Visualisation Map of Top 20 Countries of Related Documents.

Figure 5 shows the visualization map of author-supplied keywords. In this particular map, the clustering of author-supplied keywords is represented by three different colors (i.e., red, blue, and green). As such, the red color represents the first group of author-supplied keywords (cluster 1) whereas the green color represents the second group of author-supplied keywords (cluster 2). The blue color represents the third group of author-supplied keywords (cluster 3). Lines that connect the author-supplied keywords represent how each of these keywords is interrelated with other keywords. (See Figure 5—Visualisation map of the Clustering of Author-Supplied Keywords below).

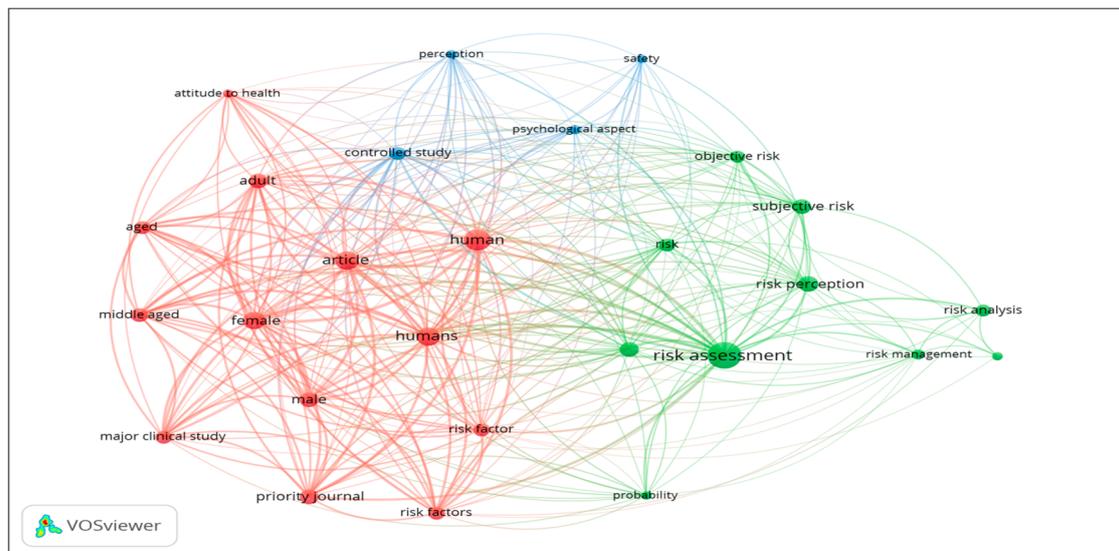


Figure 5. Visualisation map of the clustering of author-supplied keywords.

6. Conclusions and Recommendations

In conclusion, the use of ranking and descriptive statistics in the bibliometric analysis is not enough to show researchers an in-depth analysis of the available literature found in the Scopus database. To get a deeper insight as to how each related documents are linked to one another, it is necessary to create a visualization map using the VOSViewer software.

To narrow down the gap in existing literature, results found in VOSViewer would direct future researchers on what specific topic to write when it comes to “objective risk” or “subjective risk”. For example, a strong or thicker line that connects two items means that there is sufficient literature available on the subject matter. A weak or thinner line means that there is a research gap in the existing documents. For this reason, future researchers who wish to make studies on “objective risk” or “subjective risk” should locate subject areas with thinner lines.

Our research offers interesting insights on objective and subjective risk, nevertheless, like other studies, our paper is affected by some limitations. First, the search technique used in our study was restricted to “objective” or “subjective” risk within the titles, and keywords. However, some research might not refer to “objective” or “subjective” risk within the searching scope. Second, we rely only on documents published on sources that are listed in the Scopus database as it is considered the most dominant database of peer-reviewed articles, conference proceedings, and book chapters (Khatib et al. 2021). Hence, the results of our search query may not cover all publications on “objective” or “subjective” risk. Future research may make a comparison of the outputs from multiple databases such as the Web of Science and Google Scholar. Third, we limited our research to documents that are written in English, some documents on “objective” or “subjective” that are written in other languages are not included in our analysis. Fourth, the top 20 most cited documents on “objective risk” or “subjective risk”, the top 20 authors of documents on “objective risk” or “subjective risk”, the top 20 countries where researchers could locate the most cited documents on “objective risk” or “subjective risk”, and the top 20 author-supplied keywords on subjects related to “objective risk” or “subjective risk” were analyzed in this study. Therefore, the result of this study does not completely represent what researchers can find when using the Scopus database. Therefore, future researchers should consider increasing the number of documents used for bibliometric and content analysis. Fifth, the “Matthew Effect” can also lead to biased findings when highly cited documents are blindly cited without checking their quality (Luther et al. 2020; Ball and Tunger 2005).

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