

A Bibliometric Analysis on Technology Readiness

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Abstract. The successful use of technology depends not only on its availability and accessibility but also on the technological readiness of individuals, organizations, and society. While technology readiness is an increasingly important topic, previous research has only touched on certain aspects. This study employs a bibliometric analysis to identify the key areas of research, countries, languages, starting year, top journals, and prolific authors in the field of technology readiness. Using Scopus as the data source, 2810 records published between 2014 and 2023 with the keyword "Technology Readiness" were analyzed. The VOS Viewer software was utilized for data analysis. Notably, one potential area for further exploration is the relationship between service performance and technology readiness, which warrants deeper investigation by future researchers

Keywords: Technology Readiness, Bibliometric Analysis, Areas of Knowledge, VOS Viewer, Adoption.

1. Introduction

In many aspects, technology is the key to growth. For example, for companies, a promising technology satisfies an optimistic new product business case aimed at turning the technology into profit. (Clausing and Holmes 2010). The National Technology Readiness Survey (NTRS) concern statistics for the United States since 1999 demonstrate the impact of this technology on services. For instance, in the field of financial services, only 30% of consumers who had access to the Internet did so in 1999, 51% did so in 2004, and 76% did so in 2012 (Parasuraman and Colby 2015).

A new report from the World Economic Forum (WEF) in 2018 says that as described in Figure 1, it is estimated that Artificial Intelligence will create 58 Million New Jobs in the next few years (Amit Chowdhry, 2018).

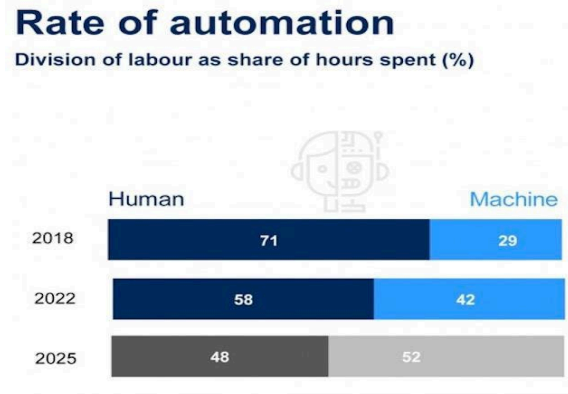


Fig.1: Rate of automation of the future of jobs.

Sumber: World Economic Forum (2018)

As depicted in the graph above, it is anticipated that by 2025, machines will have performed 71% of all jobs and tasks currently performed by humans, compared to 71% today. The global workforce will be significantly impacted by this transformation. The purpose of this report is to provide advice on how to improve the quality of human labor and how to prepare for the effects of technological advancements. Furthermore, it is based on a survey of chief human resources officers and strategy executives from over 300 global businesses operating in 12 industries and 20 developing nations. By 2022, nearly half of all businesses anticipate that automation will result in a decrease in their full-time workforce, while 40% anticipate an increase, and 25% anticipate that automation will result in the creation of new positions within the business (Amit Chowdhry, 2018)

Technology can be used to enhance a company's ability to use information more effectively. For example, Li H (2000) argues that consultant and architecture firms reap increased productivity from the use of technology. According to Bennett (2001), when widely used, Technology has the potential to produce far superior projects, resource utilization, and profits. Besides, Ariffin (2002) said that the utilization of innovation is vital, particularly for huge organizations.

Not only in the business world or selling products and services, but technology readiness also has an impact on the field of education. According to Sukirno and Siengthai (2011), the role of technology is found in lecturer performance indicators, namely in the exploration section in the field of performance publication which includes publishing articles/papers, translating/editing books, and patenting a technology product. In the field of education, lecturers' performance plays a crucial role in determining both student performance and university performance (Sukirno and Siengthai 2011). When it comes to the objectives to be achieved from a learning activity, readiness is an important condition that must be considered (Angelika and Oktavia 2023).

Although interest in the use of current technology is increasing rapidly, analysis related to

technology readiness is still scarce. A more exploratory and broader research strategy may be helpful in light of the lack of literature on the relationship between personality traits and the adoption of data standards in research on technology readiness. (Buyle et al. 2018). There has not been much scientific research related to the readiness of people to use systems or technology. This research gap is very important because the role of technology-based systems is not only relevant to service companies but also to nonservices companies (Parasuraman 2000). This necessitates the current study and limits research on technology readiness.

