INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 14, Issue 11, (2024) E-ISSN: 2222-6990

Research Trend of Technology Innovation from 1971 to 2024: A Bibliometric Analysis

Norhafizah Binti Mohamad Dasuki[1], Fauzan[1,2], Isma Addi Bin Jumbri[1], Nur Atika Binti Atan[3]

[1]Fakulti Pengurusan Teknologi dan Teknousahawanan, Centre of Technopreneurship Development, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya 76100, Durian Tunggal, Melaka, [2]Fakultas Ekonomika dan Bisnis, Universitas PGRI Kanjuruhan Malang, Malang, Indonesia, [3]School of Management and Digital Health, KPJ Healthcare University, Lot PT 17010, Persiaran Seriemas, Kota Seriemas, 71800 Nilai, Negeri Sembilan

Corresponding Author Email: norhafizahdasuki@utem.edu.my

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v14-i11/23420 DOI:10.6007/IJARBSS/v14-i11/23420

Published Date: 25 November 2024

Abstract

Purpose – The aim of this paper is to present a detailed analysis of the Technology Innovation literature published in the Scopus database from 1971 to 2024, determining the trends in the field of technology innovation and its maturity as an academic field of study. Design/methodology/approach – Employing a quantitative approach for literature review, namely bibliometric analysis, pertinent papers were sourced from the Scopus database accessed on October 4, 2024. A total of 1,742 publications were found and analysed for bibliometric purposes. We used BiblioMagika, VOSviewer, and Publish or Perish software for data analysis. Open Refine was utilised for data cleansing. Findings – The study identified a significant increase in scientific investigations of technology innovation in recent years, along with greater collaboration and international research. A few nations, notably China, the United States, and the United Kingdom, dominate technology innovation research, but institutional and individual research output is more uniformly dispersed. It also discovered that authors or institutions predominate in the literature on technological innovation. Research limitations/implications – This study exclusively utilizes the Scopus database, concentrating on article types, journal document sources, and literature published in English. Originality/value – This paper provides significant contributions. Initially, it highlights the growing research tendency in the domain of technological innovation. Secondly, it assesses the present maturity of the field according to its epistemological framework, concludes that technological innovation is progressively maturing, and fosters a growing consensus within the domain of study.

Keyword: Technology, Innovation, Bibliometric Analysis

Introduction

Innovation is essential for economic development and advancement (Tello Gamarra et al., 2019), despite the fact that the literature has typically classified this field as having a low research intensity (Bigliardi & Galati, 2013). Innovation itself is defined as a new product, process, or service that has been recognized as an important instrument for a firm in an industry to separate itself from competitors, meet consumer expectations (Bigliardi & Galati, 2013) as well as generate significant profits. Meanwhile technology in the other hand have been defined as a cultural activity that applies scientific and mechanical principles to problem-solving, involving tools, processes, resources, personnel, and systems to create specific advantages in ecological, economic, and social contexts which emphasizes on the interconnection between technology and culture (Bush,1981; McOmber,1999). Technology has emerged as the primary driving force for organizations seeking a competitive advantage (Yubo, et al., 2023), altering the ways in which organizations work (Cascio & Montealegre, 2016; Forman, King, & Lyytinen, 2014; Parker, Van den Broeck, & Holman, 2017) and changing the landscape of how business is conducted. Two pivotal events—the debut of the personal computer in 1977 and the explosive growth of consumer internet services in 1997—highlight the enormous changes that have occurred in the global technology landscape over the last 60 years (Gordon, 2012; Kim, Wang, & Boon, 2021). Technology has been ubiquitous since the early 1960s and is often linked to "innovation" and "change" (Schatzberg, 2018).

This technology innovation has significantly enhanced firm competitiveness (Afuah, 2002; Chatzoglou & Chatzoudes, 2018; Ortega, 2010; Shan & Jolly, 2012), fosters sustainable growth (Santana et al., 2015), and transforms business strategies (Akbari et al., 2021), thereby exerting an indirect influence on the broader economy (Gold, 1986; Steil et al., 2002; Casanova et al., 2017). The growth of competitive advantage is a crucial element for company growth (Lafuente et al., 2019), which can be attained through the development of technological innovations (Hoflinger et al., 2017). Although these technological innovations are important in business, not all companies are able to participate in their development (Acosta et al., 2015). Some of the fundamental and most influential classifications of technology innovation that is critically discusses, highlighting their limitations while theories of technological change have a crucial role in understanding different types of innovation. Basically, there are several commonly recognized primary types of technological innovation, and the category was based on the impact, nature, and application such as, Incremental Innovation; Radical Innovation; Disruptive Innovation; Architectural Innovation, Process Innovation, Product Innovation, Open Innovation; Sustainable or Green Innovation (Chiffi, et al, 2022).

A bibliometric examination of technological innovation from 1971–2024 is crucial for understanding development patterns, research paths, and the substantial contributions of diverse researchers and organizations to global technological progress. This bibliometric approach enables scholars and policymakers to evaluate research trends, estimate the influence of technology on economic and social development, and suggest possible unexplored research fields. This analytical method enables a systematic assessment of extensive scientific publications, patents, and research contributions, yielding quantitative insights into the evolution and dissemination of numerous technologies across disciplines and locations. Bibliometric analysis elucidates influential research domains, key authors, and prominent institutions through an examination of citation patterns, publication rates, and

collaborative networks, thereby assisting stakeholders in recognizing high-impact discoveries and developing research trends.

However, among the technological innovation that is rapidly advancing, with several key areas that shaping various industries such as Artificial Intelligence (AI) and Machine Learning, Robotics and Automation, Advanced Materials Science, Biotechnology and Genomics, Quantum Computing, Internet of Things (IoT), 5G and Advanced Connectivity; Immersive Technologies (AR/VR); Cybersecurity Innovations and last but not least Sustainable and Green Technologies (Chiffi, et al, 2022). Even though technological innovation progress has led to many reforms in business strategies (Danvila-del-Valle et al., 2019), but it is almost invariably analysed as an economic phenomenon and the definition and classification of innovations have been a continuous endeavour in economics (Coccia, 2006; Schumpeter, 1942). To better understand the progression of research on technological innovation, a bibliometric analysis was conducted to comprehensively examine existing studies. This analysis highlights the growing importance of the topic, as evidenced by the significant number of recent publications and research efforts by scholars and academicians. Accordingly, this essay will explore the development and discussion of technological innovation research over the past 53 years.

This study is essential for directing researchers, scientists, and innovators in developing more effective and efficient research methodologies. Bibliometric analysis offers academics and innovators an extensive perspective of the technological ecosystem, enabling them to strategically align their work with critical areas of interest and leverage collaborative opportunities. This study enhances foundational knowledge and acts as a crucial instrument for promoting sustainable technological advancement and innovation. This research provides empirical data to assess impact, international collaboration, and the contributions of established and developing nations within the global innovation ecosystem using a comprehensive scope and systematic methodology. This study enhances our understanding of the historical and contemporary progression of technological innovation and aids in the development of evidence-based strategies that foster sustainable and significant improvements across many industries.

Through bibliometric assessment of the literature, it serves as a vital element in formulating theoretical frameworks and developing conceptual models, effectively synthesising data, and identifying study advancement areas (Snyder, 2019). Bibliometric analyses provide an organised perspective on information (van Nunen et al., 2018). The use of statistical methodologies (Dzikowski, 2018) facilitates the identification of emerging research domains (Wang, 2018; Xu et al., 2018), as the assessment of scientific quality (Dzikowski, 2018) provides a comprehensive overview of the current research landscape by subject of interest (Benton et al., 2018). A bibliometric analysis could reveal trends in technological innovation and improve knowledge about technological progress around the world. While researchers have conducted analogous bibliometric studies on innovation systems (Suominen et al., 2019), they have not yet conducted research on innovation adoption (van Oorschot et al., 2018) or product and process innovation in manufacturing (Marzi et al., 2017) in the food industry, despite the sector's significant innovation output. This proposal aims to rectify these deficiencies with a thorough bibliometric analysis of technology innovation in Scopus-

indexed journals, concentrating on publishing trends, principal topics, citation patterns, and collaboration networks.

For this purpose, this study attempts to identify the main research areas, current dynamics and future directions of studies on technology innovation. To do so, bibliometric review techniques have been used to answer the following questions:

1. How is the development and trend of research on technology innovation?
2. Which channels (countries and journals) are most influential in research on technology innovation?
3. The most cited authors and researchers in research on technology innovation?

In summary, this study enhances academic understanding and acts as a practical resource for stakeholders influencing the future of technology. It also helps to delineate prospective research directions based on the gap analysis. It highlights the usability and efficacy of bibliometric analysis as a means of evaluating and predicting research trends; hence, it emphasizes the importance of monitoring technological progress over time. This document is structured as outlined below. The first segment focuses on examining relevant literature. The following section delineates the technique employed in the study to analyse the data. This is succeeded by a section summarising the principal results and another discussing the key discoveries. The last section concludes the study.

