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REVIEW ARTICLE

Unlocking Startup Research Trends: A Bibliometric Mapping Approach

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ABSTRACT

This research presents a comprehensive bibliometric analysis of the startup literature published in the Scopus database from 1970 to 2023. By employing advanced analytical tools such as VOSviewer and Biblioshiny, we provide a detailed examination of the evolving landscape of startup research. Our analysis identifies key trends, influential authors, and emerging research themes within the field. The findings of this study offer valuable insights for researchers, policymakers, and practitioners interested in understanding the dynamics of the startup ecosystem. By highlighting significant research gaps and emerging areas of interest, this analysis can inform future research directions and guide strategic decision-making. Additionally, our results provide a foundation for fostering collaborations and identifying potential partnerships among researchers and institutions. While this study offers a comprehensive overview of startup research based on the Scopus database, it is important to acknowledge potential limitations. Future research could benefit from expanding the analysis to include additional databases, such as Web of Science or Google Scholar, to capture a broader range of publications. Furthermore, exploring the potential biases inherent in bibliometric analysis could provide a more nuanced understanding of the research landscape.

Contribution/Originality: This study contributes to the existing literature by providing a comprehensive bibliometric analysis of startup research using new estimation methodologies, including VOSviewer and Biblioshiny. It is one of the few studies that investigates document profiles, co-occurring keyword analysis, and science mapping, offering a detailed exploration of research trends and gaps.

1. Introduction

Startups are often characterized by their entrepreneurial spirit, agility, and disruptive ideas, which can challenge existing norms and drive innovation in various sectors. According to Ministry of Science, Technology and Innovation (MOSTI) Malaysia in 2021 startup can be defined as *"a technology or innovation enabled business at an early stage, with a scalable business model and a high growth strategy"* (Ministry of Science, Technology and Innovation., 2021). Forbes as cited in Aminova and Marchi 2021) defines 'startups' as a company working to solve a problem where the solution is not obvious, and success is not guaranteed. Other definitions state that startup is a company that is built on extreme uncertainty, has at its core innovation to create products and services which they wish to revolutionize the market. Bryant (2022) stated that the failure rates among startups are significant. In the first year of operation, approximately 20% of startups fail. Within five years, this number increases to 50%, and within 10 years, it rises to 65%. Similarly, Eisenmann (2021) found that a substantial majority of startups, specifically more than two-thirds of them, fail to provide a positive return on investment to their investors. Moreover, Aminova and Marchi's (2021) revealed that nearly 90% of startups struggled to sustain their operations. The high failure rates experienced by startups underscore the challenges they face in sustaining their operations.

There are distinct contrasts between startups and traditional businesses. Startups are recognized for their agility, adaptability, and quick responsiveness to market shifts (Spender et al., 2017). They are more flexible and open to experimenting with various approaches. In contrast, traditional businesses often have more rigid structures and processes, making them less adaptable to change. Additionally, startups are typically innovative, aiming to introduce disruptive concepts or technologies into the market. They thrive in uncertain environments, taking higher risks with new business models or products. Conversely, traditional businesses focus on sustaining existing operations and might be more cautious about risks due to their established positions.

In terms of product development, startups are closely associated with the concept of Minimum Viable Product (MVP) introduced by Ries, E. (2011). MVP is a development method where a new product is launched into the market with basic features, enough to attract consumers' attention. The final product is released after obtaining adequate feedback from initial users. Startups prioritize launching a basic version of their product swiftly to gather user feedback and enhance their product rapidly. Limited resources drive this approach, allowing them to test ideas and save costs. Conversely, traditional businesses have an established market presence, customers, and refined products already (Carmelo Arguelles, 2023). They invest more in product development before launching it into the market.

Securing funding for startups is a formidable challenge primarily due to the inherent characteristics of these fledgling ventures (Carmelo Arguelles, 2023; Silva et al., 2021). Startups operate in an environment characterized by high risk and uncertainty, which often deters potential investors. The innovative nature of their products or services introduces an element of novelty that might not yet have an established market demand, further complicating their ability to attract funding. Investors typically view startups as high-risk ventures due to their limited operational history, unproven revenue streams, and uncertain market reception. Additionally, startups frequently encounter resource constraints, including limited financial capital and operational resources, adding to the

challenges of demonstrating their viability and growth potential. Amidst a competitive landscape vying for investor attention, startups face an uphill battle to secure funding essential for their development and expansion.

