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# Visualization Analysis of Organizational Resilience Research Based on CiteSpace From 1990–2022

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**ABSTRACT** The world is currently dealing with the aftermath of the coronavirus disease 2019 (COVID-19) pandemic, which has resulted in momentous changes, the likes of which had not been witnessed within the previous century. These adverse events and the resulting uncertainty have posed enormous challenges to organizations, and many are on the verge of collapse. Organizations urgently need to enhance their risk management abilities and capacity to cope with crises, and organizational resilience, as such a tool, has attracted widespread attention in China and abroad. The purpose of this study is to understand the research status and development trend of organizational resilience. In this study, we applied CiteSpace to perform a visual analysis. Searching for topics related to organizational resilience, we retrieved papers published from 1990–2022 in the Web of Science Core database. Second, we constructed an author, institution, and country/region collaboration network to identify the most prolific authors, institutions and countries, respectively. The distribution of core journals determined by journal co-citations, the document co-citation network, and a clustering analysis revealed the research topics and knowledge structure, the author co-citation network revealed which authors were influential, the keyword co-citation network indicated popular research topics, and the keyword bursts highlighted the research fields. This paper analyzes the main contributions of organizational resilience research at the author, institution, and country levels; knowledge sources; interdisciplinary characteristics and research areas in organizational resilience; and direction of future research.

**INDEX TERMS** Organizational resilience, visualization, knowledge map, general review, CiteSpace.

## I. INTRODUCTION

Climate change, the COVID-19 epidemic and local wars have overlapped, triggering huge systemic risks and causing huge impacts on society and the economy [1], [2]. Amid accelerating and deepening globalization and the changing world landscape, the society and environment in which organizations operate are becoming increasingly complex, and organizations are involved in a complex network of linkages that affect whole systems. Crises and disasters have become recurring events that organizations need to face in the process of development. For example, the 9/11 aviation attack brought devastating losses to the U.S. airline industry. The outbreak of 2008 global financial crisis caused the global

economy to shrink, and many companies went bankrupt. The 2020 COVID-19 epidemic has even affected various aspects such as human health, economic growth, social development, national security, and international relations, posing enormous challenges to organization and management. A significant number of organizations are on the verge of collapse due to their failure to prepare for such events, and organizations are under tremendous pressure to survive [3]–[5]. This challenging environment, especially major crisis events, has forced organizations to become more flexible and resilient to survive and thrive [6]. Organizational resilience is considered to be critical to the success of an organization's response to an unexpected event. It helps organizations anticipate potential threats, respond effectively to adverse events and adapt to changing conditions to achieve future success [7]. Thus, the study of organizational resilience is very important, as it not

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only deepens an organization's understanding of crises but also enhances its ability to survive and grow to maintain a competitive advantage.

"Resilience" is widely used in many fields, including ecology, psychology, climate change, critical infrastructure, and organizational science. The concept of resilience, derived from the Latin verb "resilience," can be defined as rapid recovery from difficult and potentially harmful situations [8]. Organizational resilience has drawn increasing attention from management scholars since Weick's famous study on the Mann Canyon Fire in Montana, USA. Preliminary results have been obtained on the content, influencing factors, and measurement of organizational resilience.

Since the outbreak of COVID-19, scholars in China and abroad have once again paid more attention to the study of "organizational resilience." There have been many types of research on the connotations, influencing factors, and measurement dimensions of organizational resilience. The connotations of resilience are more apt to be studied from the perspective of system capability or the outcome; specific performance is the ability to recover [9] and other abilities [7]. Research on the influencing factors of organizational resilience is mainly carried out from the aspects of individuals [10], organizations [11], and the environment [12]. Organizational resilience is both a multilevel and a multidimensional concept. It is a process of dynamic interaction between the organization and the external environment. Due to its complex connotations, scholars have not agreed on its measurement dimensions or research methods, which mainly include direct measurement [13], indirect measurement [14], and case study methods [15]. In recent years, many scholars have also conducted literature reviews on organizational resilience. Linnenluecke [16] identified five research directions for tissue resilience. Duchek [7] defines organizational resilience as a meta-capability and gives a potential overview of the capabilities that constitute organizational resilience. Williams *et al.* [17] integrates crisis management and resilience research, identifying a unique line of crisis and crisis management. Although organizational resilience research is common in international journals, the research content is relatively scattered, and there is still a lack of systematic research on the evolution and frontiers of and popular topics within organizational resilience. In addition, most of the above research is based on qualitative analyses of the literature, and given the considerable amount of literature, a qualitative analysis through reading and summarization methods has limitations, such as subjectivity and one-sidedness. There is an urgent need to analyze organizational resilience research by using scientific bibliometric methods to provide a new way of thinking for studies of organizational resilience.

The intellectual structure of a scientific field can be represented by a network of entities, such as cited references, collaboration networks, and cooccurring keywords [18]. This network can be visualized by knowledge mapping. This constitutes a new method of literature analysis for the continuous development of scientific knowledge across the landscape.

It can provide an overall and comprehensive description and help illuminate the knowledge structure, intellectual collaborations, new development trends, and hot topics that are very important to researchers, engineers and enterprise managers.

CiteSpace software shows the evolution of a knowledge field and hot trends through mapping visualization technology, which is intuitive, scientific and objective, and helps comprehensively illuminate research frontiers and overall trends. CiteSpace is currently used in many disciplines, such as leadership [19], human behavior [20] and informetrics [21]. Zhang and Li [22] applied CiteSpace to the exploration of urban resilience. Chen *et al.* [23] used CiteSpace to review the development of organizational resilience. Therefore, it is necessary to use CiteSpace software to comprehensively sort and systematically summarize the existing theoretical results in the field of organizational resilience to provide guidance and a reference for the development of this field.

In this research, we used CiteSpace as the analysis software to construct a co-citation cooperation network and perform a keyword co-occurrence analysis of the organizational resilience research literature. We aim to identify the research powers in the field of organizational resilience at the individual, institute, and country levels. In addition, we aim to determine the distribution of core journals and subject categories related to organizational resilience research. Third, we cluster the main research topics, explore the knowledge structure, and sort the evolution of organizational resilience research. Finally, the popular research topics and frontiers of organizational resilience are discussed.

The remainder of this study is organized as follows. The next section presents the data collection and research methods. Then, the research framework is presented. Section III presents the results of the descriptive statistics of the data. Section IV presents the results of visualization scientometric analysis. Section V concludes the contributions, research implications and limitations for further research.

## II. DATA COLLECTION AND RESEARCH METHODS

### A. DATA COLLECTION

Web of Science (WOS) is the most authoritative database for obtaining global academic information [24]. It contains a large number of influential academic journals and detailed information about the literature that guarantees the reliability of a study's data sources [25], [26]. Our sources of data were mainly from the WOS Core Collection (WOSCC) database, with the following retrieval codes used:

TS = (organizational resilience) or TS = (resilient organization) or TS = (organizational toughness); Database = Science Citation Index Expand (SCIE), Social Science Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index-Science (CPCI-S), and Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH); Document type = Article,

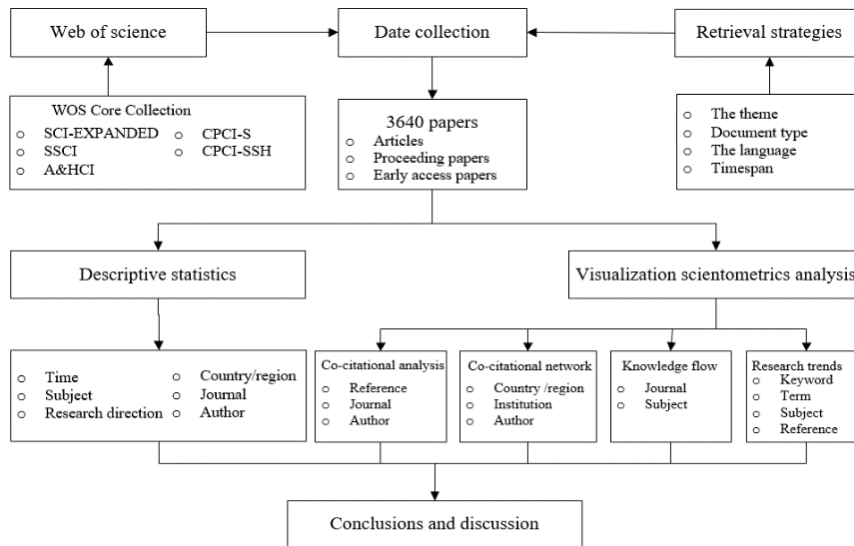


FIGURE 1. Research framework.