Literature Review

Over the past six decades, technological innovation has been a topic of significant interest to researchers, governments, and industry leaders alike (Akbari et al., 2020). The rapid pace of technological change and its impact on competitiveness have driven an exponential growth in publications on this subject. (Castillo-Vergara et al., 2021) Bibliometric analysis has become a valuable tool for synthesizing the main research themes and identifying potential areas for future research in the field of technological innovation. (Castillo-Vergara et al., 2021).

One such study, conducted by (Akbari et al., 2020), analyzed the intellectual structure of technological innovation literature based on 1,361 documents published between 1961 and 2019. The findings reveal that researchers have not adequately drawn on theoretical perspectives outside the field to study various dimensions of technological innovation, such as sources of innovation, environmental innovation, investment, and economic growth.

Similarly, a study on technological innovation in the world analyzed 3,273 documents published in scopus journals. This work aimed to identify the main research topics and highlight potential avenues for future research in the field. (Cappellesso et al., 2020).

Another relevant study, which focused on the role of digitization in organizational, environmental, and socio-economic sustainability, reviewed 605 publications from the Scopus database. The findings suggest that increased scholarship is needed to produce environmentally friendly and greener technologies capable of supporting inclusive economic models and promoting sustainable development. (Akbari et al., 2020) (Castillo-Vergara et al., 2021) (Chopra et al., 2023).

Furthermore, a recent systematic review on the role of digital social innovations in addressing the Sustainable Development Goals examined 45 peer-reviewed articles published from 2010

to 2022. The study observed the widespread use of technologies such as blockchain, IoT, artificial intelligence, and autonomous robots, which are rapidly changing various sectors, including healthcare, smart cities, agriculture, and the fight against poverty and inequality(Babatunde et al., 2022). However, the review also highlighted concerns about the ethical implications of increased data usage and the potential impact on the labor force.

In summary, the existing literature on technological innovation and trends has focused on various aspects, including the intellectual structure of the field, research topics in specific industries, the role of digitization in sustainability, and the potential of digital social innovations to address global challenges.

Technological innovation is increasingly seen as a critical factor in promoting green development, especially in regions facing significant environmental challenges. Hu et al. (2021) examined the Yangtze River Economic Belt in China, illustrating how technological innovations play a pivotal role in fostering sustainable growth. Their findings revealed a U-shaped nonlinear relationship between technological innovation and green development, showing that innovation's impact varies across economic, social, and ecological dimensions. This emphasizes the multifaceted nature of technological progress and its ability to drive environmentally responsible development.

The relationship between technological innovation and business transformation, particularly in the context of servitization, has also been a subject of inquiry. Hwang and colleagues (2019) focused on Taiwan's community innovation survey to assess how product and process innovations influence servitization—the shift from product-oriented to service-oriented business models. They found that the level of innovativeness moderates this relationship, suggesting that higher innovation intensity may accelerate servitization and lead to more dynamic business operations.

The role of leadership in technological innovation has also gained attention. Vlok et al. (2019) explored the concept of integrative leadership and its significance in driving successful technological innovation. According to their research, effective leadership competencies enable organizations to navigate rapidly changing environments, leverage diverse knowledge networks, and optimize resources. This indicates that leadership plays a central role in integrating and managing the complex processes associated with technological advancements.

In the food industry, technological innovation has been shown to improve competitiveness and respond to changing consumer demands. Castillo-Vergara et al. (2021) conducted a bibliometric analysis revealing that innovation in both product and process development is key to enhancing the sector's ability to offer novel and functional food solutions. This reflects the broader trend where technological innovation is not limited to traditional industries but also penetrates more specialized sectors like food, addressing specific consumer needs and preferences.

Technological innovation's impact on firm performance, as explored by several scholars, further highlights its strategic importance. A meta-analysis by a 2022 IEEE study demonstrated that firms adopting innovative products and processes see significant

performance improvements. The analysis also found that this effect is amplified in cultural contexts with low uncertainty avoidance and higher levels of collectivism, showcasing the importance of aligning innovation strategies with institutional and cultural contexts.

Handiwibowo (2019), emphasized the significance of Technological Innovation Capabilities (TIC), which include the knowledge, skills, and techniques organizations use to drive innovation. These capabilities enable firms to enhance their new product development (NPD) performance, giving them a competitive edge. The framework proposed by Handiwibowo aligns with other research showing how internal innovation capacities are key to sustainable competitive advantages.

In sectors like energy conservation and emission reduction, technological innovation is often driven by both internal and external factors. Sun (2022) examined small and medium-sized enterprises (SMEs) and highlighted that organizational structure, government support, and market conditions are critical drivers of innovation. This suggests that a conducive policy environment and institutional support are necessary for technological advancements in energy and environmental sectors.

Finally, in the context of global environmental policies, Kim (2021) explored how technological innovation, particularly in climate change mitigation technologies, is crucial in reducing greenhouse gas emissions. The study highlights the role of international agreements like the Kyoto Protocol, which foster innovation through regulatory frameworks that encourage the development and diffusion of green technologies.

In summary, the literature demonstrates that technological innovation is a key driver across various industries and sectors. Whether it is green development in China, servitization in Taiwan, or product innovations in the food industry, technological advancements significantly enhance organizational competitiveness, environmental sustainability, and overall performance. Moreover, the role of leadership, institutional contexts, and technological capabilities cannot be understated in enabling organizations to navigate the complexities of innovation in today's rapidly evolving global landscape.

Method

In technological innovation, bibliometric analysis is the most effective way for addressing research challenges, including trend analysis. Bibliometric analysis is a quantitative approach to examining academic literature that utilises a bibliography to characterise, evaluate, and monitor published research (Garfield, Sher, and Torpie 1964; Liang and Liu 2018; White and McCain 1989). The objective is to analyse publications, citations, and information sources. This research will facilitate the assessment of authors' scientific productivity, the annual publication growth rate, citation analysis, author network analysis, journals, universities, countries, citation-based keywords, frequency analysis methods, and several other data points. It facilitates the identification of research clusters, offers insights into current research interests, and pinpoints emerging trends in a field. Each bibliometric technique is advantageous for particular research enquiries, and bibliometrics for scientific mapping can tackle the most prominent questions (Aria and Cuccurullo 2017).

At 5:52 PM on Friday, October 4, 2024, we extracted metadata from the Scopus database. Scopus is a database that provides precise and extensive information, together with specialised analytical tools and a diverse array of subjects. Metadata was gathered from 1971 to 2024 using an "technology innovation" examination of article titles. Enhanced specificity and information retrieval have been recorded through the use of title-specific searches (Aleixandre et al. 2015; Sweileh et al. 2017). Metadata can be downloaded in both RIS and CSV formats. Metadata from published literature was assessed utilising biblioMagika to do frequency analysis and compute citation metrics (Ahmi 2024). For data visualization, VOSviewer is used.