This article conducts a bibliometric analysis using the Scopus information base to identify the research fields that produced the most results, the countries and languages responsible for the majority of technology readiness research, the year that technology readiness research began, and the most significant authors and journals that publish the majority of technology readiness research. The VOS Viewer software was used to analyze these data. This study aims to identify journals and authors to counsel while focusing on this peculiarity, allowing scientists who are new to technology readiness research to do so.

2. Literature Review

A person's willingness to accept and use new technology is called technology readiness (Musyaffi n.d. 2021). As per Parasuraman (2000), technology readiness is isolated into Positive Innovation Availability (PTR) and Negative Innovation Status (NTR). Additionally, Positive Technology Readiness includes the following elements that encourage the adoption of new technology: Optimism is a positive perspective on innovation and the conviction that innovation offers more prominent control, adaptability, and effectiveness to individuals in their lives who use it; Innovation is the propensity to lead the way in new ideas and technologies ((Parasuraman 2000).

Acceptance of new technology is hampered by two aspects of negative technology readiness: discomfort, which refers to the sensation of being overwhelmed by innovation and the apparent lack of control over it; and insecurity, which is characterized by skepticism about one's capacity for effective work and concern about the potential negative effects of using technology. Insecurity is a lack of trust in technology (Parasuraman, 2000). The ease of use, usefulness, and other design features of technology has typically been the focus of research into predictors of technology usage (Meuter et al. 2005).

The banking sector follows the latest trend where banks have adopted online banking applications for transactions. E-banking is a banking technology that can obtain information and carry out banking transactions online. E-banking applications, like Internet banking as another means of service delivery, offer several benefits for banks, including reduced costs, market differentiation, work process flow, increased sales, increased reach, increased customer loyalty, and opportunities to draw in new customers (Musyaffi, 2021).

A person's perspective and tendency to use technology products and services in their daily lives can be represented by their level of technology readiness. In different regards, technology readiness is connected with whether the innovation can help individuals in finishing an expert objective in the encompassing or client region (Kuo, Liu, and Ma 2013).

Research on technology readiness is considered important because technology is fundamentally changing the way people live, work, and interact with people around the world and can impact all disciplines (Hamdan 2018). The novelty of the term "technological readiness" actually intends that there is some steady debate encompassing its definition.

3. Method

In this study, the data used in the bibliometric analysis were taken from Scopus conducted in May 2023. A bibliometric analysis consists of applying statistical methods to determine qualitative and quantitative

changes in a given scientific research topic, establish the profile of publications on the topic, and detect tendencies within a discipline (De Bakker, Groenewegen, and Den Hond 2005). This study aims to provide ease of formation and visualization of bibliometric maps, which is becoming increasingly popular in bibliometric research. For this reason, this study analyzes all documents in Scopus whose title, abstract, and content mention "technology readiness". Therefore, the following is the syntax for the search:

(TITLE-ABS-KEY("technology readiness") AND PUBYEAR > 2013 AND PUBYEAR < 2024)

The received results have been downloaded in CSV format to be processed using VOSviewer to visualize and analyze the trends in the bibliometric form. Articles, proceedings, reviews, book reviews, editorial materials, book chapters, meeting abstracts, notes, and letters are all included in the 2810 documents that made up the sample. The bibliometric analysis was completed by separating the terms or points of view that are frequently discussed in the field of technology readiness research, identifying scholars or researchers who are actively circulating examination on technology readiness and joint effort among these journalists, and examining the amount of dispersed focus on designs from 2014 to 2023. This study will see the growth trend of number of published studies related to technology readiness. Trend patterns are usually seen from charts that go up or down over a long period of time, such as 10 years (Agung Budi Santoso 2017) These data were analyzed using the Visualization of Similarities (VOS) Viewer. Vosviewer can also create publication maps, author maps, or journal maps based on co-citation networks or to build keyword maps based on shared networks (Hudha et al. 2020).

Bibliometric analysis is one well-proven means to study such scientific activity in a more objective manner (Tan, Goudarzlou, and Chakrabarty 2010). Based on trends in research subjects (such as author keywords) and research activity trends (such as categories, journals, language, and country distributions), this study aimed to identify the characteristics of scientific articles (Li and Zhao 2015).

The bibliometric pointers utilized in this study are as per the following:

- Most cited articles on technology readiness
- The language of research publications on technology readiness.
- Research area where the authors have published research on technology readiness.
- The year in which research papers on technology readiness were published between the years 2014 and 2023.
- Countries where the authors published research on technology readiness.
- Journal where the author has published research on technology readiness.
- Authors whose research on technology readiness has been published.
- Term Analysis from research publications on technology readiness.