Traditional businesses, in contrast to startups, often face relatively fewer challenges in obtaining funding due to several key differences in their operational context ventures (Carmelo Arguelles, 2023; Silva et al., 2021). These established enterprises typically have a track record of stability, established market presence, and proven revenue streams. As a result, they usually have more stable financial resources, greater access to various funding options such as debt financing, and established relationships with investors or financial institutions. Traditional businesses usually operate in markets with existing demand, established customer bases, and known competitors. This market stability and established reputation make them more appealing and less risky for potential investors or lenders compared to startups, facilitating their access to funding for various operational needs and growth initiatives.

Table 1 presents prior bibliometric studies within the context of startup research. The first study, conducted by Silva et al. (2021) in 2021, focused on providing a systematic review of literature pertaining to startups and delineating future research directions. This study utilized data from Scopus and Web of Science (WOS) databases, examining a total of 228 documents. The bibliometric attributes examined included the distribution of keywords, identification of most cited articles, analysis of top authors, and exploration of leading countries in startup research. On the other hand, the second study, conducted by Spender et al. (2017) in 2017, aimed to review literature on startups and open innovation. It covered a broader range of sources, incorporating data from Scopus, Web of Science, and Emerald databases, with a smaller dataset of 41 documents. This study employed thematic analysis alongside bibliometric methods, exploring keyword distribution, top journals, leading countries, and the distribution of publications per year within the realm of startups and open innovation.

Table 1: Summary of previous studies

Author	Domain/Search Strategy	Data Source & Scope	TDE	Bibliometric Attributes Examined
Silva et al. (2021)	Startups: a systematic review of literature and future research directions	Scopus and WOS	228	- Keywords distribution - Most cited articles - Top authors - Top countries
Spender et. al (2017)	Startups and open innovation: a review of the literature	Scopus, WOS, Emerald	41	- Thematic Analysis - Keywords distribution - Top Journal - Top countries - Distribution publication per year

TDE=Total documents examined

Compared to prior studies that primarily focused on traditional bibliometric analyses such as citation analysis and article distribution, my research on Startup aims to bridge existing gaps in the literature. This study extends the bibliometric analysis by exploring document profiles, including document type, source type, languages used, and subject areas within the field of Startup research. This addresses a significant oversight in

previous studies and aims to provide a more comprehensive understanding of the landscape. The paper dives into various aspects such as publication trends, author-specific contributions, institutional and national involvements, source title analysis, and keyword examination.

Additionally, it employs science mapping and network analysis techniques to offer an extensive summary of author contributions, source materials, and citation trends observed in earlier research. The research aims to fill this void by offering an updated and comprehensive analysis of Startup, potentially covering aspects that were not thoroughly addressed in previous studies. It seeks to present a more relevant and up-to-date perspective on the status of Startup research in 2023 and beyond. It is hoped that the insights gained from this study will be valuable for both academic understanding and practical implementation within the realm of Startup research. The study will also investigate the primary themes and subjects emerging from the analysis of co-occurring author keywords in the Startup literature.

This study aims to address several key research objectives related to the field of Startup. Firstly, it aims to define document profiles by examining document types, source types, languages, and subject areas within the context of Startup research. Furthermore, this study intends to explore the evolution of publication patterns related to Startup over time and current trends in the field. It also aims to identify the most productive authors in the Startup field and analyze the central themes and subjects within their research. Moreover, the study aims to investigate the influence of various institutions on the advancement of Startup research and examine their contributions. Additionally, it seeks to determine the level of participation of different countries in Startup research and how this involvement varies across regions and timeframes. The study also aims to explore how an examination of source titles can enhance our understanding of research in the Startup domain. Lastly, it aims to identify documents with the highest citation rates in the field of Startup and analyze the primary themes and subjects addressed in these documents.

The paper is structured as follows. Firstly, the subsequent section will delve into the progression of the literature review within the broader scope of Startup. Following this, prior bibliometric studies related to Startup will be examined. Subsequently, the paper will outline the bibliometric methodology utilized in this study, which encompasses the utilization of various bibliometric tools. This section will also include references and a flowchart illustrating the process for conducting the bibliometric analysis. The focus will then shift to the detailed analysis conducted to address the research questions. After the analysis, there will be a dedicated section for discussing the findings, highlighting contributions, acknowledging limitations, and presenting recommendations for future research.