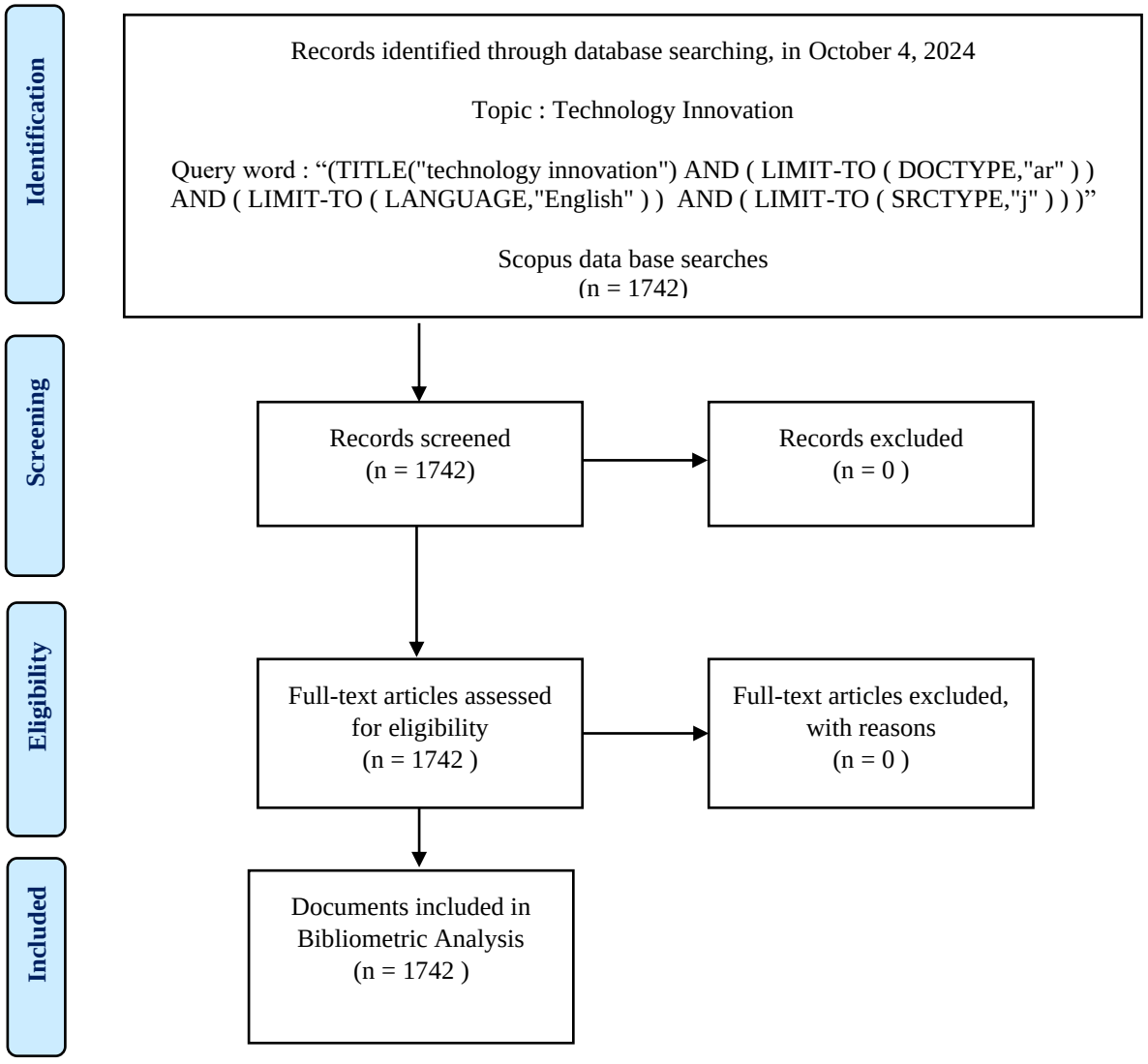

Figure 1. Data Identification PRISMA Flow Diagram
Source: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009).

Result and Findings

Basic Information

The data of this study is focused on the type of article documents and journal document sources, as well as documents that use English only. By using the query "technology innovation" which is focused on the article title, there are 1742 publications identified on

technology innovation. The publication time span is 53 years (1971-2024), total citations 48,466 from 5442 contributors who wrote about technology innovation studies. And the average citations is 27.81 per article, while citations per author is 8.91. For 53 years, studies on technology innovation found h-index 101 and g-index 184. Table 1 shows basic information from studies on technology innovation.

Table 1
Basic Information

Main Information	Data
Publication Years	1971 - 2024
Total Publications	1742
Number of Contributing Authors	5442
Number of Cited Papers	1412
Total Citations	48,466
Citation per Paper	27.81
Citation per Cited Paper	34.32
Citation per Year	897.52
Citation per Author	8.91
Author per Paper	3.12
Citation sum within h-Core	40,094
h-index	101
g-index	184

Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

Document Profile

Table 2 presents the results of the analysis in the form of categories of published documents based on subject areas. In general, the distribution reveals that the literature on Technology Innovation occurs in various fields such as "Environmental Science", "Business, Management and Accounting", and "Social Sciences". As illustrated in table 2, the results of the analysis show that the documents are in Environmental Science with 613 (35.19%), followed by Business, Management and Accounting with 452 (25.95%) documents, and Social Sciences 426 (24.45%) documents.

Table 2
Subject Area

Subject Area	TP	%
Environmental Science	613	35.19%
Business, Management and Accounting	452	25.95%
Social Sciences	426	24.45%
Engineering	345	19.80%
Energy	343	19.69%
Computer Science	325	18.66%
Economics, Econometrics and Finance	266	15.27%
Decision Sciences	125	7.18%
Medicine	111	6.37%
Mathematics	104	5.97%
Psychology	60	3.44%

Multidisciplinary	56	3.21%
Agricultural and Biological Sciences	49	2.81%
Earth and Planetary Sciences	45	2.58%
Materials Science	41	2.35%
Chemical Engineering	38	2.18%
Arts and Humanities	25	1.44%
Physics and Astronomy	21	1.21%
Biochemistry, Genetics and Molecular Biology	17	0.98%
Chemistry	16	0.92%
Pharmacology, Toxicology and Pharmaceutics	14	0.80%
Nursing	10	0.57%
Health Professions	9	0.52%
Neuroscience	6	0.34%
Dentistry	1	0.06%
Immunology and Microbiology	1	0.06%
Veterinary	1	0.06%
Undefined	2	0.11%

RQ 1: Research Trends on technology innovation

Descriptive analysis of annual publication growth, addressing trends and impacts of publications in technology innovation studies.

A detailed statistical summary of annual publications on technology innovation is presented in Table 4. Referring to the Scopus database, the first author who reviewed technology innovation was W. Bierfelder in 1976 with the title “Innovation in acceptable doses: problems of supplementing educational technology innovations in firms”, published in R&D Management, vol. 6, issue 1, pages 183-187 (Bierfelder, 1976). However, in 1971 someone had already written a paper entitled “Technology: Innovation research”, published in Nature, vol. 233, issue. 5316, page 156, but the author of the paper is unknown. Publications in 2023 showed the largest compared to other years, with 368 documents, and the highest citations occurred in 2022. However, documents published in 1991 received the highest citations, with 6310 citations coming from an article entitled “Development of an instrument to measure the perceptions of adopting an information technology innovation” written by Gary C. Moore and Izak Benbasat, and published in Information Systems Research, vol. 2, issue. 3, pages 192 – 222 (Moore and Izak, 1991), Figures 2 and 3 show the increase in publication activity and trends regarding technology innovation from year to year.

Table 4
Annual Research Output and Citation Metrics

Year	TP	NCA	NCP	TC	C/P	C/CP	*h*	*g*	*m*
1971	1	0	0	0	0.00	0.00	0	0	0.000
1976	1	1	0	0	0.00	0.00	0	0	0.000
1979	1	1	0	0	0.00	0.00	0	0	0.000
1980	1	1	1	5	5.00	5.00	1	1	0.022
1981	2	5	2	7	3.50	3.50	1	2	0.023
1983	1	1	0	0	0.00	0.00	0	0	0.000
1984	3	3	2	161	53.67	80.50	2	3	0.049
1985	1	2	0	0	0.00	0.00	0	0	0.000
1986	2	3	1	1	0.50	1.00	1	1	0.026
1987	3	6	3	30	10.00	10.00	2	3	0.053
1988	2	2	2	14	7.00	7.00	2	2	0.054
1989	3	3	1	8	2.67	8.00	1	2	0.028
1990	5	9	4	120	24.00	30.00	2	5	0.057
1991	1	2	1	6310	6310.00	6310.00	1	1	0.029
1992	2	4	1	40	20.00	40.00	1	2	0.030
1993	2	2	1	46	23.00	46.00	1	2	0.031
1994	4	10	3	631	157.75	210.33	3	4	0.097
1995	4	7	3	237	59.25	79.00	3	4	0.100
1996	1	1	1	7	7.00	7.00	1	1	0.034
1997	3	7	3	1169	389.67	389.67	3	3	0.107
1998	8	9	4	53	6.63	13.25	3	7	0.111
1999	5	10	4	116	23.20	29.00	3	5	0.115
2000	6	9	5	93	15.50	18.60	4	6	0.160
2001	9	13	9	369	41.00	41.00	6	9	0.250
2002	9	17	7	1071	119.00	153.00	7	9	0.304
2003	9	15	6	448	49.78	74.67	5	9	0.227
2004	6	18	6	245	40.83	40.83	4	6	0.190
2005	14	43	13	276	19.71	21.23	8	14	0.400
2006	18	34	14	449	24.94	32.07	9	18	0.474
2007	19	49	13	431	22.68	33.15	9	19	0.500
2008	17	43	16	862	50.71	53.88	10	17	0.588
2009	19	40	17	780	41.05	45.88	9	19	0.563
2010	21	51	18	536	25.52	29.78	9	21	0.600
2011	13	31	13	251	19.31	19.31	8	13	0.571
2012	38	82	31	485	12.76	15.65	11	21	0.846
2013	37	111	30	1081	29.22	36.03	15	32	1.250
2014	36	91	31	872	24.22	28.13	17	29	1.545
2015	40	98	30	649	16.23	21.63	14	25	1.400
2016	50	123	41	998	19.96	24.34	15	31	1.667
2017	51	176	43	911	17.86	21.19	15	29	1.875
2018	42	140	38	1584	37.71	41.68	20	39	2.857
2019	67	212	60	2805	41.87	46.75	23	52	3.833
2020	73	219	72	3301	45.22	45.85	24	57	4.800
2021	126	455	124	7278	57.76	58.69	41	84	10.250
2022	263	900	253	8077	30.71	31.92	48	81	16.000
2023	368	1251	330	4732	12.86	14.34	33	52	16.500
2024	333	1129	154	927	2.78	6.02	15	22	15.000

Note: TP=total number of publications; NCA=number of contributing authors; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; g=g-index; m=m-index.

Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

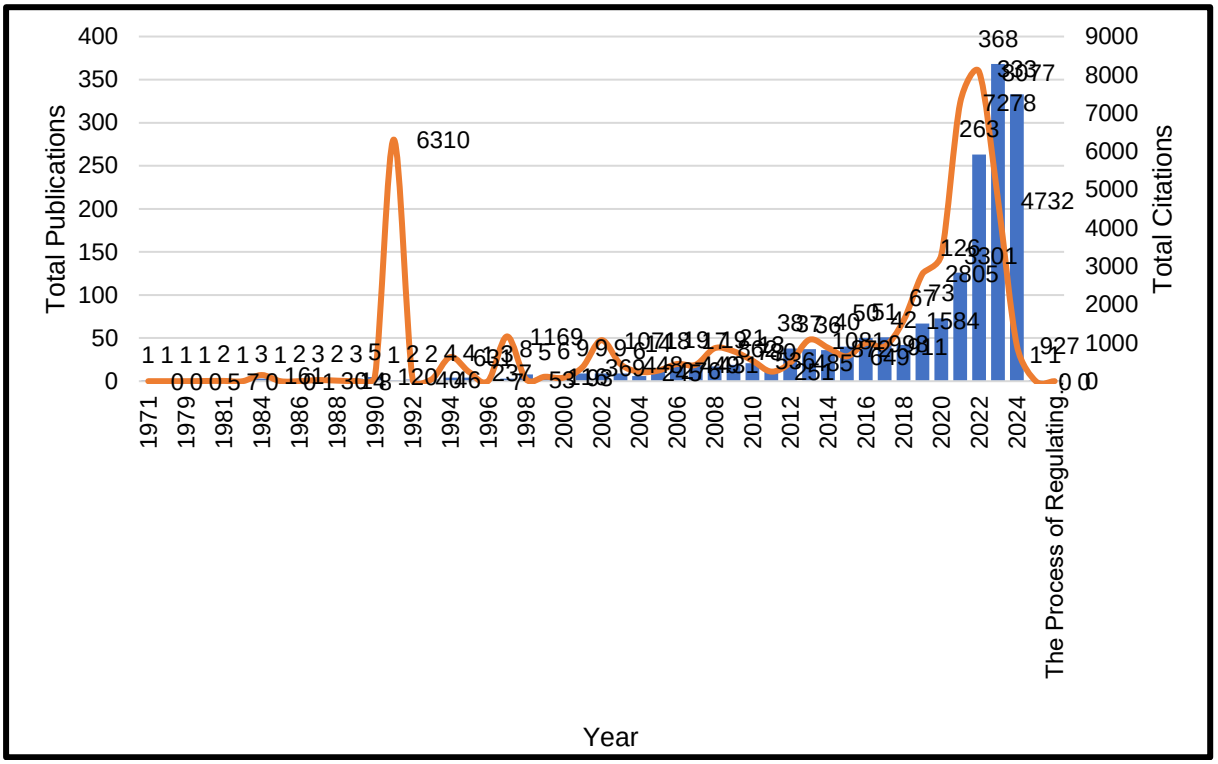

Figure 2. Total publications and total citations by year
Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

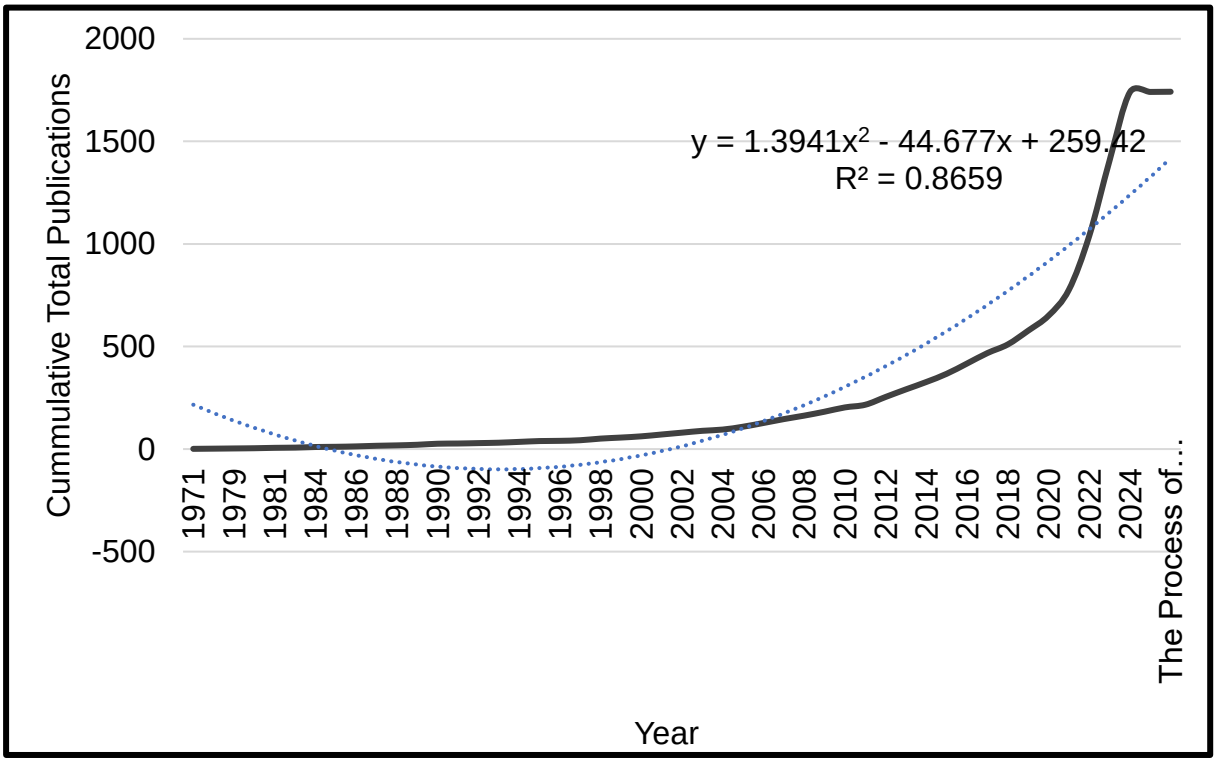

Figure 3. Cumulative Growth of Publications Over Time (1991-2024)
Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

RQ 2: Which channel are the most influential in technology innovation research

The second question in this study is what channels are the most productive and influential in the study of technology innovation. To answer this question we analyze the most productive and influential countries and source titles.

Publications by Countries

This analysis answers the question of the most important country in the study of technology innovation. From the Scopus database that has been collected, there are researchers from 87 countries who have published documents on technology innovation. The countries that contribute to the publication of technology innovation are shown in Table 5, and the geographical distribution is shown in Figure 4. More than fifty percent of studies on technology innovation are produced by researchers from China with a total publication of 1099 (63.09%) documents, followed by the United States and the United Kingdom, each with 221 (12.69%) and 96 (5.51%). Meanwhile, Malaysia is ranked 6th out of 10 countries that contribute the most to studies on technology innovation, with 45 documents (2.58%).

Table 5
Top 10 Most Productive Countries Contributed to the Publications

Country	Continent	TP	%
China	Asia	1099	63.09%
United States	North America	221	12.69%
United Kingdom	Europe	96	5.51%
South Korea	Asia	56	3.21%
Pakistan	Asia	47	2.70%
Malaysia	Asia	45	2.58%
Australia	Oceania	43	2.47%
Canada	North America	35	2.01%
India	Asia	35	2.01%
Italy	Europe	32	1.84%