Proceedings and Early Access; Language = English; and Timespan = 1990-2022.

Based on the above retrieval strategy, we retrieved 3640 articles, proceeding papers and early access papers from the SCI-EXPANDED, SSCI, A&HCI, CPCI-S, and CPCI-SSH databases that were downloaded on March 31, 2022. We saved the “record content” as a complete record (including the title, authors, abstract, keywords, source journals, cited references and research directions) in other file formats and plain text.

## B. RESEARCH METHOD AND FRAMEWORK

Scientific knowledge visualization based on social network analysis and graph theory is a new type of bibliometric method [27]. CiteSpace-based analysis, which includes the potential knowledge contained in the scientific literature from scientometrics, a visualization of the data, and information, involves citation visualization analysis software that allows multiple variables and time sharing. Dynamic characterizations [28], which were developed and provided for free by Dr. Chen Chaomei at Drexel University, USA [29], have been widely applied worldwide due to their advanced and powerful functions [30]. In this study, CiteSpaceIII 6.1 R1 was used to visualize and construct a knowledge map of organizational resilience articles. Due to functional limitations, CiteSpaceIII 5.8 R3 was used for the network of authorship collaboration and cooccurring subject category.

A framework was constructed to analyze and visualize publications on organizational resilience from 1990-2022, as shown in Figure 1. The analysis steps were as follows:

First, we retrieved and collected data and then established a scientometric database on organizational resilience. Second, we deduced descriptive statistical analysis and visualization scientometrics analysis. Based on the descriptive statistics, the following six general findings were presented for the

existing organizational resilience research: the time distribution of organizational resilience papers published from 1990-2022, subject fields, research directions, statistics on high-yield countries/regions, journals, and authors. For the scientometric analysis, a co-citation analysis based on the reference, journal, and authors revealed the reference and authors’ influence and the co-citation relationship among journals. The co-operation among countries/regions, institutions, and authors could be obtained by drawing a co-citation network based on the country/region, institution, and author analysis. The distribution of publications in the field of organizational resilience, citation trajectory, and knowledge flow about the disciplinary migration of journals could be obtained by using the dual-map analysis module, and through the co-occurrence keywords and literature, popular research topics and future directions could be identified.

## III. DESCRIPTIVE STATISTICS OF THE FINDINGS

### A. TEMPORAL DISTRIBUTION OF PUBLICATIONS

The temporal distribution of publications from 1990-2022 and some periodical characteristics of acritical evolution are illustrated in Figure 2. The research shows a steady quantity of organizational resilience articles worldwide divided into three rough stages. In the first stage (preliminary), fewer than 10 articles per year were published from 1990-1999. In the second stage (rapid development), from 12 papers in 2000 to 116 papers in 2012, the study of organizational resilience developed rapidly. In the third stage (vigorous development), a number of articles about organizational resilience were published from 2013-2022; this is the vigorous development stage.

### B. SUBJECT FIELDS

From the distribution of the subject fields, organizational resilience involves multidisciplinary fields and mainly

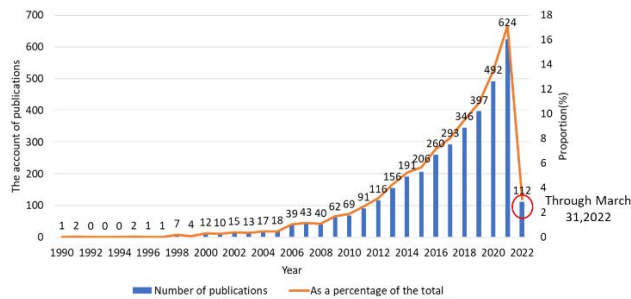


FIGURE 2. Temporal distribution of organizational resilience from 1990–2022.

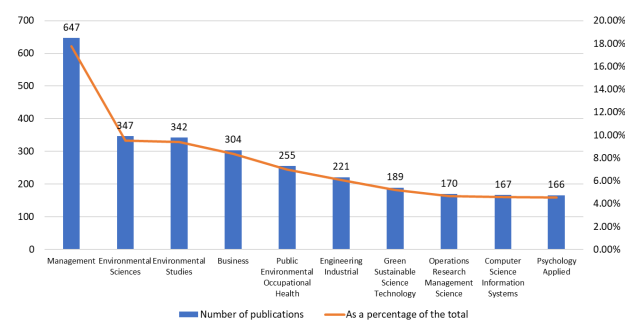


FIGURE 3. Subject distribution of organizational resilience.

focuses on management (17.77% of the total), environmental sciences (9.53%), environmental studies (9.40%), business (8.35%), and public environmental occupational health (7.01%), as shown in Figure 3.

### C. RESEARCH DIRECTIONS

Organizational resilience from 1990-2022 involves many research directions; the top ten include business economics (22.88%), environmental sciences ecology (16.04%), engineering (16.02%), psychology (10.69%), and computer science (10.38%), as presented in Figure 4.

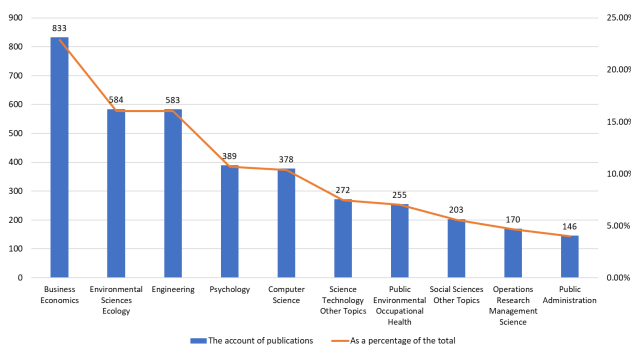


FIGURE 4. Distribution of the research directions of the organizational resilience literature.

### D. HIGH-YIELD COUNTRIES/REGIONS

In the top 10 high-yield countries or regions found from 1990-2022, most publications were from Western countries

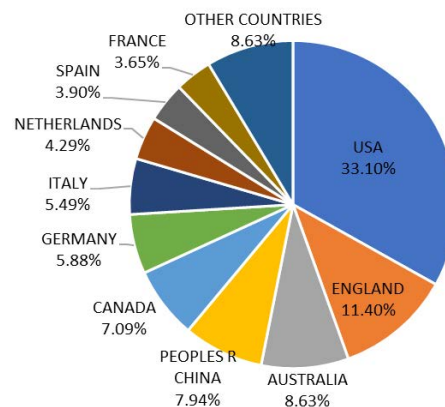


FIGURE 5. Distribution of the countries/regions of the organizational resilience literature from 1990–2022.

and China (Figure 5). The United States (33.10%) ranked first in the number of organizational resilience publications during this period, followed by England (11.40%), Australia (8.63%), and China (7.94%).

### E. HIGH-YIELD JOURNALS

From the perspective of high-yield journal distribution, as indicated in Table 1, high-yield journals include Sustainability (108), the International Journal of Environmental Research and Public Health (41), Safety Science (40), Ecology and Society (33), and Frontiers in Psychology (30). The eleven journals listed in Table 1 are highly productive journals of organizational resilience research.

### F. HIGH-YIELD AUTHORS

Table 2 shows that the top ten high-yield authors primarily come from the United States, Iran, China, Spain, Canada, England, Israel, Australia and Brazil. Importantly, there are cooperative relationships among these authors, such as Luthans F and Avey J. However, it is impossible to present these relationships in the table.

## IV. VISUALIZATION SCIENTOMETRIC ANALYSIS

### A. CO-CITATION ANALYSIS

A co-citation relationship occurs when two or more articles, authors, or journals appear in a third bibliography [31]. Co-citation analysis by CiteSpace provides software for building professional structures or maps, monitoring the development trends of scientific fields, and evaluating the extent of the interrelationships between professions. Evaluating these relationships mainly involves three types of co-citation analysis: co-cited authors, co-cited journals, and co-cited documents [32], [33].