Figure 2 depicts how the 2014–2023 publication period's data were obtained from the Scopus website using the keyword technology readiness. The number of studies on technology readiness that have been published will be examined in this study.

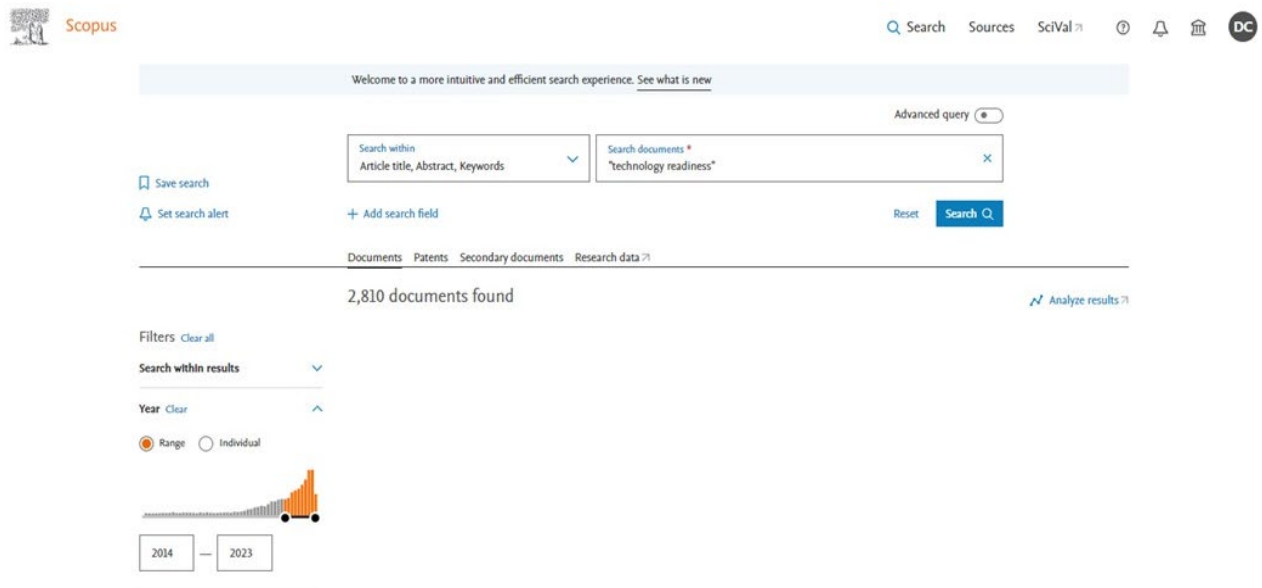


Fig.2: Data Source

4. Result and Discussion

4.1. Most Cited Articles

The rising popularity of technology readiness and digitization is primarily to blame for the recent rise in interest in technology. In this manner, to acquire a comprehension of the elements of field research and the most persuasive distributions in the exploration field.

Table 1 only contains the top 10 citations out of 2810 publications and 36780 citations, namely articles related to technology readiness that are the most cited. The results from Table 1 showed that Parasuraman and Colby's (2015) article on the Technology Readiness Index reached 534 citations.

Table 1. Most cited articles on technology readiness.

Document Title	Authors	Source Title	Total Citations
An Updated and Streamlined Technology Readiness Index: TRI 2.0	Parasuraman A.; Colby C.L.	Journal of Service Research	534
Industrial automation based on cyber-physical systems technologies: Prototype implementations and challenges	Leitão P.; Colombo A.W.; Karnouskos S.	Computers in Industry	463
Understanding the Blockchain technology adoption in Supply chains-Indian Context	Kamble S.; Gunasekaran A.; Arha H.	International Journal of Production Research	383
Smart Homes and home health monitoring technologies for older adults: A systematic review	Liu L.; Stroulia E.; Nikolaidis I.; Miguel-Cruz A.; Rios Rincon A.	International Journal of Medical Informatics	381
Energy harvesting technologies in roadway and bridge for different applications – A comprehensive review	Wang H.; Jasim A.; Chen X.	Applied Energy	302