2. Research Objectives

This study aims to address several key research objectives related to the field of Startup. Firstly, it aims to define document profiles by examining document types, source types, languages, and subject areas within the context of Startup research. Furthermore, this study intends to explore the evolution of publication patterns related to Startup over time and current trends in the field. It also aims to identify the most productive authors in the Startup field and analyze the central themes and subjects within their research. Moreover, the study aims to investigate the influence of various institutions on the

advancement of Startup research and examine their contributions. Additionally, it seeks to determine the level of participation of different countries in Startup research and how this involvement varies across regions and timeframes. The study also aims to explore how an examination of source titles can enhance our understanding of research in the Startup domain. Lastly, it aims to identify documents with the highest citation rates in the field of Startup and analyze the primary themes and subjects addressed in these documents.

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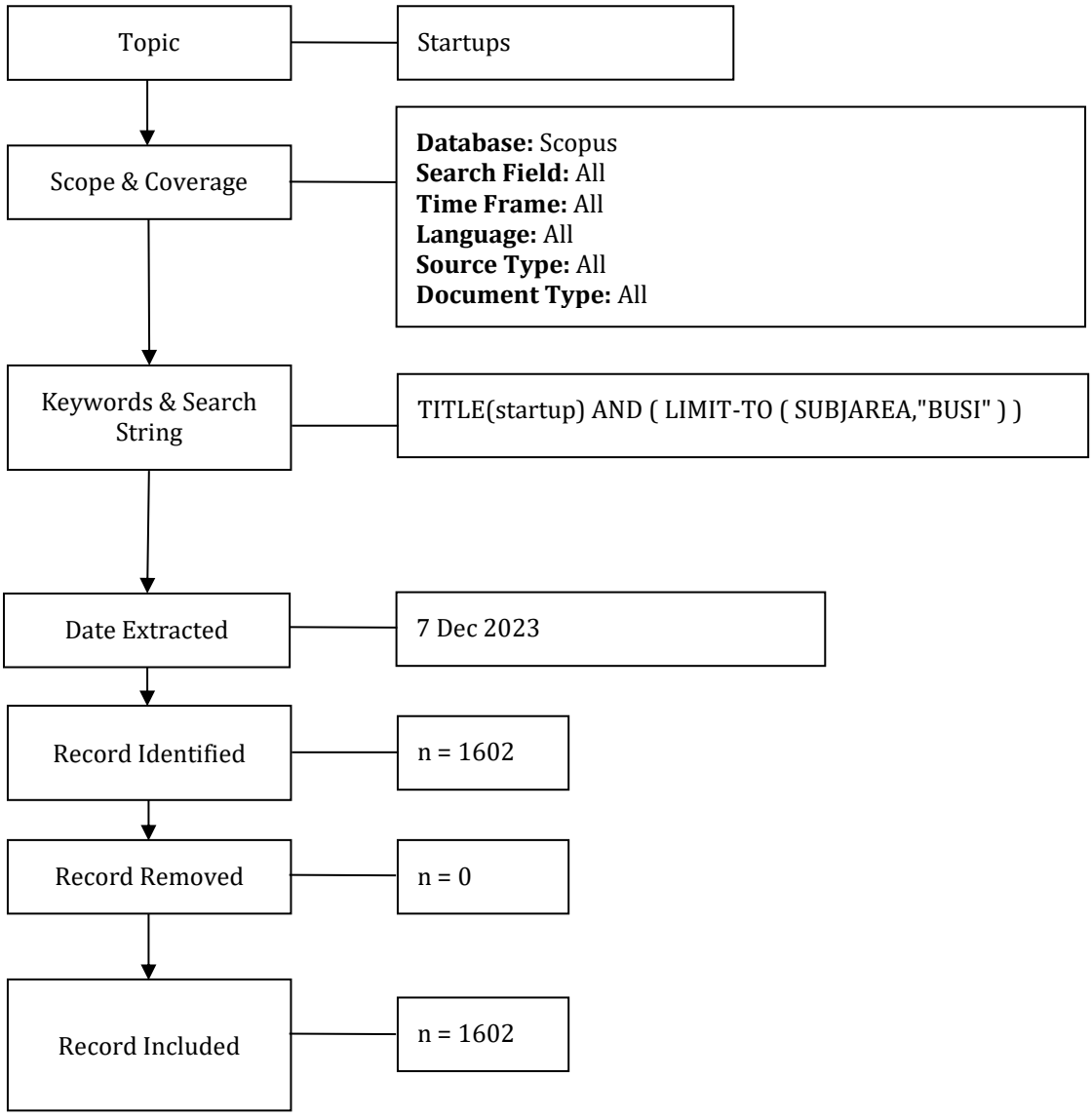
3. Research Methods

This bibliometric analysis focused on scrutinizing publications obtained from the Scopus scientific database. The choice of Scopus as the primary data source for this study was based on its extensive coverage, containing a repository of over 70 million records, which includes a wide range of multidisciplinary journals. Scopus was selected due to several notable attributes, including its rigorous quality control measures, support for full-text searches, capability for handling lengthy search queries, advanced search features, and the reliability of search results across various locations, as evidenced by previous research (Klopfenstein & Dampier, 2021; Martín-martín et al., 2018).