#### 1) AUTHOR CO-CITATION

The development and improvement of research on organizational resilience mainly depend on the consociation of researchers in related fields. In a co-cited author network, a knowledge mapping analysis of coauthors can visualize

**TABLE 1. High-yield journals in organizational resilience from 1990–2022.**

Number	Journal	Number of publications	Proportion	Impact factor (2020)	Publisher
1	SUSTAINABILITY	108	2.97%	3.251	MDPI
2	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	41	1.13%	3.390	MDPI
3	SAFETY SCIENCE	40	1.10%	4.877	ELSEVIER
4	ECOLOGY AND SOCIETY	33	0.91%	4.403	RESILIENCE ALLIANCE
5	FRONTIERS IN PSYCHOLOGY	30	0.82%	2.988	FRONTIERS MEDIA SA
6	PLOS ONE	25	0.69%	3.240	PUBLIC LIBRARY SCIENCE
7	INTERNATIONAL JOURNAL OF DISASTER RISK REDUCTION	20	0.55%	4.320	ELSEVIER
8	JOURNAL OF CLEANER PRODUCTION	20	0.55%	9.297	ELSEVIER SCI LTD
9	RELIABILITY ENGINEERING AND SYSTEM SAFETY	20	0.55%	6.188	ELSEVIER SCI LTD
10	BUSINESS STRATEGY AND THE ENVIRONMENT	17	0.47%	10.302	WILEY
11	INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH	17	0.47%	8.568	TAYLOR & FRANCIS LTD

**TABLE 2. High-yield authors in the field of organizational resilience from 1990–2022.**

Author	Country	Number of publications	Number of citations	Maximum number of citations	H index
Luthans F	UNITED STATES	15	18808	1639	57
Azadeh A	IRAN	11	1179	171	18
Avey J	UNITED STATES	10	7362	1450	25
Wang J	CHINA	10	556	126	13
Salanova M	SPAIN	9	8333	2911	34
Salehi V	CANADA	8	975	175	15
Anderson JE	ENGLAND	7	1332	378	20
Carmeli A	ISRAEL	7	1197	176	19
Cooke FL	AUSTRALIA	7	2691	126	30
De Carvalho PVR	BRAZIL	7	897	99	16

the data of influential authors in different fields. In addition, an author co-citation analysis can be used to determine the distribution of highly cited authors. Moreover, the relative influence of scholars is confirmed by degree centrality and betweenness centrality. Degree centrality is the most direct measure of node centrality in network analysis. The greater the degree of a node is, the higher the degree centrality of the node is and the more important the node is in the network. Betweenness centrality is used to identify and measure the importance of the literature, and literature with

high betweenness centrality is often a key pivot connecting two different fields, also referred to as a turning point in CiteSpace. Thus, boundary spanning potential can be identified [34]. In the author co-citation network, the node size represents the co-citation frequency of each author, and the links indicate the indirect collaborative relationship based on their author co-citation frequency. Nodes with purple rings indicate betweenness centrality greater than 0.1, and the coarser the purple rings are, the more important the nodes are. Figure 6 presents the author co-citation network



FIGURE 6. Author co-citation network.

that contributes to organizational resilience research, which includes 540 nodes and 913 co-citation links. The selection criteria are the top 50 per slice, and the largest subnetwork includes 447 nodes, which accounts for 82% of the whole, to ensure that the generated author co-citation network is comprehensive. Density represents the density of the network, meaning the “actual number of relationships” divided by the “theoretical maximum number of relationships” in the network. It reflects the closeness of the overall cooperation of the researchers [35]. The network density of the author co-citation network is 0.0063, which explains why the cooperation degree of the entire author co-citation network is at the medium level.

Table 3 lists the top 10 cited authors and those with the highest centrality according to the citation frequency of articles in organizational resilience. As shown in Table 3, the most cited author is Van D (412), and the other top 9 cited authors are Weick K (344), Holing C (271), Luthans F (256), Folke C (238), Hollnagel E (200), Lengnick-hall C (186), Walker B (185), Posdaskoff P (183), and Masten A (182). In addition, the three cited authors with the highest centrality are Weick K (0.24), Holing C (0.21), and Van D (0.18), indicating that these authors are key nodes in the field of organizational resilience research and play a role of high linkage. Moreover, the four authors with a high degree of centrality are Weick K (30), Quinn (23), Holing C (22), and Luthans F (22), which indicates that these authors are important nodes in the co-cited authors network in the field of organizational resilience.

As mentioned above, the outcomes of the co-cited author analysis in the field of organizational resilience not only increase the knowledge of this research but also help us identify the influential authors in each area of organizational resilience research.

2) JOURNAL CO-CITATIONS

When at least one article from both journals is listed in the reference list of cited articles, both journals are co-cited together [36]. A journal co-citation analysis can confirm the core or edge position of journals in a discipline and help study the structure of academic fields with academic journals as

TABLE 3. Top 10 and high-centrality cited authors in organizational resilience.

Ranking	Frequency	Degree	Centrality	Author	Year
1	412	16	0.18	Van D	2005
2	344	30	0.24	Weick K	2002
3	271	22	0.21	Holing C	2001
4	256	22	0.11	Luthans F	2007
5	238	13	0.03	Folke C	2004
6	200	11	0.03	Hollnagel E	2007
7	186	15	0.04	Lengnick-hall C	2012
8	185	17	0.09	Walker B	2000
9	183	11	0.03	Podsakoff P	2008
10	182	16	0.06	Masten A	2005
11	159	23	0.16	Quinn	2008

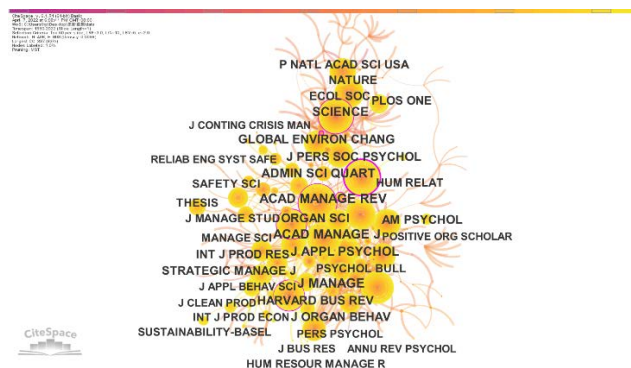


FIGURE 7. Journal co-citation network.

the means of communication [37]. In a journal co-citation network, the nodes represent journals, the links represent co-cited journal relationships, the size of the nodes represents the number of citations of a journal, and the distance between nodes represents the journal co-citation frequency. The network in Figure 7 contains 406 nodes and 803 links. The selection criteria are the top 50 per slice, and the largest subnetwork includes 337 nodes, accounting for 83% of the whole. In addition, the network density of the journal co-citation network is 0.0098. As analyzed above, the generated journal co-citation network is comprehensive, and the co-citation relationship of journals is strong.

Table 4 lists the top 10 journals with high centrality cited by the citation frequency of articles in organizational resilience. As shown in Table 4, the journals with the highest citation frequency, centrality, and impact factor are the Academy of Management Review (frequency 594, centrality 0.18, IF 12.638), Administrative Science Quarterly (frequency 529,

**TABLE 4.** Top 10 and high centrality cited journals of organizational resilience.

Ranking	Frequency	Degree	Centrality	Journal (Publisher)	IF (2020)
1	594	23	0.18	Academy of Management Review (ACAD MANAGEMENT)	12.638
2	564	23	0.05	Academy of Management Journal (ACAD MANAGEMENT)	10.194
3	561	26	0.09	Journal of Management (SAGE PUBLICATIONS INC)	11.790
4	531	20	0.02	Journal of Applied Psychology (AMER PSYCHOLOGICAL ASSOC)	7.429
5	529	18	0.24	Administrative Science Quarterly (SAGE PUBLICATIONS INC)	11.113
6	451	14	0.12	Science (AMER ASSOC ADVANCEMENT SCIENCE)	47.728
7	432	21	0.11	Harvard Business Review (HARVARD BUSINESS SCHOOL PUBLISHING CORPORATION)	6.870
8	419	21	0.14	Organization Science (INFORMS)	5.000
9	417	17	0.07	Journal of Personality and Social Psychology (AMER PSYCHOLOGICAL ASSOC)	7.673
10	407	27	0.08	Journal of Organizational Behavior Management (ROUTLEDGE JOURNALS, TAYLOR & FRANCIS LTD)	1.677

centrality 0.24, IF 11.113), and Science (frequency 451, centrality 0.12, IF 47.728). In addition, the Harvard Business Review (6.870) and Organization Science (5.000) have higher centrality, and all the journals are cited more than 400 times.