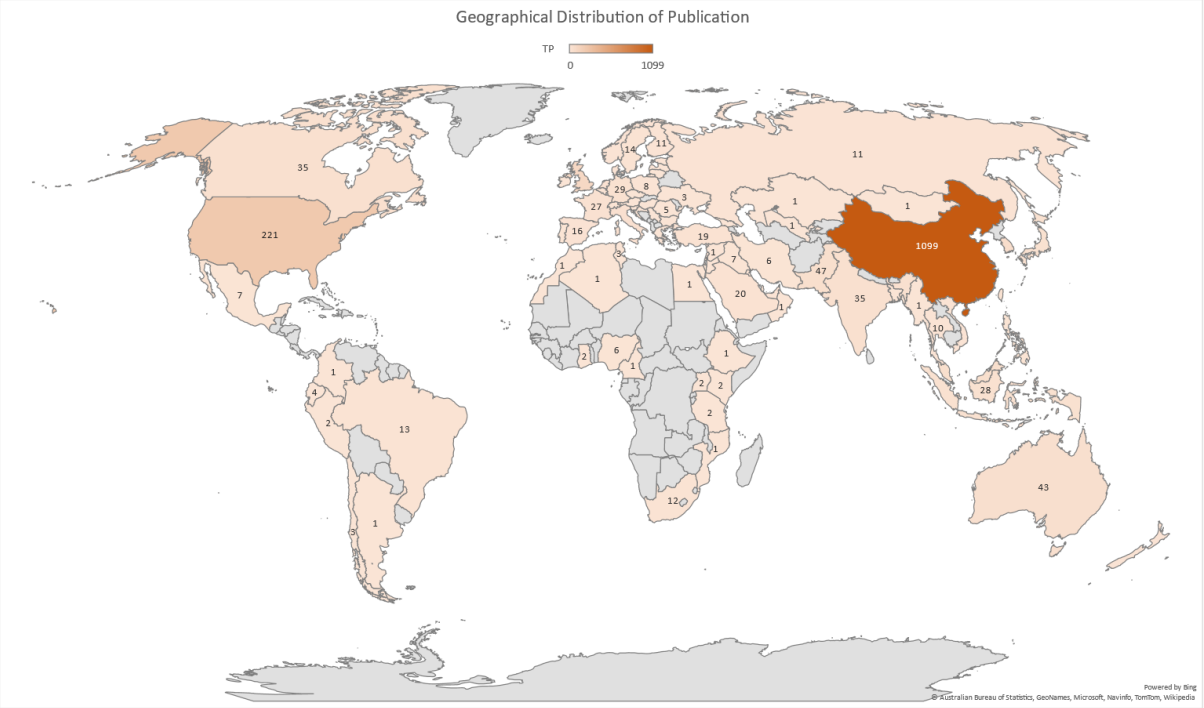

Figure 4. Geographical Distribution of Publication

Figure 5 further shows the network visualization map of authors based on the countries they are affiliated with. Only countries with more than three articles and more than one citation are considered in this analysis. Based on the full count method, the findings show that China plays a very prominent role in cooperating with other countries. China has closely cooperated with Singapore, Philippines, and Ukraine, while the United States cooperates with Austria, Australia, the Netherlands, while the United Kingdom seems to cooperate with India, the United States and China. Figure 5 shows the network visualization map of co-authorship based on countries with at least one citation count and three document counts (full count).

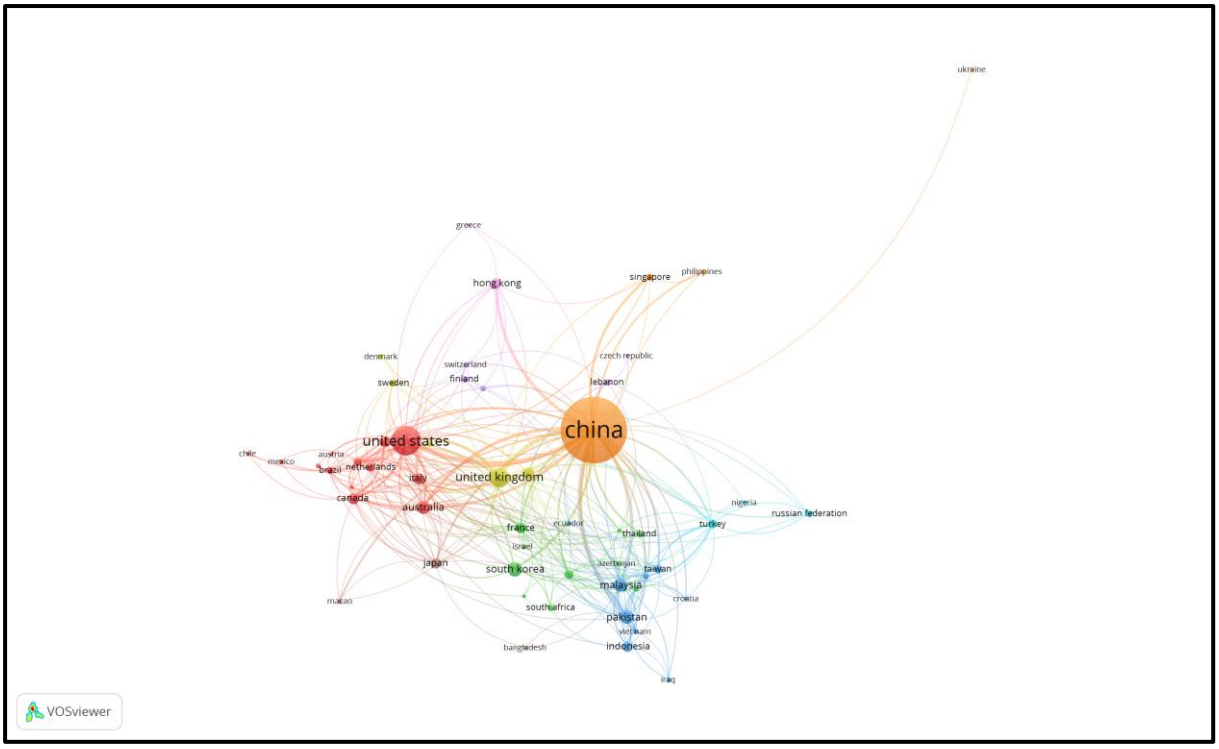

Figure 5: Network visualization map of the co-authorship
Unit of analysis = Countries Counting method: Full counting Minimum number of documents of a country = 5 Minimum number of citations of a country = 1

Publications by Source Title

Research on technology innovation is also published in various journals, conference proceedings, books, and book series. However, this study only focuses on articles and journals. Table 6 shows the most active source titles publishing articles on technology innovation. As can be seen from the table, “Sustainability (Switzerland)” is the highest source of documents publishing about technology innovation with 117 documents. The source of documents that received the most citations was “Technological Forecasting and Social Change” with 2562 citations, and an average citation per paper of 67.42.

Figure 6 is the result of VOSviewer's analysis of citations based on sources that place Sustainability (Switzerland) as the most dominant source from other sources. This analysis is based on sources that have a minimum of 5 documents and 1 citation.

Table 6
Most Productive Source Title

Source Title	TP	NCA	NCP	TC	C/P	C/CP	*h*	*g*	*m*
Sustainability (Switzerland)	117	402	106	1584	13.54	14.94	20	35	2.500
Environmental Science and Pollution Research	88	320	83	2168	24.64	26.12	24	44	4.000
Journal of Cleaner Production	43	152	41	2556	59.44	62.34	26	43	2.364
Frontiers in Environmental Science	41	137	40	546	13.32	13.65	11	21	2.750
Technological Forecasting and Social Change	38	130	35	2562	67.42	73.20	20	38	1.176
International Journal of Environmental Research and Public Health	33	130	33	1159	35.12	35.12	17	33	2.125
Energy Economics	25	93	23	2367	94.68	102.91	15	25	1.364
PLoS ONE	24	79	15	135	5.63	9.00	6	11	1.200
Journal of Environmental Management	21	68	17	1758	83.71	103.41	12	21	3.000
Environment, Development and Sustainability	20	73	13	126	6.30	9.69	6	11	1.200
Renewable Energy	20	67	18	1159	57.95	64.39	14	20	2.800
Energy Policy	15	54	13	1038	69.20	79.85	11	15	0.478
Resources Policy	14	52	12	333	23.79	27.75	9	14	3.000
Economic Research-Ekonomska Istrazivanja	14	49	11	143	10.21	13.00	6	11	1.500
Technology Analysis and Strategic Management	14	30	11	403	28.79	36.64	8	14	0.364
Heliyon	13	47	8	38	2.92	4.75	4	6	2.000
Sustainability (Switzerland)	13	42	7	10	0.77	1.43	2	2	2.000
International Journal of Technology Management	13	42	10	138	10.62	13.80	7	11	0.250
Energy	12	48	10	175	14.58	17.50	6	12	1.200
Technology in Society	12	41	10	687	57.25	68.70	9	12	0.375

Note: TP=total number of publications; NCA=number of contributing authors; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; g=g-index; m=m-index.
Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