We conducted frequency and percentage calculations for each publication and generated the necessary graphs using Microsoft Excel. Furthermore, we expanded our analysis by utilizing VOSviewer (version 1.6.20), a freely available software tool developed by van Eck and Waltman (2010), which aids in extracting citation data, bibliographical details, and keywords to visualize co-authorship and co-citation networks among authors. Additionally, our study utilized Biblioshiny for analyzing keywords in the titles and abstracts of documents. Biblioshiny, a shiny application developed for use with the Bibliometrix R package, was created by Aria and Cuccurullo (2017) and primarily focuses on facilitating science mapping analyses.

This study conducted a bibliometric analysis using the Scopus database as of 7 December 2023. To identify relevant publications in any language, we utilized the search query “TITLE(startup) AND (LIMIT-TO (SUBJAREA,"BUSI"))” within the Scopus database. This was to make sure we didn't miss any important articles related to Startup, even if they did not explicitly mention "startup" in their titles. The search approach is shown in Figure 1. Initially, we found 1602 publications using this method.

Figure 1: Flow diagram of the searching strategy.



4. Results

The dataset related to startups spans from the year 1970 to 2023 and comprises a total of 1602 publications contributed by an equal number of authors. Among these publications, 979 have been cited, accumulating a total of 23,885 citations. On average, each publication has received 14.91 citations, while cited papers have an average of 24.40 citations. The h-index, a measure of the impact and productivity of the dataset, is 70, indicating that there are 70 papers with at least 70 citations each. The g-index, another impact metric, stands at 132. These bibliometric indicators provide a comprehensive overview of the dataset's scholarly impact and productivity in the field of startups.

4.1. Documents Profiles

Table 2 provides a breakdown of the document types within the dataset related to startups. The majority of publications are articles, accounting for 60.61% of the total with 970 publications. Conference papers contribute 14.42% (231 publications), while book chapters make up 11.36% (182 publications). Notes and reviews each represent

4.18% of the total, with 67 publications each. Short surveys contribute 2.37% (38 publications), books account for 1.81% (29 publications), editorials make up 0.50% (8 publications), and errata constitute 0.25% (4 publications). The overall total of publications in the dataset is 1602.

Table 2: Type of Document

Document Type	Total Publications (TP)	Percentage (%)
Article	970	60.61%
Conference Paper	231	14.42%
Book Chapter	182	11.36%
Note	67	4.18%
Review	67	4.18%
Short Survey	38	2.37%
Book	29	1.81%
Editorial	8	0.50%
Erratum	4	0.25%
Total	1602	100.00

In Table 3, the source types of the startup-related publications are presented. Journals emerge as the primary source type, constituting 64.42% of the total publications with 1031 articles. Conference proceedings contribute 10.86% with 174 publications, while books make up 10.11% with 162 publications. Trade journals account for 8.18% of the total, representing 131 publications, and book series contribute 6.49% with 104 publications.

Table 3: Source Type

Source Type	Total Publications (TP)	Percentage (%)
Journal	1031	64.42%
Conference Proceeding	174	10.86%
Book	162	10.11%
Trade Journal	131	8.18%
Book Series	104	6.49%
Total	1602	100.00

Table 4 provides an overview of the languages in which startup-related publications are available. English is the predominant language, representing 97.94% of the total publications, with 1568 articles. Other languages include German (0.94% with 15 publications), Spanish (0.44% with 7 publications), Portuguese (0.31% with 5 publications), Russian (0.19% with 3 publications), French (0.12% with 2 publications), and Chinese (0.06% with 1 publication). Additionally, there are 4 publications (0.25%) marked as undefined language. The total number of publications in the dataset is 1605, acknowledging that some documents may be prepared in dual languages.