As discussed above, the journal co-citation analysis provides the distribution of the sources of critical knowledge in organizational resilience, which could help us identify the journals that are cited and determine the core journals and the connections between them. At the same time, the results of the journal co-citation network reveal the strong interdisciplinary characteristic of organizational resilience.

### 3) DOCUMENT CO-CITATIONS

Documents are repositories of critical knowledge. If two (or more) documents are cited by one or more subsequent documents at the same time, then the two documents have a co-citation relationship [38]. Through document co-citation analysis, we can objectively explore the underlying knowledge base of a research field and its knowledge structure and evolutionary path [39], [40]. In the document co-citation network, the nodes that represent cited documents were marked with the first author and the year of publication when there were more than 15 cited counts. The links indicate the co-citation relationship between these documents. The node size shows the importance of a document, and the distance between nodes signifies the citation frequency of the document. When the distance between nodes is smaller, the co-citation frequency is higher, and the research topics are more similar [27]. The network in Figure 8 contains 1023 nodes and 1146 links. The selection criteria are the top 50 per slice; the largest subnetwork includes 783 nodes,

accounting for 76% of the whole; and the network density is 0.0022.

The top 10 cited documents are listed in Table 5; from the citation count, Linnenluecke, Williams *et al.*, and Annarelli are the top three cited articles. These articles have been widely recognized by peers and have high value in organizational resilience research. Linnenluecke identified five research streams—organizational responses to external threats, organizational reliability, employee advantages, the adaptability of business models, and supply chain design principles to reduce vulnerability—and noted that they define “resilience” differently [16]. Williams *et al.* [17] discussed the resilience implications of studies of crisis and developed an integrative framework to understand and explain the interaction between crisis and resilience in a dynamic process, including capabilities for durability, organizing and adjusting, responses to disturbances, and a feedback loop from experiences. Combining with Table 3, it can be seen that the articles of Van D and Lengnick-hall C are also of high value. These two authors not only appear in the top 10 and high-centrality cited authors in organizational resilience (Table 3), but their articles also appear in the top 10 co-cited documents in organizational resilience (Table 5) shows that these two papers have important positions in their fields.

The documents in organizational resilience with a centrality greater than 0.10 are listed in Table 6. They establish relationships between unrelated nodes and play an important role in the structure. Based on centrality, articles by Youssef C (2007) centrality 0.14, Linnenluecke M (2010) centrality 0.13, and Avey J *et al.* (2011) centrality 0.11 are the top three. These articles are critical nodes in the document co-citation network and play an intermediary role.

TABLE 5. Top 10 co-cited documents in organizational resilience.

Ranking	Count	Author	Document	Journal	Year
1	85	Linnenluecke M	Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda	INT J MANAG REV	2017
2	67	Williams T	Organizational Response to Adversity: Fusing Crisis Management and Resilience Research Streams	ACAD MANAG ANN	2017
3	43	Annarelli A	Strategic and Operational Management of Organizational Resilience: Current State of Research and Future Directions	OMEGA-INT J MANAGE S	2016
4	41	Ortiz-de-mandojana N	The Long-term Benefits of Organizational Resilience through Sustainable Business Practices	STRATEGIC MANAGE J	2016
5	35	Van D	Managing Risk and Resilience	ACAD MANAGE J	2015
6	30	Kamalahmadi M	A Review of the Literature on the Principles of Enterprise and Supply Chain Resilience: Major Findings and Directions for Future Research	INT J PROD ECON	2016
7	28	Hosseini S	A Review of Definitions and Measures of System Resilience	RELIAB ENG SYST SAFE	2016
8	27	Lengnick-hall C	Developing a Capacity for Organizational Resilience Through Strategic Human Resource Management	HUM RESOUR MANAGE R	2011
9	25	Robertson I	Resilience Training in the Workplace from 2003 to 2014: A Systematic Review	J OCCUP ORGAN PSYCH	2015
10	25	Duchek S	Organizational Resilience: A Capability-based Conceptualization	BUSINESS RES	2020

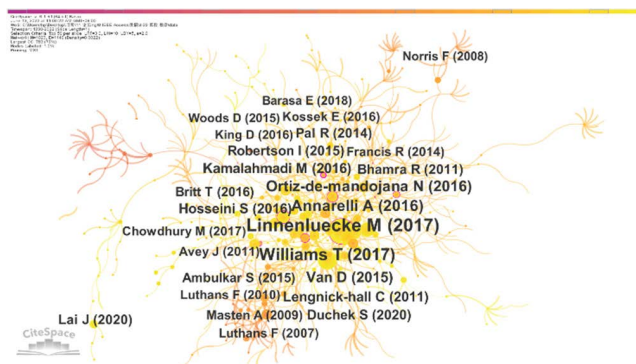


FIGURE 8. Document co-citation network.

The node of Youssef C (2007) has a relatively high citation frequency (14) and the highest (0.14) centrality; he discusses the impact on employees of three important psychological resource competencies—hope, optimism and resilience—and notes that these three competencies are associated with job outcomes [41]. Linnenluecke M (2017) appears in both Tables 5 and Table 6, with the highest count of co-citations (85) and a centrality with 0.1, indicating the importance of this paper. These higher-centrality co-cited documents constitute the knowledge base of organizational resilience research.

The co-citation clustering formed by the relationships among multiple articles reflects common research directions and focal issues [42]. A clustering analysis can divide a large amount of research data into different units according to the relative correlation degree of terms to identify the research topics, research trends, and their relationships in a research field [18]. The quality of clustering is measured by the modularity Q value and the mean silhouette S value. The modularity Q value measures the extent to which a network



FIGURE 9. Document co-citation clustering network.

can be divided into independent blocks. The mean silhouette S value is a measure of network homogeneity [18]. When these values are close to 1.0, the overall clarity of the configuration is high [43]. A clustering analysis was performed on the co-citation network of the documents; the modularity Q value is equal to 0.8405, and the mean silhouette S value is equal to 0.9486. According to Chaomei Chen,  $Q > 0.3$  is considered significant, and  $S > 0.7$  indicates that the clustering label is highly reliable [18]. Therefore, our clustering network is significant, and the clustering label is highly reliable. In this research, 20 co-citation clusters were identified through the log-likelihood rate (LLR) algorithm because the LLR algorithm has high quality, high intraclass similarity, and low interclass similarity. The document co-citation clustering network is shown in Figure 9.

The LLR algorithm generates clustering labels based on the uniqueness and coverage of the keywords of the documents in each cluster. Quality depends on the variety, breadth, and depth of keywords in articles, and the labels are



**TABLE 6.** Higher-centrality documents in organizational resilience.

Ranking	Centrality	Author	Document	Journal	Year
1	0.14	Youssef C	Positive Organizational Behavior in the Workplace: The Impact of Hope, Optimism, and Resilience	J MANAGE	2007
2	0.13	Linnenluecke M	Beyond Adaptation: Resilience for Business in Light of Climate Change and Weather Extremes	BUS SOC	2010
3	0.11	Avey J	Meta-analysis of the Impact of Positive Psychological Capital on Employee Attitudes, Behaviors, and Performance	HUM RESOUR DEV Q	2011
4	0.10	Linnenluecke M	Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda	INT J MANAG REV	2017
5	0.10	Kamalahmadi M	A Review of the Literature on the Principles of Enterprise and Supply Chain Resilience: Major Findings and Directions for Future Research	INT J PROD ECON	2016
6	0.10	Pal R	Antecedents of Organizational Resilience in Economic Crises—An Empirical Study of Swedish Textile and Clothing SMEs	INT J PROD ECON	2014
7	0.10	Steen R	A Risk Perspective Suitable for Resilience Engineering	SAFETY SCI	2011
8	0.10	Koronis E	Introducing Corporate Reputation Continuity to Support Organizational Resilience Against Crises	J APPL BUSINESS RES	2012
9	0.10	Zwack J	If Every Fifth Physician Is Affected by Burnout, What About the Other Four? Resilience Strategies of Experienced Physicians	ACAD MED	2013

the focus of each cluster [18]. The top 20 largest co-cited document clusters are listed in Table 7, which reveals the intellectual structure of organizational resilience. Notably, each significant group has representative literature, which is the most frequently cited article. Therefore, we focus on what this article represents [44]. In this research, generating a cluster tag indicates the main research topic in the field of organizational resilience, and it can fall into four rough classes: resilience of different research objects (#1, #2, #3, #5, #9, #10, and #20), psychological resilience (#0, #11, #14, and #15), disaster recovery (#6, #7, and #17), and significant terms in organizational resilience (#12, #13, and #16).