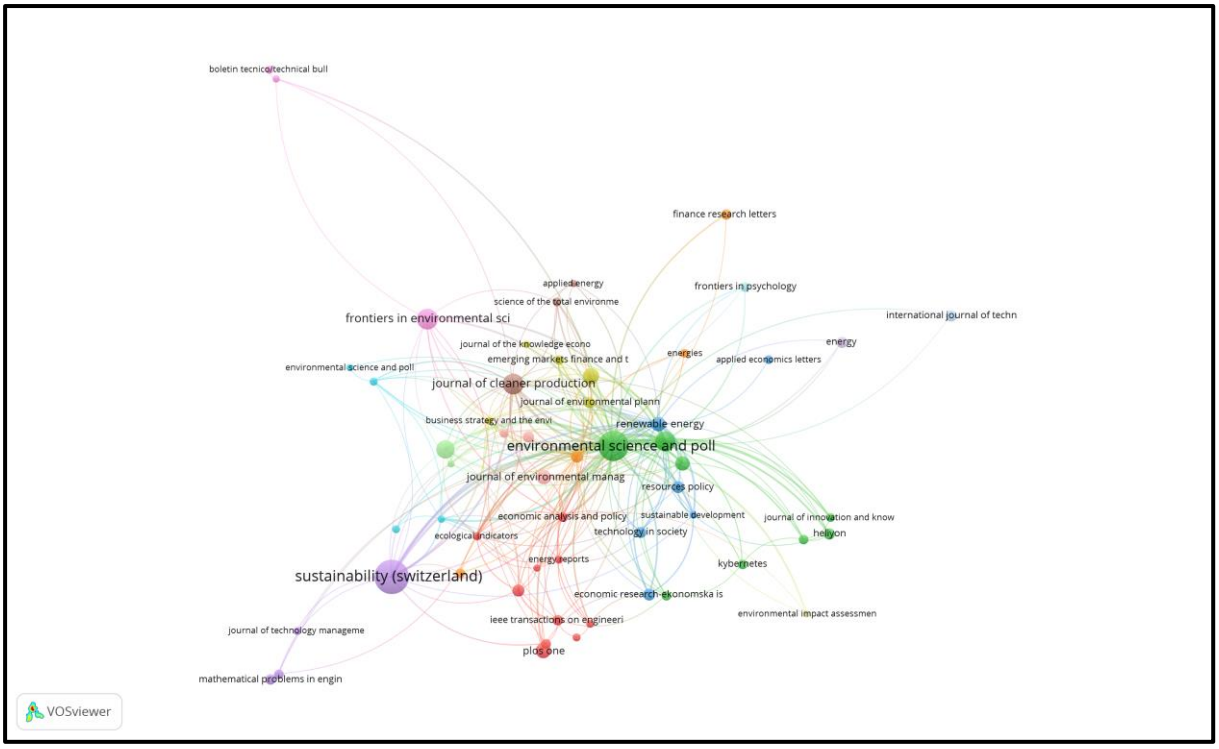

Figure 6. Network visualisation map of the Citation by source
Note: Minimum number of documents of a source = 5; Minimum number of citations of a source = 1,

RQ 3 : Most Cited Author and Researcher

This part of the study answers the third RQ, which aims to determine the most influential authors in technology innovation research. To answer RQ3, 1742 articles were analyzed through the total number of citations for each document. Although there are several ways to measure the influence of research publications, citation analysis is the most common (Ding and Cronin, 2011).

At the same time, Table 7 shows the most cited articles based on the Scopus database (depending on the total number of citations for each document). Moore and Benbasat (1991) ranked first in the article entitled “Development of an instrument to measure the perceptions of adopting an information technology innovation” (Moore and Benbasat, 1991), published in Information System Research, vol. 2, issue. 3, pages, 192-222, with a total number of citations of 6310, and an average of 185.59 citations per year.
Figure 7 shows the results of citation analysis using VOSviewer based on authors who have a minimum of 4 documents and 1 citation in each document.

Table 7
Top 20 Highly Cited Articles

No.	Author(s)	Title	Source Title	TC	C/Y
1	Moore G.C.; Benbasat I. (1991)	Development of an instrument to measure the perceptions of adopting an information technology innovation	Information Systems Research	6310	185.59
2	Anselin L.; Varga A.; Acs Z. (1997)	Local Geographic Spillovers between University Research and High Technology Innovations	Journal of Urban Economics	1097	39.18
3	Du K.; Cheng Y.; Yao X. (2021)	Environmental regulation, green technology innovation, and industrial structure upgrading: The road to the green transformation of Chinese cities	Energy Economics	640	160.00
4	King J.L.; Gurbaxani V.; Kraemer K.L.; McFarlan F.W.; Raman K.S.; Yap C.S. (1994)	Institutional factors in information technology innovation	Information Systems Research	600	19.35
5	Du K.; Li P.; Yan Z. (2019)	Do green technology innovations contribute to carbon dioxide emission reduction? Empirical evidence from patent data	Technological Forecasting and Social Change	570	95.00
6	Du K.; Li J. (2019)	Towards a green world: How do green technology innovations affect total-factor carbon productivity	Energy Policy	529	88.17
7	Cai X.; Zhu B.; Zhang H.; Li L.; Xie M. (2020)	Can direct environmental regulation promote green technology innovation in heavily polluting industries? Evidence from Chinese listed companies	Science of the Total Environment	459	91.80
8	Lv C.; Shao C.; Lee C.-C. (2021)	Green technology innovation and financial development: Do environmental regulation and innovation output matter?	Energy Economics	445	111.25

9	Zhao Y.; Pugh K.; Sheldon S.; Byers J.L. (2002)	Conditions for classroom technology innovations	Teachers College Record	433	18.83
10	Ni Y.Q.; Xia Y.; Liao W.Y.; Ko J.M. (2009)	Technology innovation in developing the structural health monitoring system for Guangzhou New TV Tower	Structural Control and Health Monitoring	397	24.81
11	Shin H.; Kang J. (2020)	Reducing perceived health risk to attract hotel customers in the COVID-19 pandemic era: Focused on technology innovation for social distancing and cleanliness	International Journal of Hospitality Management	364	72.80
12	Feng S.; Zhang R.; Li G. (2022)	Environmental decentralization, digital finance and green technology innovation	Structural Change and Economic Dynamics	359	119.67
13	Lyytinen K.; Rose G.M. (2003)	The disruptive nature of information technology innovations: The case of internet computing in systems development organizations	MIS Quarterly: Management Information Systems	349	15.86
14	Shan S.; Genç S.Y.; Kamran H.W.; Dinca G. (2021)	Role of green technology innovation and renewable energy in carbon neutrality: A sustainable investigation from Turkey	Journal of Environmental Management	336	84.00
15	Koellinger P. (2008)	The relationship between technology, innovation, and firm performance-Empirical evidence from e-business in Europe	Research Policy	323	19.00
16	Lin B.; Ma R. (2022)	Green technology innovations, urban innovation environment and CO2 emission reduction in China: Fresh evidence from a partially linear functional-coefficient panel model	Technological Forecasting and Social Change	304	101.33
17	Wang H.; Cui H.; Zhao Q. (2021)	Effect of green technology innovation on green total factor productivity in China: Evidence from spatial durbin model analysis	Journal of Cleaner Production	303	75.75

18	Tang C.; Xu Y.; Hao Y.; Wu H.; Xue Y. (2021)	What is the role of telecommunications infrastructure construction in green technology innovation? A firm-level analysis for China	Energy Economics	275	68.75
19	Guo Y.; Xia X.; Zhang S.; Zhang D. (2018)	Environmental regulation, government R & D funding and green technology innovation: Evidence from China provincial data	Sustainability (Switzerland)	272	38.86
20	Godil D.I.; Yu Z.; Sharif A.; Usman R.; Khan S.A.R. (2021)	Investigate the role of technology innovation and renewable energy in reducing transport sector CO2 emission in China: A path toward sustainable development	Sustainable Development	269	67.25

Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024)

VOSviewer is used to analyze cocitation and further analyze author collaboration in the field of technology innovation. This analysis is based on the fact that influential authors have at least 4 publications and have been cited at least once and is calculated using full calculation. The analysis results found that out of 4623 authors, not all of them collaborate with each other, but only 69 authors collaborate with each other. The color of the connecting line, circle size, font size and thickness determine the strength of the author connection. Connected authors (shown in the same color) are usually grouped together. For example, in the purple cluster, Lin Boqiang, Xu, Xiaofeng, Shao, Yanmin, and Feng, Yuan work closely together and often conduct joint research (Figure 7).

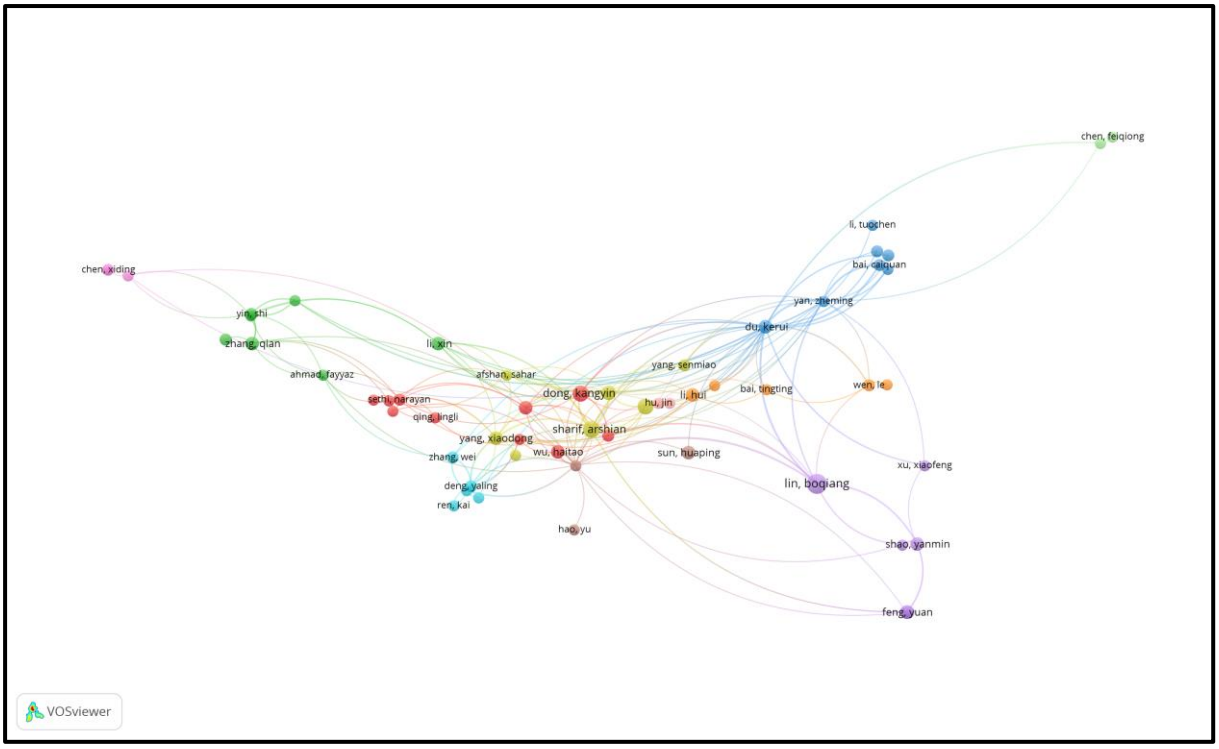

Figure 7. Network visualisation map of the Citation by author
Note: Minimum number of documents of a author = 4; Minimum number of citations of a author = 1,