High power density superconducting rotating machines - Development status and technology roadmap	Haran K.S.; Kalsi S.; Arndt T.; Karmaker H.; Badcock R.; Buckley B.; Haugan T.; Izumi M.; Loder D.; Bray J.W.; Masson P.; Stautner E.W.	Superconductor Science and Technology	262
Technological, organizational, and environmental factors influencing managers' decision to adopt cloud computing in the UK	Gutierrez A.; Boukrami E.; Lumsden R.	Journal of Enterprise Information Management	190
Technologies for chemical recycling of household plastics – A technical review and TRL assessment	Solis M.; Silveira S.	Waste Management	180
Review of modern low-emissions combustion technologies for aero gas turbine engines	Liu Y.; Sun X.; Sethi V.; Nalianda D.; Li Y.-G.; Wang L.	Progress in Aerospace Sciences	175
Predicting e-readiness at firm-level: An analysis of technological, organizational and environmental (TOE) effects on e-maintenance readiness in manufacturing firms	Aboelmaged M.G.	International Journal of Information Management	167
Technology readiness level assessment of composites recycling technologies	Rybicka J.; Tiwari A.; Leeke G.A.	Journal of Cleaner Production	157
Total			3194

Source: Data processed

Table 1 showed the top of 10 citations, with a total of citations is 3194. Based on the most cited articles, it is estimated that the research of Parasuraman and Colby (2015) is the most cited by the number of 534 total Citations. Furthermore, Leitão, Colombo, and Karnouskos (2016) with 463 total citations, and Kamble, Gunasekaran, and Arha (2019) had 383 total citations.

4.2. Language

There are indexed journals on Scopus that are published in languages other than English. For example, diaries from China, Germany, Spain, and Russia are for the most part conveyed in English.

Table 2. Language of research publications on technology readiness

Ranking	Language	Number of Publications
1	English	2775
2	Chinese	14
3	German	8
4	Spanish	4
5	Russian	3
6	French	2
7	Afrikaans	1
8	Italian	1
9	Korean	1
10	Portuguese	1
	Total	2810

Source: Data processed

According to information gathered from Scopus, the number of publications on technology readiness by language is shown in Table 2. English is the most used language, as expected (2775 documents). Chinese is the second most spoken language (14 documents).

This pattern lives up to expectations, as the primary journal is in English, which is a must-know language for all researchers in the modern global academic community. A surprising finding was that more documents were written in minority languages such as Spanish, French, Portuguese, or Russian. This result may be due to country preferences for larger journals in Spanish, French, Portuguese, or Russian, which are thus more likely to be published in their language (Table 2).

4.3. Research Area

Technology readiness was recently utilized by specialists to quantify the entrance of various technology related products and services among people (Jaafar et al. 2007). Researchers have previously investigated readiness to embrace technology by employing various scientific constructs that explain people's propensity to adopt technology (Kaushik and Agrawal 2021). Table 3 contains only the top 10 research areas of the 27 research areas with a total 6104 number of publications.

Table 3. Research area on technology readiness.

Ranking	Research area	Number of Publications
1	Engineering	1454
2	Computer Science	652
3	Energy	553
4	Physics and Astronomy	483
5	Business, Management, and Accounting	404
6	Materials Science	356
7	Earth and Planetary Sciences	343
8	Environmental Science	321
9	Social Sciences	293
10	Mathematics	268
	Total	5127

Source: Data processed

The number of documents issued in various fields of knowledge is depicted in Table 3. The Scopus contains 1454 documents in Engineering . In computer science 652 documents, In energy 553 documents, in physics and astronomy 483 documents, and 404 documents in business, management, and accounting. These figures reveal a large difference between the number of documents in engineering and the number of other knowledge areas.

These findings imply that technology readiness is a very relevant topic in the field of engineering. According to Hedelind and Jackson (2011),Technology such as automation affects the competitive advantage of manufacturing companies. Because technology is embodied in every value activity and is involved in achieving linkages between activities, it can have strong effects on both cost and differentiation. Using highly automated manufacturing systems is a way for companies with high labor costs to compete.

The ranking does not include 10 research areas that address technology readiness. Because there are less than 50 technology readiness documents in each category, the number of documents in this field is irrelevant.

4.4. Year of publication

A quest for the idea of technology readiness in Scopus uncovers technology readiness status articles composed beginning around 1973. However, a more in-depth examination of this document reveals that it does not discuss technology readiness in implementation but rather technology and systems as a scientific study. According to Scopus, the ongoing meaning of the term technology readiness previously showed up in a diary in 1973. However, prior to 2004, there were very few documents published annually (less than 50 per year).

Table 4. The year in which research papers on technology readiness were published between the years 2014 and 2023.