Table 4: Languages

Language	Total Publications (TP)*	Percentage (%)
English	1568	97.94%
German	15	0.94%
Spanish	7	0.44%
Portuguese	5	0.31%

Russian	3	0.19%
French	2	0.12%
Chinese	1	0.06%
Undefined	4	0.25%
Total	1605*	100.00

*some documents have been prepared in dual languages

Table 5 presents the distribution of startup-related publications across various subject areas. The majority of publications fall under the subject area of Business, Management, and Accounting, constituting 100.06% with 1603 articles. Other prominent subject areas include Economics, Econometrics, and Finance (30.96% with 496 publications), Engineering (22.85% with 366 publications), Decision Sciences (14.67% with 235 publications), and Computer Science (12.36% with 198 publications). Social Sciences represent 11.36% with 182 publications, followed by Mathematics (4.31% with 69 publications), Chemical Engineering (3.00% with 48 publications), and Materials Science (2.87% with 46 publications). The table further delineates the distribution across various disciplines, highlighting the multidisciplinary nature of startup research.

Table 5: Subject Area

Subject Area	Total Publications (TP)	Percentage (%)
Business, Management and Accounting	1603	100.06%
Economics, Econometrics and Finance	496	30.96%
Engineering	366	22.85%
Decision Sciences	235	14.67%
Computer Science	198	12.36%
Social Sciences	182	11.36%
Mathematics	69	4.31%
Chemical Engineering	48	3.00%
Materials Science	46	2.87%
Energy	39	2.43%
Psychology	33	2.06%
Environmental Science	27	1.69%
Biochemistry, Genetics and Molecular Biology	24	1.50%
Arts and Humanities	10	0.62%
Medicine	9	0.56%
Agricultural and Biological Sciences	4	0.25%
Earth and Planetary Sciences	4	0.25%
Physics and Astronomy	4	0.25%
Nursing	3	0.19%
Pharmacology, Toxicology and Pharmaceutics	3	0.19%
Veterinary	3	0.19%
Chemistry	1	0.06%
Multidisciplinary	1	0.06%

4.2. Publication Trends

Table 6 offers a year-wise breakdown of startup-related publications and citation metrics. With a total of 1602 publications (TP), including 979 cited publications (NCP) and 23,885 citations (TC), the table provides insights into the evolving landscape of startup research from 1970 to 2023. The average citations per publication (C/P) and per

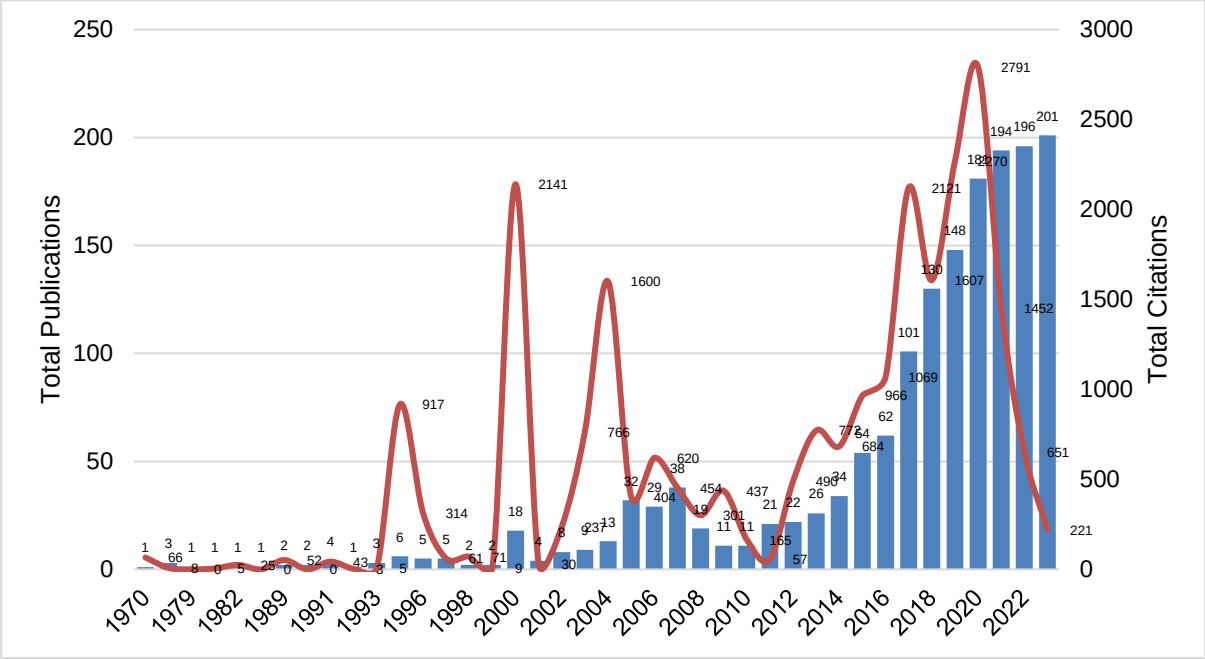
cited publication (C/CP) are 14.91 and 24.40, respectively. The h-index and g-index, reflecting publication impact and productivity, exhibit an upward trend over the years. While the early years (1970-2010) show modest publication numbers, there is a noticeable surge from 2010 onwards, signifying increased academic interest in startup research. Citation metrics parallel this trend, indicating growing impact. Notably, recent years (2021-2023) exhibit a slight decline, possibly indicating a shift in research focus or a transitional period. In summary, Table 6 highlights the dynamic evolution and increasing impact of startup research within the academic landscape.