Conclussion

The first research question is about identifying current trends in the field of technology innovation. Therefore, to meet the main objective of exploring research trends on technology innovation, a bibliometric analysis has been conducted. Using bibliometric analysis can assess research productivity and publications in a particular research field (Moed et al., 2001). According to Gu's (2004), information obtained from bibliometric data can evaluate the performance of a field of study, and help related research institutions to set some policies related to fund allocation, and to compare scientific input and output. In addition, bibliometric research findings can further explain the factors that support the contribution of research in a field of study and guide researchers to conduct influential research (Akhavan et al., 2016).

Therefore, the focus of this study is on technology innovation publications collected from the Scopus database. This study uses a specified search query to find 1742 documents from the specified database. The main keywords used to search for relevant documents are "technology AND innovation" and its equivalents. The research on technology innovation (according to documents collected from the Scopus database) was initiated by W. Bierfelder (1976) with the title "Innovation in acceptable doses: problems of supplementing educational technology innovations in firms". Since then until 2024, the number of publications has increased slightly. Starting from 2005 until now, the number of publications on technology innovation has increased. The trend of technology innovation publications has increased linearly, meaning that the topic of technology innovation is still interesting to researchers.
Regarding the second research question, which is to find the impact of publications in the field of technology innovation, a citation matrix has been used. The importance of technology

innovation publications can be explained from the citation metrics discussed in this study. As a consequence of 53 years of publications in the field of technology innovation (1971-2024), 1742 articles have been published and more than 48,466 citations. In general, technology innovation documents collected from the Scopus database are cited 897.52 times each year, 27.81 citations per paper and 3.12 authors per paper, and have also achieved an h-index of 101, and a g-index of 184. As for the author who published the most research on servant leadership is Lin Boqiang who is affiliated with Xiamen University, China.

This study only focuses on the type of document article, source document journal, and articles that use English only. China, the United States and the United Kingdom have been ranked as the top countries with the largest contribution to the publication of technology innovation. Research on technology innovation is usually published in publications in the fields of "Environmental Science", "Business, Management and Accounting", and "Social Sciences". Research on technology innovation is concentrated in the field of social sciences. While the source of documents that often publish studies on technology innovation is Sustainability (Switzerland).

As for answering the third research question regarding the most influential authors in technology innovation publications, we analyzed 1742 document sources. The results of the analysis found that “Development of an instrument to measure the perception of adopting an information technology innovation” written by (Moore and Benbasat, 1991) is the most cited article.

Limitation of the Study

Although bibliometric analysis has special characteristics, this study also has some limitations, which should be limited so that readers can understand this article clearly and strengthen future research. The results are only from certain keywords, namely technology innovation based on document titles. So, search query results for other fields (e.g., author and source) are not involved in this analysis. The main point is that most academic studies use titles as search queries for relevant documents. Some researchers may also focus on search words on authors or sources; as a result, their research may not be directly related to their objectives. Therefore, data filtering (filtering and cleaning) is needed before data analysis. Future research can extend to it.

Future Research

It should also be noted that no search query is 100% ideal; therefore, false positives and false negatives should be considered (Sweileh et al., 2017). The current study exclusively relied on the Scopus database as the primary source for documents. Although Scopus is one of the most comprehensive databases that archives all academic research, it does not cover all published sources (Ahmi & Mohamad, 2019). Further databases, for example, Web of Science, Google Scholar, Dimensions and others, can be used in future studies. Integrating all these databases can help add interesting and valuable results. Despite these limitations, the current study adds to the knowledge by providing current research trends on technology innovation. This study also contributes by applying bibliometric methods to expand the knowledge of technology innovation literature.

Acknowledgments

The authors would like to acknowledge of Universiti Teknikal Malaysia Melaka (UTeM) for financial funding under the Grant Tabung Penerbitan Fakulti.

References

Acosta, M., Coronado, D., & Romero, C. (2015). Linking public support, R and D, innovation and productivity: New evidence from the Spanish food industry. Food Policy, 57, 50–61. https://doi.org/10.1016/j.foodpol.2015.09.005

Afuah, A. (2002), Mapping technological capabilities into product markets and competitive advantage: the case of cholesterol drugs, *Strategic Management Journal*, (23)

Ahmi, A., & Mohamad, R. (2019). Bibliometric analysis of global scientific literature on web accessibility. *International Journal of Recent Technology and Engineering*, *7*(6), 250–258.

Ahmi, A. (2024). *Bibliometric Analysis Using BiblioMagika*. available from https://bibliomagika.com.

Akbari, M., Khodayari, M., Khaleghi, A., Danesh, M., & Padash, H. (2020, October 23). Technological innovation research in the last six decades: a bibliometric analysis. *Emerald Publishing Limited*, 24(5), 1806-1831. https://doi.org/10.1108/ejim-05-2020-0166

Akbari, M., Khodayari, M., Khaleghi, A., Danesh, M., & Padash, H. (2021). Technological innovation research in the last six decades: a bibliometric analysis. *European Journal of Innovation Management*, *24*(5), 1806-1831.

Akhavan, P., Ebrahim, N. A., Fetrati, M. A., & Pezeshkan, A. (2016). Major trends in knowledge management research: A bibliometric study. *Scientometrics*, 107(3), 1249–1264. https://doi.org/10.1007/s11192-016-1938-x

Aldianto, L., Tjakraatmadja, J.H., Larso,D., Primiana ,I., & Anggadwita, G. (2021). A technological innovativeness measurement framework: A case study of technology-based Indonesian companies. *Gadjah Mada International Journal of Business*. 23(1) https://doi.org/10.22146/gamaijb.33105

Aria, M., and Corrado, C. (2017). Bibliometrix: An R-Tool for Comprehensive Science Mapping Analysis. *Journal of Informetrics* 11 (4): 959–75. https://doi.org/10.1016/j.joi.2017.08.007.

Babatunde, A. O., Togunwa, T. O., Awosiku, O., Siddiqui, M. F., Rabiu, A. T., Akintola, A. A., Dauda, B. J., & Aborode, A. T. (2022, October 24). Internet of Things, Machine Learning, and Blockchain Technology: Emerging technologies revolutionizing Universal Health Coverage. *Frontiers Media*, 10. https://doi.org/10.3389/fpubh.2022.1024203

Bierfelder, W. (1976). Innovation in acceptable doses: problems of supplementing educational technology innovations in firms. *R&D Management*, *6*(1 S), 183–187. https://doi.org/10.1111/j.1467-9310.1976.tb01251.x

Bigliardi, B., & Galati, F. (2013). Innovation trends in the food industry: The case of functional foods. *Trends in Food Science and Technology*, 31(2), 118–129. http://dx.doi.org/10.1016/j.tifs.2013.03.006

Bush, C. L. (1981). Taking hold of technology: Topic guide for 1981–1983. Washington, DC: American Association of University Women.

Cappellesso, G., Raimundo, C. M., & Thomé, K. M. (2020, July 14). Measuring the intensity of innovation in the Brazilian food sector: a DEA-Malmquist approach. *Emerald Publishing Limited*, 17(4), 395-412. https://doi.org/10.1108/inmr-07-2019-0095

Casanova, L., Cornelius, P. K., & Dutta, S. (2017). Global Innovation Competitiveness: How Emerging Economies Compare * . *Financing Entrepreneurship and Innovation in Emerging Markets*. https://doi.org/10.1016/b978-0-12-804025-6.00002-2

Cascio, W. F., & Montealegre, R. (2016). How technology is changing work and organizations. *Annual Review of Organizational Psychology and Organizational Behavior*, *3*, 349–375.

Castillo-Vergara, M., Quispe-Fuentes, I., & Poblete, J. (2021, June 30). Technological Innovation in the Food Industry: A Bibliometric Analysis. *Kaunas University of Technology*, 32(3), 197-209. https://doi.org/10.5755/j01.ee.32.3.26000

Chatzoglou, P., and Chatzoudes, D. (2018), The role of innovation in building competitive advantages: an empirical investigation, *European Journal of Innovation Management*, 21 (1), 44-69, doi: 10.1108/EJIM-02-2017-0015.