Ranking	Year	Number of Publications
1	2023	202
2	2022	480
3	2021	453
4	2020	353
5	2019	298
6	2018	257
7	2017	239
8	2016	220
9	2015	161
10	2014	147
	Total	2810

Source: Data processed

Between 2014 and 2023, the number of publications is shown in Table 4. The information shows how interest in this field of information has expanded from one year to another. Table 4 displays the number of publications from 2014 to 2023. The data demonstrate that interest in this area of study has grown annually. Except for the first two years, which appear to be relatively stable, the number of publications increases annually. The number of publications has steadily increased from 2016 to 2023. Academic interest in this subject has grown since 2020. There will be nearly 100 more articles on technology readiness in 2021 than there were in 2020, and a similar pattern will continue in 2022. At the time this examination was directed, information was gathered in mid-May 2023, and there were 202 distributed archives. The number is expected to rise in 2022, according to estimates. This interest shows that innovation preparation is as yet vital to society that scientists actually believe should make it happen.

4.5. Countries

Table 5 and Figure 5 show that, in the United States, there have been 766 publications since 2014 on technology readiness. The United Kingdom ranks second, with 321 publications. After that, Germany was in third place with 300 publications, while Indonesia was in eleventh place with 107 publications.

Table 5. Countries where technology readiness research has been published.

Ranking	Country	Number of Publications
1	United States	766
2	United Kingdom	321

3	Germany	300
4	Italy	214
5	Spain	162
6	France	160
7	Netherlands	158
8	China	150
9	Malaysia	137
10	India	117
11	Indonesia	107
	Total	2592

Source: Data processed

Table 5 contains only the top 11 countries of the 107 countries with a total number of publications is 4244. Since they have less than 100 publications and are not applicable to this study, The study does not cover all remaining countries in the analysis because they have fewer than 50 publications and are therefore irrelevant to the study. The majority of journals are based in the USA or the UK, which explains the variation in the number of documents.

4.6. Journals

When conducting a literature review, it is essential to know about the journals that publish research on technology readiness. This is true not only for choosing which journal to read but also for understanding the focus of each journal on technology readiness.

Table 6 presents the journals that publish the most technology readiness documents and their impact factors based on Scopus data. All journals remembered for the Scopus data set are explored for quality yearly in view of four sorts of mathematical quality measures: SJR (SCImago Journal Rank), h-Index, CiteScore, and SNIP (Source Normalized Impact per Paper). Table 6 contains only 10 journals of the 160 journals that publish research on technology readiness.

Table 6. Journal where the author has published research on technology readiness.

Ranking	Countries	Number of Publications
1	Proceedings of The International Astronautical Congress Iac	117
2	Proceedings of SPIE The International Society For Optical Engineering	109
3	IEEE Aerospace Conference Proceedings	49
4	Sustainability Switzerland	35
5	Proceedings of The Annual Offshore Technology Conference	33
6	Energies	32
7	Journal of Cleaner Production	29
8	Renewable and Sustainable Energy Reviews	21
9	Acta Astronautica	19
10	ACM International Conference Proceeding Series	18
11	Journal of Astronomical Telescopes Instruments and Systems	18
12	Journal of Physics Conference Series	18
	Total	498

Source: Data processed

According to Table 6, the Proceedings of the International Astronautical Congress has published

more technology readiness research than any other journal, with 117 documents on the subject. With 109 publications, Proceedings of SPIE comes in second. The International Society for Optical Engineering comes in third.

Research on technology readiness has been published in 1276 journals, according to Scopus. However, in the interest of conciseness, this study only takes into account the 12 journals with the highest number of publications.

4.7. Authors

According to Li and Zhao (2015), research demonstrates that author keyword analysis is a useful strategy for mapping published research. When conducting a bibliometric analysis of research in a particular field, measuring research performance at the micro level (i.e., at the level of individual scientists) (Rey-Martí, Ribeiro-Soriano, and Palacios-Marqués 2016). The study of these influential authors will allow researchers to build upon their knowledge and gain a broader perspective (Wang et al. 2014).

Table 7. Authors who have published research on technology readiness.

Ranking	Author Name	Number of Publications
1	Fusaro, R.	11
2	Mansouri, S.S.	11
3	Udugama, I.A.	11
4	Viola, N.	11
5	Gernaey, K.V.	9
6	Rodrigo, M.A.	9
7	Stahl, H.P.	9
8	Sutliff, D.L.	9
9	Lavagna, M.	8
10	Nakazono, B.	8
	Total	96

Source: Data processed

The primary authors of technology readiness are listed in Table 7. Articles and all documents are used in this section. Table 7 only contains the top ten authors out of the 160 after authors with fewer than eight published articles were filtered out. Due to the fact that the majority of authors had only published three articles, we established this threshold to keep the table manageable.