Table 6: Year of Publication

Year	TP	NCP	TC	C/P	C/CP	*h*	*g*
1970	1	1	66	66.00	66.00	1	1
1978	3	2	8	2.67	4.00	2	2
1979	1	0	0	0.00	0.00	0	0
1981	1	1	5	5.00	5.00	1	1
1982	1	1	25	25.00	25.00	1	1
1985	1	0	0	0.00	0.00	0	0
1989	2	1	52	26.00	52.00	1	2
1990	2	0	0	0.00	0.00	0	0
1991	4	2	43	10.75	21.50	2	4
1992	1	1	3	3.00	3.00	1	1
1993	3	3	5	1.67	1.67	1	2
1994	6	6	917	152.83	152.83	4	6
1996	5	5	314	62.80	62.80	4	5
1997	5	3	61	12.20	20.33	1	5
1998	2	2	71	35.50	35.50	2	2
1999	2	1	9	4.50	9.00	1	2
2000	18	5	2141	118.94	428.20	3	18
2001	4	3	30	7.50	10.00	3	4
2002	8	4	237	29.63	59.25	3	8
2003	9	4	766	85.11	191.50	4	9
2004	13	7	1600	123.08	228.57	5	13
2005	32	5	404	12.63	80.80	3	20
2006	29	8	620	21.38	77.50	6	24
2007	38	8	454	11.95	56.75	7	21
2008	19	9	301	15.84	33.44	6	17
2009	11	9	437	39.73	48.56	5	11
2010	11	7	165	15.00	23.57	4	11
2011	21	10	57	2.71	5.70	4	7
2012	22	13	490	22.27	37.69	5	22
2013	26	16	772	29.69	48.25	11	26
2014	34	16	684	20.12	42.75	10	26
2015	54	30	966	17.89	32.20	12	31
2016	62	42	1069	17.24	25.45	17	32
2017	101	71	2121	21.00	29.87	22	45
2018	130	91	1607	12.36	17.66	21	37
2019	148	110	2270	15.34	20.64	26	44
2020	181	145	2791	15.42	19.25	24	49
2021	194	146	1452	7.48	9.95	19	30
2022	196	119	651	3.32	5.47	12	17
2023	201	72	221	1.10	3.07	7	9
Total	1602	979	23885	14.91	24.40		

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication; h=h-index; and g=g-index.

Figure 2: Publications and Citations by Year



4.3 Publications by Authors

Table 7 provides insights into the most productive authors based on total publications. Notably, Richard Goering leads with 21 publications, while Abrahamsson and Wang follow closely with 20 each. Antonio Ghezzi stands out with a substantial total citation (TC) count of 781, resulting in an impressive average citations per publication (C/P) and per cited publication (C/CP).

Table 7: Most Productive Authors Based on Total Publication

Author's Name	TP	NCP	TC	C/P	C/CP
Goering, Richard (7004856913)	21	1	1	0.05	1.00
Abrahamsson, Pekka (7006011356)	20	16	470	23.50	29.38
Wang, Xiaofeng (57219149655)	20	16	429	21.45	26.81
Nguyen-Duc, Anh (55925400800)	16	12	162	10.13	13.50
Ghezzi, Antonio (24831905500)	16	13	781	48.81	60.08
Merritt, Rick (12243224100)	11	0	0	0.00	0.00
Prikladnicki, Rafael (13612977400)	11	10	57	5.18	5.70
Chanin, Rafael (14009800300)	10	9	50	5.00	5.56
Sales, Afonso (8944846500)	9	8	47	5.22	5.88
Kemell, Kai-Kristian (57203633786)	9	6	30	3.33	5.00
Cavallo, Angelo (57201683425)	9	7	457	50.78	65.29
Steiber, Annika (50362149400)	8	8	65	8.13	8.13
Melegati, Jorge (57050359600)	8	6	44	5.50	7.33
Wirbel, Loring (35868235400)	6	0	0	0.00	0.00
Risku, Juhani (57028415000)	6	2	5	0.83	2.50

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication.