First, for the resilience of different research objects, the objects selected in the literature include employee resilience [45], supply chain resilience [46], engineering resilience [47], ecological system resilience [48], and small business enterprise (SME) resilience [49]. Second, research on psychological resilience mainly involves psychological capital [50], influencing factors of psychological capital [51], [52], burnout, and psychological resilience [53], [54]. Third, regarding disaster recovery, Francis and Bekera proposed a resilience analysis framework and identified ecological versus engineered resilience for engineering and infrastructure [55]. Wang *et al.* [56] proposed service outsourcing and disaster response methods in the relief supply chain. In the future, the impact of a “black swan event” on organizational resilience needs to be further strengthened. Finally, the significant term organizational resilience, which presents the research area and literature branches of organizational resilience, makes it easier for other researchers to review noteworthy results of relevant research and expand their research directions. Notably, an increasing number of

researchers are focusing on organizational resilience; for example, Linnenluecke reviewed resilience in business and management [16], and Ortiz-de-Mandojana and Bansal [57] pointed out that sustainable business practices could promote the long-term benefits of organizational resilience. In addition, at a time of great uncertainty and amid the social, economic, and political crises caused by the COVID-19 pandemic, some scholars have explored organizational resilience from different perspectives. For example, Orchiston *et al.* explored organizational resilience in the tourism sector [58]; Sawalha [59] identified potential objectives, elements, and practices of organizational resilience within insurance organizations; Bento *et al.* [60] described organizational resilience in the oil and gas industry; and Annarelli *et al.* [61] built a framework to evaluate organizational resilience within the service industry.

## B. COLLABORATION NETWORK

Scientific collaboration occurs when different authors, institutions, or countries appear in a paper, and the network formed by the partnership is the scientific collaboration network [62]. Collaboration network analysis is critical to understand scholarly development trends and cooperative relationships and identify influential authors and institutions [26]. This study analyzes the country collaboration network, institutions’ collaboration networks, and authorship collaboration networks.

### 1) NETWORK OF COUNTRY/REGION COLLABORATIONS

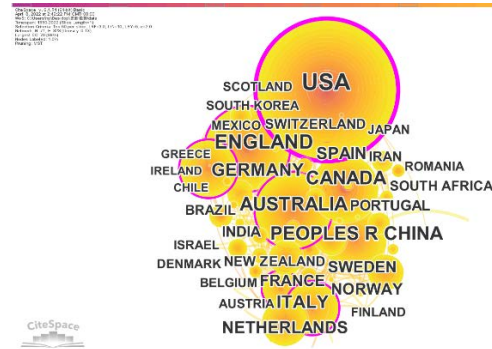
The country collaboration network consisted of 71 nodes and 323 links for the 1990-2022 study, as indicated in Figure 10. In the country collaboration network, 32 countries were

**TABLE 7. Top 20 co-cited document clusters in organizational resilience.**

Cluster ID	Size	Silhouette	Mean (year)	Labels
0	76	0.969	2010	Psychological capital
1	74	0.938	2015	Supply chain resilience
2	56	0.883	2019	Organizational resilience
3	54	0.936	2017	Employee resilience
4	54	0.882	2017	Safety
5	46	0.941	2014	Resilience engineering
6	40	0.972	2015	Livelihoods; disaster resilience
7	39	0.959	2016	Emergency
8	37	0.911	2015	Communication
9	37	0.996	2006	Social-ecological systems
10	34	0.932	2021	Supply chains
11	33	1	2018	Burnout
12	32	0.985	2011	Local government
13	31	0.936	2016	Performance measurement and management
14	29	0.958	2017	Psychological resources
15	29	0.982	2014	Depression
16	28	0.948	2011	Governance
17	20	0.995	2013	Disaster
18	14	1	2015	Cocoa; adaptation to climate change
20	10	1	2022	Small business

identified through relative contributions (more than thirty papers) to the field of organizational resilience research. The countries/regions with the most published articles included the United States (1134 papers, 0.26), England (392 papers, 0.14), Australia (293 papers, 0.14), China (251 papers, 0.06), Canada (245 papers, 0.06), and Germany (197 papers, 0.13). These top six countries are considered core nodes in the national cooperation network from which to build links to other nodes.

The outputs show that the United States was the first country in which researchers focused on the area of organizational resilience. Moreover, it was the main contributor to the study of organizational resilience, in which researchers published 1134 articles, and established contact with other countries began in 1998. The centrality of the United States is 0.26 (ranked first) in the country collaboration network, which indicates that the cooperation between the United States and other countries in the field of organizational resilience is



**FIGURE 10. Country/region collaboration network related to the organizational resilience literature.**

strong. In contrast, although researchers in Australia, England, and Germany published few articles, their centrality is high, which indicates that European countries play a critical role in building connections with other countries according to their centrality, particularly England (392 articles, 0.14) and Germany (197 articles, 0.13). In addition, Australia has high centrality and has been cooperating with other countries since 2006.

**2) NETWORK OF INSTITUTION COLLABORATION**

Analysis of the institutional cooperation network is helpful to identify the relationships between institutions in organizational resilience research and its impact. In the collaborative network, the node size represents the number of articles published by the related institution.

The institutional collaboration network generated 391 nodes and 360 links from 1990-2022, as shown in Figure 11. With ten articles used as the threshold, 37 research institutions are included. The top 10 institutions are University of Queensland (34), Arizona State University (30), Monash University (24), University of Michigan (22), University of Oxford (20), University of Toronto (19), University of Canterbury (18), University of Washington (18), Stanford University (17), Stockholm University (16), and University of California, Berkeley (16). In terms of the number of articles published from institutions, the University of Queensland, closely followed by Arizona State University and Monash University, is the greatest contributor and leader in organizational resilience research. As a result, the output of these institutions in organizational resilience is unique. At the same time, from the national perspective, US institutions account for 45% of the top 10 institutions. Australia is the next country in terms of top institutions, with the University of Queensland ranking first and Monash University ranking third, and these institutions have many connections with others, which reflects more cooperation with other institutions. This result echoes network of country/region collaborations, in which the United States and Australia have a high centrality (Figure 10).

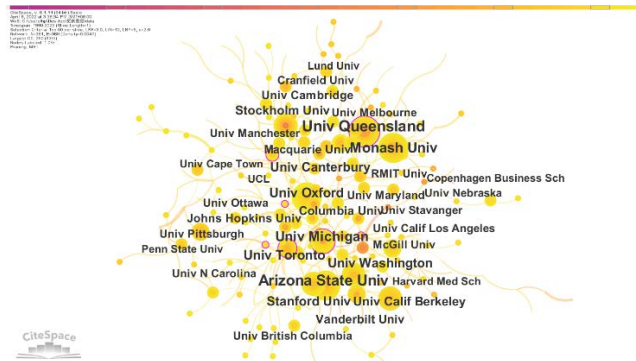


FIGURE 11. Institution collaboration network related to the organizational resilience literature.



FIGURE 13. Keyword co-occurrence network related to organizational resilience research.