Chiffi, D., Moroni, S., & Zanetti, L. (2022). Types of technological innovation in the face of uncertainty. *Philosophy & Technology*, 35(4), 94.

Chopra, R., Agrawal, A., Sharma, G D., Kallmuenzer, A., & Vasa, L. (2023). Uncovering the organizational, environmental, and socio-economic sustainability of digitization: evidence from existing research. *Review of Managerial Science.* 18, 685-709 . https://doi.org/10.1007/s11846-023-00637-w

Coccia, M. (2018). Classification of innovation considering technological interaction. *Journal of Economics Bibliography*, *5*(2), 76-93.

Danvila-del-Valle, I., Estévez-Mendoza, C., & Lara, F. J. (2019). Human resources training: A bibliometric analysis. *Journal of Business Research*, 101, 627-636. https://fardapaper.ir/mohavaha/uploads/2019/08/Fardapaper-Human-resources-training-A-bibliometric-analysis.pdf

Ding, Y., & Cronin, B. (2011). Popular and/or prestigious? Measures of scholarly esteem. *Information Processing and Management*, 47(1), 80–96. https://doi.org/10.1016/j.ipm.2010.01.002

Dzikowski, P. (2018). A bibliometric analysis of born global firms. *Journal of Business Research*, 85, 281–294. https://doi.org/10.1016/j.jbusres.2017.12.054

Cubillos, A. A., Calderon, J.A.A., & Suescun, O.Y.B. (2020). Innovaciones tecnológicas en las fuerzas militares de los países del mundo: Una revisión preliminar. *Investigación Administrativa*. https://doi.org/10.21830/19006586.537

Forman, C., King, J. L., & Lyytinen, K. (2014). Special section introduction— Information, technology, and the changing nature of work. *Information Systems Research*, 25(4), 789–795.

García, A., Calero, C.A., Vera-Contreras , D.A., Barba-Escobar, A., Alvarez-Diaz, J., Soler-Giraldo, G. & V-Nino, E. D. (2022). Eighth International Meeting of Technological Innovation. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/2163/1/011001

Gary, C., Moore and Izak, B. (2016). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research,* 2(3), 192–222. https://www.jstor.org/stable/23010883

Gold, B. (1986), Some empirical perspectives on the economic effects of technological innovations, *Omega-International Journal of Management Science*, 14 (2), 99-118, doi: 10.1016/0305-0483(86)90014-9.

Gu, Y. (2004). Global knowledge management research: A bibliometric analysis. *Scientometrics*, 61(2), 171–190. https://doi.org/10.1023/B:SCIE.0000041647.01086.f4

Handiwibowo, G. A. (2019). Do technological innovation capabilities contribute to new

product development performance? A conceptual framework. *Proceedings of the 1st Asian Conference on Humanities, Industry, and Technology for Society,(ACHITS).EAI*. http://dx.doi.org/10.4108/eai.30-7-2019.2287608

Hoflinger, P. J., Nagel, C., & Sandner, P. (2017). Reputation for technological innovation: Does it actually cohere with innovative activity? *Journal of Innovation & Knowledge*, 3(1), 26–39. https://doi.org/10.1016/j.jik.2017.08.002

Hwang, B.-N., & Hsu, M.Y. (2019). The impact of technological innovation upon servitization: Evidence from Taiwan Community Innovation Survey. *Journal of Manufacturing Technology Management*,30(7),1097-1114. https://doi.org/10.1108/JMTM-08-2018-0242

Kim, S., Wang, Y., & Boon, C. (2021). Sixty years of research on technology and human resource management: Looking back and looking forward. *Human Resource Management*, 60(1), 229-247.

Kim, Y. (2021). Technological innovation, the Kyoto Protocol, and open innovation. *Journal of Open Innovation : Technology, Market, and Complexity*. 7(3). https://doi.org/10.3390/joitmc7030198

Lafuente, E., Leiva, J. C., Moreno-Gomez, J., & Szerb, L. (2019). A non-parametric analysis of competitiveness efficiency: The relevance of firm size and the configuration of competitive pillars. *BRQ Business Research Quarterly*. https://doi.org/10.1016/j.brq.2019.02.002

Marzi, G., Dabic, M., Daim, T., & Garces, E. (2017). Product and process innovation in manufacturing firms: a 30-year bibliometric analysis. *Scientometrics*, 113(2), 673–704. https://doi.org/10.1007/s11192-017-2500-1

McOmber, J. B. (1999). Technological autonomy and three definitions of technology. *Journal of communication*, *49*(3), 137-153.

Moed, H. F., Luwel, M., & Nederhof, A. J. (2001). Towards research performance in the humanities. *Library Trends*, *50*(3), 498–520.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, 6(7), 1–6. https://doi.org/10.1371/journal.pmed.1000097

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, 2(3), 192-222.

Ortega, M.J.R. (2010), Competitive strategies and firm performance: technological capabilities' moderating roles, *Journal of Business Research*, 63 (12), 1273-1281, doi: 10.1016/j.jbusres.2009.09.007.

Parker, S. K., Van den Broeck, A., & Holman, D. (2017). Work design influences: A synthesis of multilevel factors that affect the design of jobs. *Academy of Management Annals*, 11(1), 267–308.

Santana, N.B., Rebelatto, D.A.D., Perico, A.E., Moralles, H.F. and Leal, W. (2015), Technological innovation for sustainable development: an analysis of different types of impacts for countries in the BRICS and G7 groups, *The International Journal of Sustainable Development and World Ecology*, 22 (5), 425-436, doi: 10.1080/13504509.2015.1069766.

Schatzberg, E. (2018). *Technology: Critical history of a concept*, Chicago, IL: University of Chicago Press.

Schumpeter, J. A. (2013). *Capitalism, socialism and democracy*. routledge.

Shan, J. and Jolly, D.R. (2012), Accumulation of technological innovation capability and competitive performance: a quantitative study in Chinese electronic information industry, *International Journal of Innovation and Technology Management*, 9 (05), 1250038

Singhal, C., Mahto, R.V., & Kraus, S., (2022). Technological innovation, firm performance, and institutional context: A meta-analysis. *IEEE Transactions on Engineering Management*. 69(6), 2976-2986. https://doi.org/10.1109/TEM.2020.3021378

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104(March), 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Steil, B., Victor, D.G. and Nelson, R.R. (2002), Technological Innovation and Economic Performance, Princeton University Press, United Kingdom.

Suominen, A., Seppanen, M., & Dedehayir, O. (2019). A bibliometric review on innovation systems and ecosystems: a research agenda. *European Journal of Innovation Management*, 22(2), 335–360. https://doi.org/10.1108/EJIM-12 2017-0188

Sweileh, W. M., Samah, W., Al-Jabi, Adham, S., AbuTaha, S. H., Zyoud, F. M. A. A., and Ansam F. S. (2017). Bibliometric Analysis of Worldwide Scientific Literature in Mobile - Health: 2006-2016. *BMC Medical Informatics and Decision Making* 17 (72): 1–12. https://doi.org/10.1186/s12911-017-0476-7

Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of management review*, *20*(3), 510-540.

van Nunen, K., Li, J., Reniers, G., & Ponnet, K. (2018). Bibliometric analysis of safety culture research. *Safety Science*, 108(November 2016), 248–258. https://doi.org/10.1016/j.ssci.2017.08.011

van Oorschot, J. A. W. H., Hofman, E., & Halman, J. I. M. (2018). A bibliometric review of the innovation adoption literature. *Technological Forecasting and Social Change*, 134(June), 1–21. https://doi.org/10.1016/ j.techfore.2018.04.032

Vidigal, M. C. T. R., Minim, V. P. R., Simiqueli, A. A., Souza, P. H. P., Balbino, D. F., & Minim, L. A. (2015). Food technology neophobia and consumer attitudes toward foods produced by new and conventional technologies: A case study in Brazil. *LWT - Food Science and Technology*, 60(2), 832–840. https://doi.org/10.1016/j.lwt.2014.10.058

Vlok, A., Ungerer, M.,& Malan. J. (2019). Integrative leadership for technology innovation. *International Journal of Technology Management*. 79(3-4),247-273. https://doi.org/10.1504/IJTM.2019.099608

Wang, Q. (2018). A bibliometric model for identifying emerging research topics. *Journal of the Association for Information Science and Technology*, 69(2), 290–304. https://doi.org/10.1002/asi.23930

White, H. D., and Katherine W. M. (1989). Bibliometrics. *Annual Review of Information Science and Technology (ARIST)* , 24, 119–86

Xu, X., Chen, X., Jia, F., Brown, S., Gong, Y., & Xu, Y. (2018). Supply chain finance: A systematic literature review and bibliometric analysis. *International Journal of Production Economics*, 204(August), 160–173. https://doi.org/10.101 6/j.ijpe.2018.08.003

Yubo, S., Ramayah, T., Hongmei, L., Yifan, Z., & Wenhui, W. (2023). Analysing the current status, hotspots, and future trends of technology management: Using the WoS and scopus database. *Heliyon*.