On the other hand, Table 8 shifts focus to the most powerful authors based on total citations. Brian S. Silverman and Joel A.C. Baum top the list with 2665 citations each, leading to notable average C/P and C/CP figures. Antonio Calabrese showcases an

exceptional C/P and C/CP of 1797, emphasizing the impact of his singular publication. Ghezzi, present in both tables, again demonstrates his influence, contributing to the field's citation metrics significantly. These tables offer a comprehensive overview of both prolific and influential authors in the startup research domain.

Table 8: Most Powerful Authors Based on Total Citation

Author's Name	TP	NCP	TC	C/P	C/CP
Silverman, Brian S. (7101647920)	3	3	2665	888.33	888.33
Baum, Joel A.C. (24304945600)	3	3	2665	888.33	888.33
Calabrese, Tony (6505982525)	1	1	1797	1797.00	1797.00
Foster, George (35333876500)	5	5	958	191.60	191.60
Davila, Antonio (7006340871)	5	5	958	191.60	191.60
Thurik, Roy (56000233900)	4	4	928	232.00	232.00
Bosma, Niels (13805519100)	3	3	802	267.33	267.33
Kogut, Bruce (7005662043)	1	1	797	797.00	797.00
Shan, Weijan (57542015200)	1	1	797	797.00	797.00
Walker, Gordon (24587991000)	1	1	797	797.00	797.00
Ghezzi, Antonio (24831905500)	16	13	781	48.81	60.08
Kuckertz, Andreas (8728172700)	6	5	752	125.33	150.40
Berger, Elisabeth S.C. (57020862500)	5	4	720	144.00	180.00
Gaudig, Anja (57208919664)	2	2	600	300.00	300.00
Hinderer, Sebastian (57213197563)	1	1	567	567.00	567.00

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication.

4.4. Publications by Institutions

Table 9 provides an insightful overview of the most productive institutions in the field of startup research, emphasizing both the quantity and impact of their publications. The University of Jyväskylä in Finland stands out with a total of 54 publications, 320 cited publications, and 27 total citations, resulting in an average of 5.93 citations per publication and 11.85 citations per cited publication.

Table 9: Most Productive Institutions Based on Total Publication

Affiliation	Country	TP	NCP	TC	C/P	C/CP
University of Jyväskylä	Finland	54	320	27	5.93	11.85
Free University of Bozen-Bolzano	Italy	47	996	39	21.19	25.54
EE Times	USA	45	1	1	0.02	1.00
Pontifical Catholic University of Rio Grande do Sul	Brazil	42	214	38	5.10	5.63
Politecnico di Milano	Italy	34	1717	26	50.50	66.04
University of São Paulo	Brazil	27	226	24	8.37	9.42
Norwegian University of Science and Technology	Norway	26	519	21	19.96	24.71
University of Hohenheim	Germany	25	5038	21	201.52	239.90
University of Tehran	Iran	24	275	22	11.46	12.50
University of Oulu	Finland	21	131	19	6.24	6.89

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication.

Following closely is the Free University of Bozen-Bolzano in Italy, contributing significantly with 47 publications, 996 cited publications, and 39 total citations. Their

work demonstrates an average of 21.19 citations per publication and 25.54 citations per cited publication. Notably, EE Times from the USA, with 45 publications, holds a unique position, although it has a minimal total citation count of 1, resulting in an average of 0.02 citations per publication and 1.00 citation per cited publication. These institutions showcase diverse contributions to the startup research landscape, with variations in both quantity and impact.

On the other hand, Table 10 highlights the institutions with the most significant total citation impact in the realm of startup research. The University of Toronto (Canada) emerges as a powerhouse with 11 publications, 5427 cited publications, and 11 total citations. Impressively, this institution achieves an average of 493.36 citations per publication and per cited publication, reflecting the substantial influence of its work in the field. Following closely is the University of Hohenheim (Germany), contributing 25 publications, 5038 cited publications, and 21 total citations. With an average of 201.52 citations per publication and 239.90 citations per cited publication, it underscores the institution's substantial impact on startup-related scholarly discussions. Noteworthy mentions include Harvard University (USA), with 15 publications and 2787 cited publications, and Stanford University (USA), with 17 publications and 1856 cited publications. Both institutions exhibit significant average citations per publication and per cited publication, reinforcing their influential roles in advancing the understanding of startups within academic circles.