3) NETWORK OF AUTHORSHIP COLLABORATION

Research collaboration provides scientists with a way to acquire expertise, access scientific resources and establish academic communication networks among the elite of the scientific community [63]. The authorship collaboration network identified the influential authors by analyzing a knowledge graph of authorship. CiteSpace III can generate authorship collaboration networks by selecting analysis data, setting appropriate thresholds, and excluding isolated nodes. The authorship collaboration networks in organizational reliance research consist of 756 nodes and 608 links (Figure 12). Due to a large number of nodes, connections, and small team collaboration networks, the top 20 cooperation networks are selected for display in this study. The node size indicates the number of papers published by the author, and the distance between the nodes and the thickness of the links indicate the level of cooperation between authors [30]. The authors with the most publications are Fred and James, who have published eight papers. In Figure 12, the nodes are connected to form several relatively independent small authorship collaboration networks, indicating that there are usually fixed teams of cooperation here. There are connections between authors, showing cooperative relationships, while collaboration networks are relatively independent and

closed, lacking cooperation with others. The connection density of the authorship collaboration network is 0.0021, which explains why the cooperation degree of the whole authorship collaboration network is low.

C. EMERGING RESEARCH TRENDS

Keywords summarize the articles' core ideas and areas of concern and facilitate understanding of the research papers [64]. Therefore, the evolution of popular research topics and emerging trends in organizational resilience research can be illuminated by analyzing keywords with co-occurrence, clustering, time zones and bursts, subjects with co-occurrence, and time zones.

1) POPULAR RESEARCH TOPICS

Through the co-occurrence and cluster analysis of keywords, we can determine the popular research topics and identify their research paradigm [65]. The network of keyword co-occurrence contains 216 nodes and 663 links. The selection criteria are the top 50 per slice; the largest subnetwork includes 214 nodes, accounting for 99% of the whole; and the network density is 0.0286. The whole keyword co-occurrence network shows central convergence and peripheral divergence and is connected to the surrounding nodes. The larger the nodes are, the more times the keyword appears in the co-occurrence network. The descending order of the co-occurrence network of organizational resilience is resilience (399, 2004), management (323, 2006), performance (304, 2006), impact (258, 2006), model (197, 2003), framework (179, 2012), system (159, 2008), organization (156, 2000), organizational resilience (155, 2011), and risk (139, 2010).

We construct a keyword clustering network in organizational resilience research according to the log-likelihood ratio, as shown in Figure 14. The modularity  $Q=0.4407 > 0.3$  indicates that the results are significant, and  $S=0.7635 > 0.7$  indicates that the clustering label is highly reliable. Figure 14 shows the clustering results, indicating that organizational resilience-related studies have formed distinct factions according to different research contents, methods, perspectives, and objects. The research objects and

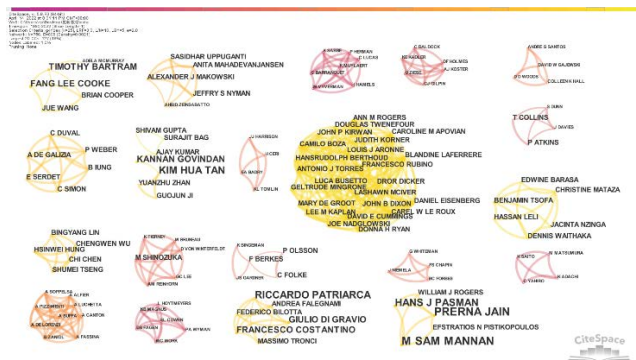


FIGURE 12. Authorship collaboration network related to the organizational resilience literature.

**TABLE 8.** Keyword co-occurrence clustering report.

Cluster ID	Size	Silhouette	Year	Keywords
0	38	0.872	2011	Psychological capital; optimism; hope; self-efficacy; job satisfaction
1	37	0.721	2013	Organizational resilience; supply chain resilience; psychological capital; resilience engineering; SMEs
2	35	0.599	2013	Mental health; burnout; care; stress; social support
3	33	0.666	2010	Strategy organization; organizational change; perspective; connectivity; diversity; response
4	31	0.875	2012	Climate change; community sustainability; community engagement; vulnerability; governance; adaptation
5	17	0.851	2011	Unlearning; crisis; configurations; sustainability indicators; turbulence; dynamic capabilities
6	16	0.796	2012	Health care; service; resilience; improvement; patient safety
7	7	0.908	2011	Organizational performance; ecosystem services; cocoa; spatial planning



**FIGURE 14.** Keyword co-occurrence clustering network related to organizational resilience research.

contents of each fraction both overlap and are different from each other. Through the co-citation literature clustering and keyword clustering of organizational resilience, the research focus of organizational resilience can be sorted into four aspects—the research background, research object, research method, and research topic—and the keyword co-occurrence clustering report is presented in Table 8.

*Aspect 1 (Research Background):* Research in organizational resilience is carried out in the context of uncertainty, such as climate change, vulnerability, crisis, risk, and adverse events. These uncertain events create significant shocks to and challenges for organizations, forcing them to build resilience to cope with disruption. Bethune *et al.* [66] noted that as risks at the local, national, and international levels are increasingly systemic and unpredictable, destinations need enhanced resilience for faster recovery and development.

In addition, the context of COVID-19 forces scholars to actively explore the way of survival of organizations, and provide some roles, influences and suggestions for the organization and management of COVID-19. In the context of COVID-19, Rai *et al.* [2] established a resilience framework

capable of sustaining social and economic value, identifying special social and economic sustainability structures from an organizational perspective. Khlystova *et al.* [3] identified the fundamental conditions for the entrepreneurial industry to survive and adapt to the COVID-19 epidemic, namely the adaptation and use of digital capabilities by the creative subsector. Albott *et al.* [67] outlined potential psychological stress responses of healthcare providers to the COVID-19 crisis in the context of the COVID-19 pandemic and described resilience promotion strategies at the organizational and individual levels.

*Aspect 2 (Research Objects):* The research objects of organizational resilience include supply chain resilience, community resilience, engineering resilience, organizational resilience of SMEs, and employee resilience.

Supply chain resilience is more associated with risk management, and scholars have explored ways to reduce supply chain reactions or recover quickly after disruptions [68]. Jain *et al.* [69] developed a framework model and identified 13 key factors of supply chain resilience. With technology advancing and the approach to supply chain management shifting from traditional to digital, Khan *et al.* [70] identified 15 key factors of digital supply chains and determined their direct and indirect impacts on digital supply chains. Ivanov [71] stated that technologies such as big data analytics, artificial intelligence, and blockchain have been used in supply chain resilience. By developing conceptual guidelines for digital supply chain management and leveraging technology, establishing and leveraging end-to-end visibility can improve supply chain resilience.

Regarding community resilience, its influencing factors have been a focus of study. Cimellaro *et al.* [72] proposed a holistic framework for assessing community resilience and identified seven measures of it. Bakker *et al.* [73] explored the relationship between social capital and community resilience in fishing communities, noting that different forms of social capital, bonding, bridging or linking, are seen as assets that

enhance community resilience. Balaei *et al.* [74] constructed a comprehensive resilience model for community water systems and identified important social factors that affect water supply resilience.

Engineering resilience has been studied mainly in the field of safety. In high-risk environments where keeping systems secure is critical, resilience engineering is an alternative to traditional security management that can improve an organization's resilience in identifying, adapting and absorbing disruptions [47]. Azadeh *et al.* [75] found that awareness, preparedness and flexibility are the most important factors in engineering resilience in petrochemical plants. Salehi and Veitch [76] analyzed the factors in developing the adaptive capacity of organizational resilience at different levels of management, providing ideas and methods for improving the safety profile of complex systems.

The study of SME resilience is an extension of that of the organizational resilience of firms. Due to SMEs' disadvantages in terms of resources and capabilities, they operate with significant risks. Iborra *et al.* [77] suggested that SMEs can cope with the changing environment through ambidexterity capability and strategic consistency. In a subsequent study [78], they explored the relationship between strategic consistency in ambidexterity and the resilience outcomes of SMEs after stressful and disruptive events, noting an inverted U-shaped relationship between the two.

Employee resilience has been the focus of organizational resilience research due to the range of problems faced by employees in organizations, such as low job satisfaction and burnout. In an early study, Luthans *et al.* [79] introduced resilience into the field of organizational behavior as part of psychological capital. Amid the COVID-19 epidemic, the issue of the mental health of health care workers has received greater attention, and in this context, Albott *et al.* [67] proposed ways to enhance the resilience of health care workers at the organizational and individual levels.