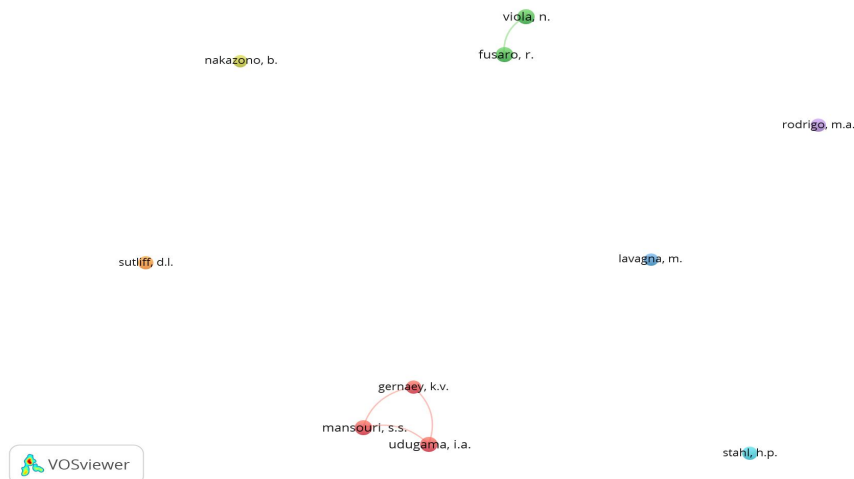


Fig.3: Authors network visualization of VOS Viewer.

A network visualization created by the authors who discussed technology readiness is depicted in Figure 3. The author has published more scientific research on technology readiness the larger the circle. The various colors indicate the authors' collaborative group. According to the results of processing the data with VOS Viewer, Fusaro, R., Mansouri, S.S., Udugama, I.A., and Viola, N. are the primary authors. They frequently publish research on technology readiness and collaborate with other authors, as indicated by the red and green lines in Figure 3.

4.8. Term Analysis

In the unit of analysis, we will create a map using data from the Vos Viewer with a minimum number of occurrences of terms of 100 of the 63761 terms and 1451 that meet the threshold.

Figure 4, which is an organization representation of a term, shows the quantity of examinations whose titles and modified works talk about terms connected with technology readiness and the connection between these terms. From this figure, it is known that the relationship between the topic and the absorption capacity in terms of the title of the article and keywords is not the entire content of the article. Based on Figure 4, In general, technology readiness research can be divided into two major groups, the technology readiness level group (marked in red) and the study group (marked in green).



Fig.7: Density Overlay Visualization of VOS Viewer.

5. Conclusions

In order to identify the researcher's research areas, this article presents a bibliometric analysis of technology readiness research, the language of publications, trends in the number of publications over time, the most relevant journals for literature review, term analysis from research publications, and the most prolific and cited technology readiness authors. This analysis gives people who are just starting out in the field of technology readiness advice about which journals to look at and which authors have the best reputations.

1276 of the 2810 technology readiness research documents analyzed bibliometrically from the Scopus database are scientific articles. English is the most widely used language for publication (2775 documents), and the area of engineering has the most documents published (1454 documents—more than any other ranking area combined). The term "technology readiness" first appeared in 1973, but researchers didn't start paying attention to the idea until 2020. In 2021, there were 453 published documents, and the number of publications kept going up each year. The majority of technology readiness research is conducted in the United States (766 publications). Proceedings of the International Astronautical Congress Iac is the journal that publishes the most technology readiness research (117 documents), and Fusaro, R., Mansouri, S.S., Udugama, I.A., and Viola, N. are the authors who publish the most technology readiness research (11 documents).

The variable or aspect that has been widely studied in the “technology readiness” keyword is the technology readiness level. Although technology readiness level has been dominant in research on technology readiness, further researchers can explore the discussion of technology readiness level by relating it to variables that are still rarely studied, namely performance, impact, service, effect, adoption, and others. Technology readiness research can also be explored by involving services and education areas. So that all areas are currently required to use technology and automation to increase efficiency, provide better services, encourage innovation, and maintain customer security and privacy. Development on technology readiness can also improve performance. This can be a great idea and a new contribution to researchers in the technology readiness space.

This study uncovers a few discoveries that can assist with directing specialists in the area of technology readiness, albeit future examinations ought to incorporate more articles that can exhibit the job of technology readiness for both individual and enterprise technology development and which have more impact factors.

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