*Aspect 3 (Research Methods):* The research methods in organizational resilience mainly include scale measurement and structural equation modeling (SEM), regression analysis, and the network structure of organizational resilience (topological structure and small world). Measuring organizational resilience has been a key concern for scholars, and thus, developing scales of organizational resilience is a common research method. SEM is often used in the analysis of outcomes to explore the relationship between factors and organizational resilience. Feng and Trinh [80] used SEM to analyze the drivers of a resilient safety culture in a built environment. The use of regression analysis to explore the effects between organizational resilience and factors and the interaction effects is also a common approach. Moran [81] used multiple regression analysis to investigate the direct and interaction effects among organizational decline, organizational rigidity response, organizational resilience response and institutional effectiveness.

*Aspect 4 (Research Topics):* Organizational resilience research mainly includes the evaluation dimensions of

organizational resilience (organizational performance, resilience, sustainability, dynamic capabilities), the impact of organizational behavior on resilience (strategy organization, organizational change), and the influencing factors of employee resilience (psychological capital, optimism, burnout, self-efficacy).

The evaluation dimensions of organizational resilience cover multiple perspectives, such as the outcome perspective and the capability perspective. Organizational performance is evaluated based on the outcome perspective. Lv *et al.* [82] argued that resilient organizations are able to achieve high levels of performance growth and low levels of financial volatility in the long term; thus, they used long-term growth and financial volatility to measure organizational resilience. Dynamic capability, on the other hand, is an evaluation based on a capability perspective, which argues that resilient organizations need to have certain capabilities. Duchek [7] argued that organizational resilience is an organization's ability to anticipate potential threats, respond effectively to adverse events, and adapt to changing conditions. Kantu and Say [83] developed a scale to measure organizational resilience in terms of robustness, agility and integrity.

The influence of organizational behavior on organizational resilience is mainly reflected in organizational strategy and organizational change. Organizational resilience has attracted a great deal of attention from management and strategy scholars, and thus, they have taken an alternative approach (different from the individual-level studies) to explore the factors influencing organizational resilience at the organizational level (especially at the level of organizational strategy). Carmeli and Markman [84] identified two factors that are important for organizational resilience: capture and governance. Capture strategy is related to market expansion, while governance strategy refers to an organization's ability to assimilate, retain, defend, and increase its dominance in an annexed market.

## 2) RESEARCH FRONTIERS

Price first proposed the idea of the research frontier, which reveals the nature of evolutionary dynamics in the research field. Chen defined a group of burst concepts or research problems in a specific field as a research frontier. "Burst" refers to the surge in the frequency of terms, keywords, or cited literature within a certain period, which is shown by the burst rate [55]. We generated a keyword co-occurrence time zone network, shown in Figure 15, which arranges keywords by the peak time of occurrence. Figure 15 shows that the word "resilience" first appeared in 2004. From 2004-2010, the keywords that appeared the most were "resilience," "knowledge," "management," "performance," "stress," "impact," "risk," and "climate change;" these were the initial focus of organizational resilience research. From 2011-2015, the keywords that appeared the most frequently were "organizational resilience," "sustainability," "adaptation," "framework," "crisis," "challenge"

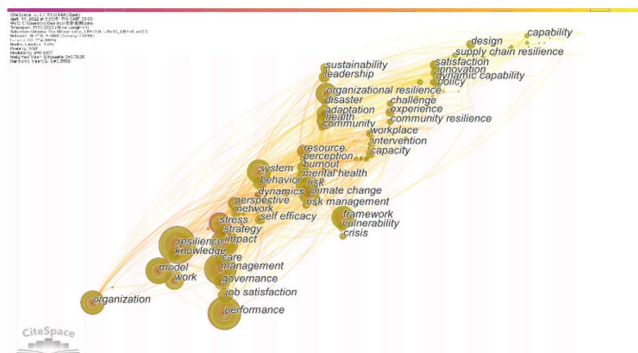


FIGURE 15. Keyword co-occurrence time zone network.

and community resilience.” From 2016-2022, the most frequently occurring keywords were “innovation,” “dynamic capability,” “supply chain resilience,” “COVID-19 pandemic,” “capability,” “disaster resilience,” and “psychological resilience,” and it is seen that organizational resilience in recent years mainly focuses on supply chain resilience, crisis management, organizational resilience and psychological resilience caused by COVID-19.

The top 30 keywords with citation bursts are shown in Figure 16. Considering the burst strength and its corresponding red lines, the evolution of research frontiers is shown below. ① From 2000-2010, the keyword with the highest bursts is “organization” [85]. ② From 2006-2017, the keywords with the highest bursts are “social ecological system” [86], “dynamics” [87], “life” [88], “hope” [89], “response” [90], and “vulnerability” [91]. These findings show that scholars were focused on the concepts of social ecosystems and service ecosystems based on earlier research. At the same time, the term “resilience” was introduced into the field of organizational behavior. The

**Top 30 Keywords with the Strongest Citation Bursts**

Keywords	Year	Strength	Begin	End	1990 - 2022
organization	1990	4.87	2000	2010	-----
social ecological system	1990	5.67	2006	2015	-----
dynamics	1990	8.41	2007	2016	-----
life	1990	5.31	2007	2015	-----
hope	1990	4.66	2008	2014	-----
response	1990	4.5	2010	2017	-----
vulnerability	1990	5.08	2012	2016	-----
psychological capital	1990	6.49	2014	2018	-----
positive organizational behavior	1990	5.45	2014	2018	-----
decision making	1990	7.41	2015	2017	-----
attitude	1990	5.97	2015	2017	-----
perspective	1990	6.24	2016	2018	-----
antecedent	1990	5.06	2016	2018	-----
intervention	1990	8.01	2017	2019	-----
quality	1990	6.64	2017	2019	-----
implementation	1990	5.69	2017	2018	-----
climate	1990	5.68	2017	2018	-----
engagement	1990	4.74	2017	2019	-----
city	1990	5.68	2018	2020	-----
community resilience	1990	5.61	2018	2020	-----
recovery	1990	5.42	2018	2020	-----
validation	1990	5.37	2018	2020	-----
risk management	1990	4.84	2018	2019	-----
quality of life	1990	7.54	2019	2020	-----
challenge	1990	7.2	2019	2020	-----
capability	1990	10.45	2020	2022	-----
supply chain resilience	1990	8.29	2020	2022	-----
dynamic capability	1990	7.97	2020	2022	-----
future	1990	7.58	2020	2022	-----
mediating role	1990	7.08	2020	2022	-----

FIGURE 16. Top 30 keywords with citation bursts.

research topics include psychological capital, such as life and hope, and provide a research framework for organizational resilience. ③ From 2014-2019, the keywords with the highest bursts are “psychological capital” [92], “positive organizational behavior” [92], “attitude” [93], “implementation” [94] and “engagement” [95], which indicates that scholars’ research perspective gradually shifted from the meso to the micro, including organizational psychology and employee resilience. From a research perspective, microlevel research on employee resilience is gradually gaining attention. Bustinza *et al.* [96] reinforced the importance of human resource practices (HRPs) in building organizational resilience. Cooke *et al.* [97] considered employee resilience as a set of skills and attributes that can be developed through the effective use of high-performance work systems (HPWSs) to benefit both individuals and organizations. ④ From 2018-2022, the keywords with the highest bursts are “city” [98], “community resilience” [72], “risk management” [99] “supply chain resilience” [100] “dynamic capability” [101] and “moderating role” [96]. With the development of digital technology, Dubey *et al.* [100] proposed applying blockchain technology to the disaster relief supply chain system to improve the resilience and transparency of its suppliers. Scholars in this period focused on risk management, responding to emergent risks and challenges by shaping urban resilience, supply chain resilience, and community resilience.

**3) CO-OCCURRING SUBJECT CATEGORY**

Co-occurrence analysis reveals the relationship between the co-occurrence feature items using the degree of correlation among them [102]. Through the co-occurrence analysis of the subject category, we could obtain the cross-relationships between disciplines and the subjects in organizational resilience. In a network of cooccurring subject categories, the node size represents the number of publications that belong to the subject. The thickness of the line is determined by the co-occurrence strength; if the link between the two nodes is thick, the co-occurrence intensity between the two subjects is relatively high.

The network of cooccurring subject categories in the field of organizational resilience consists of 213 nodes and 1055 links (presented in Figure 17). With 170 articles as the threshold displayed in the network, 15 cooccurring subjects are included, namely, social science (969); business and economics (744); engineering (562); environmental sciences & ecology (552); management (463); computer science (363); psychology (357); humanities (CPCI-SSH) (272); science and technology—other topics (257); environmental sciences (236); public, environmental & occupational health (234); business (224); engineering, industry (186); green & sustainable science & technology (176); and social sciences—other topics (172). Thus, organizational resilience has been applied to a variety of interrelated disciplines. For example, Steen and Aven [47] applied resilience to engineering industry, Ortiz-de-Mandojana and Bansal [57] explored the application



**FIGURE 17.** Cooccurring subject category map related to the organizational resilience literature.

of organizational resilience in business and economics, and Albot *et al.* [67] explored the application of resilience in occupational health.

The time zone view of a subject category in organizational resilience is presented in Figure 18. Over time, the published fields have shown different changes because of diverse concerns among researchers who published articles. The subject category can be divided into three distinct stages over time. From 1998-2000, which constituted the initial stage, the research focused on business and economics, environmental sciences & ecology, management, and psychology. From 2002-2008, the research concentrated on social science; engineering; computer science; humanities; business; environmental sciences; and public, environmental & occupational health. Finally, from 2010-2013, the research areas were engineering industrial, green & sustainable science & technology, and social science—other topics.



**FIGURE 18.** Time zone view of the subject categories.

**V. RESEARCH CONCLUSIONS AND FUTURE RESEARCH OUTLOOK**

**A. RESEARCH CONCLUSIONS**

Based on the analyses of the descriptive statistics, co-citations, collaboration networks, and emerging research trends in the previous part of the paper, we can draw the following conclusions.

Regarding contributions to the organizational resilience research, from a micro (author)-perspective, the high-yield

authors are Luthans F, Azadeh A, and Avey J, while the most frequently cited authors are Van D, Weick K, Holing C, Luthans F, and Folke C. Thus, Luthans F is both a high-yield and a highly-cited author. From a meso (institutional)-perspective, the key research mainly comes from universities, and the University of Queensland, Arizona State University, Monash University, and the University of Michigan are high-yield institutions in these fields. From a macro (country)-perspective, the United States, England, and Australia have high-yielding institutions in the field. The United States has a high number of publications and high centrality in the country cooperation network, and England and Australia have high centrality.

Regarding the core journals, high-yielding journals include Sustainability, the International Journal of Environmental Research and Public Health, and Safety Science. At the same time, highly cited journals are the Academy of Management Review, Administrative Science Quarterly, and Science; most of these have high quality and are sources of knowledge for the study of organizational resilience.

The subject field distribution mainly focuses on management, environmental sciences, environmental studies, business, and public environmental occupational health. Through the co-occurrence analysis of the subject category, we obtained the cross-relationships between disciplines and the subjects in organizational resilience. The most published papers are on subjects in social science, business and economics, engineering, environmental sciences & ecology, management and so forth. The cooccurring subject category in the field of organizational resilience includes social science, business and economics, engineering, environmental sciences & ecology, management, and so forth. However, the subjects of economics, environmental sciences & ecology, management, and psychology were early disciplines in which organizational resilience research was carried out, which indicates the strength of organizational resilience research.

The research clustering is mainly reflected in the following aspects: different research objects (employee resilience, supply chain resilience, engineering resilience, ecological system resilience, and SME resilience), psychological resilience (psychological capital, influencing factors of psychological capital, burnout, and psychological resilience), disaster recovery (recovery of engineering or infrastructure from a disaster), and significant terms in organizational resilience (organizational resilience research in the face of great uncertainty and social, economic and political crises caused by the COVID-19 pandemic). A regular knowledge base has been established in these areas of study. Overall, the organizational resilience knowledge structure has been scaled.

Regarding popular research topics, the following were found: “research background (climate change, vulnerability, crisis, risk, and adverse events),” “research object (supply chain resilience, community resilience, engineering resilience, organizational resilience of SMEs, and employee resilience),” “research method (scale measurement and SEM, regression analysis, and social network)” and “research topic

(evaluation dimensions, organizational resilience, and the influencing factors in organizational resilience).”

The latest research frontiers mainly include the application of blockchain technology to enhance the resilience of supply chain management, improve urban resilience and increase the resilience of cities and communities to crises.

In the current context of more uncertainty and emergencies, the study of organizational resilience has unique significance for organizations. This study provides valuable insights for organizational resilience researchers to understand the current state of research and trends in organizational resilience through a visual analysis of research in the field from 1990-2022. First, this study reveals the research strengths (individual, institute, and country/region) in organizational resilience, providing valuable information for cross-institutional and cross-regional research. Second, it clarifies the distribution of journals and subject categories in organizational resilience research, providing valuable information for the development of interdisciplinary organizational resilience research. Furthermore, this study explores the knowledge structure of the field and further reveals the knowledge base and research themes in it. Finally, this study discusses popular research topics and frontier areas of organizational resilience, providing new ideas for future research directions in the field. Of course, organizational resilience research cannot develop without the joint efforts of Chinese and foreign researchers.

## B. MANAGERIAL IMPLICATIONS

By quantitatively analyzing the literature published from 1990-2022 related to organizational resilience, this study dynamically demonstrates the evolutionary and frontier hotspots of organizational resilience research. Although research in this area has received widespread attention from scholars, its theoretical development is still immature, and the results of this study provide several reference directions for future organizational resilience studies.

### 1) ENHANCING COLLABORATIVE RELATIONSHIPS AND INTEGRATING ACADEMIC RESOURCES

From the perspective of collaborative relationships in organizational resilience research, the overall collaboration among authors is low, with strong collaboration within teams and weak collaboration among them. In terms of geographical distribution, the core research on organizational resilience is mainly concentrated in the United States, the United Kingdom, and Australia. Therefore, in the future, we should promote multifaceted cooperation among authors and countries to enhance the overall and systematic nature of organizational resilience research and promote its development.

### 2) IN-DEPTH EXPLORATION OF THE INFLUENCING MECHANISM OF ORGANIZATIONAL RESILIENCE

Contexts such as disasters and crises have created more challenges for organizations, and organizations urgently need to enhance their resilience to cope with risks. Future

research should explore the paths of organizational resilience enhancement in depth, as well as the impact mechanisms of different antecedent conditions on organizational resilience. Existing literature pays more attention to the micro (organization members) and meso (organization itself) level factors, and less attention to the macro (external environment) level; such as how policies, regulations, and institutional environment affect organizational resilience. In the future, the external macro environment factors can be considered.

### 3) DEEPENING THE RESEARCH METHODOLOGY OF ORGANIZATIONAL RESILIENCE

Although organizational resilience theory has received widespread attention from scholars since its emergence, there are relatively few empirical studies, and the methods used are relatively homogeneous, mostly exploring the “net effect” of a single factor on organizational resilience. Since the formation of organizational resilience is a complex and nonlinear process, many factors affect it simultaneously and often in a competitive manner; thus, the impact of individual variables on organizational resilience is very limited. Other research methods on organizational resilience, such as the qualitative comparative analysis method, can be further examined to explore the causal relationships between the combination of different variables and organizational resilience. Therefore, different research methods can be used to explore organizational resilience in the future.

### 4) CULTURAL INTEGRATION

The development of organizational resilience is inseparable from the national institutional environment and cultural background. Different cultural backgrounds and institutional environments have different impacts on organizational resilience. How to perfectly combine organizational resilience with the national cultural and institutional environment in a highly uncertain environment is a major challenge for organizational resilience research. Therefore, exploring organizational resilience in different national cultural backgrounds and institutional environments is an important development direction.

Despite some meaningful results visualized from publications related to organizational resilience, this study has some deficiencies. All the CiteSpace input data were downloaded from the WOS databases SCIE and SSCI, and > 99% of the articles were in English, leading to language bias and the ignoring of other data sources.

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