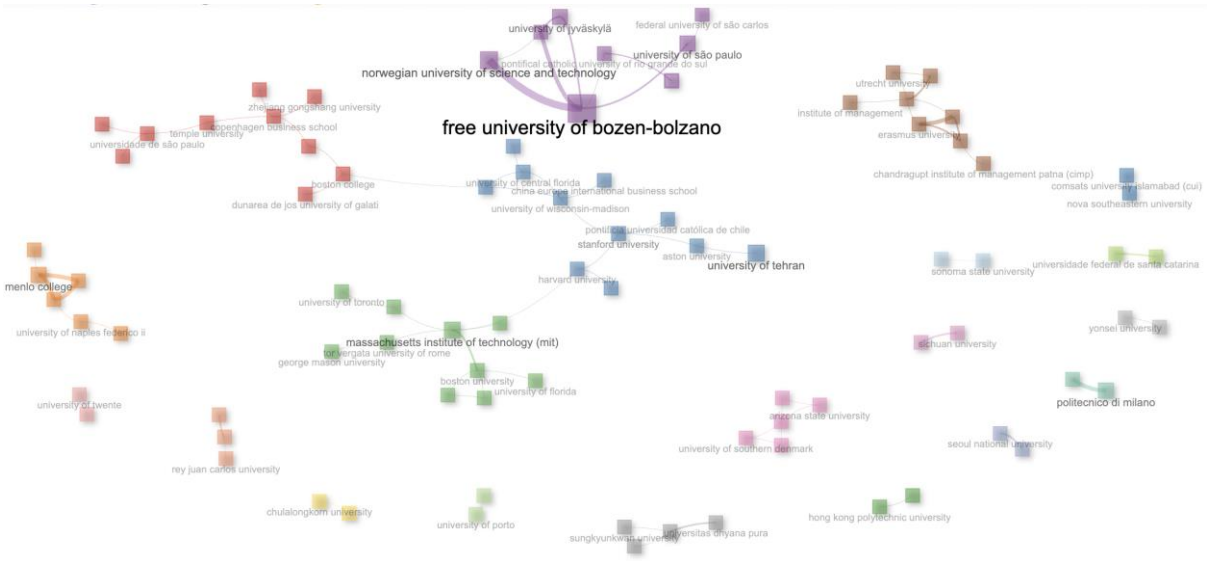
Table 10: Most Powerful Institutions Based on Total Citation

Affiliation	Country	TP	NCP	TC	C/P	C/CP
University of Toronto	Canada	11	5427	11	493.36	493.36
University of Hohenheim	Germany	25	5038	21	201.52	239.90
Harvard University	USA	15	2787	15	185.80	185.80
Stanford University	USA	17	1856	14	109.18	132.57
Politecnico di Milano	Italy	34	1717	26	50.50	66.04
University of Pennsylvania	USA	14	1589	14	113.50	113.50
EIM Business and Policy Research	Netherlands	4	1331	4	332.75	332.75
Free University of Bozen-Bolzano	Italy	47	996	39	21.19	25.54
Erasmus University	Netherlands	10	931	7	93.10	133.00
Morgan Stanley	Hong Kong	1	797	1	797.00	797.00

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication.

Figure 3 visually represents the collaborative network among various affiliations involved in startup-related research. The nodes in the network correspond to different institutions or entities, and the edges connecting them denote collaborative relationships. The size of each node indicates the degree of collaboration, with larger nodes suggesting higher collaboration. The network provides insights into the interconnectedness of institutions within the startup research landscape, showcasing patterns of collaboration and identifying central players or hubs in the network. Analyzing the figure can unveil key affiliations that actively engage with others in the field, facilitating a better understanding of the collaborative dynamics shaping the landscape of startup-related research.

Figure 3: Network visualization map of co-authorship by organizations (Top 200 organizations)



4.5. Publications by Countries

Table 11 presents the top 20 countries that have contributed to startup-related publications, detailing their respective publication metrics. The United States leads the list with 811 publications, accumulating 21,622 total citations, and an average of 26.66 citations per publication (C/P).

Table 11: Top 20 Countries contributed to the publications

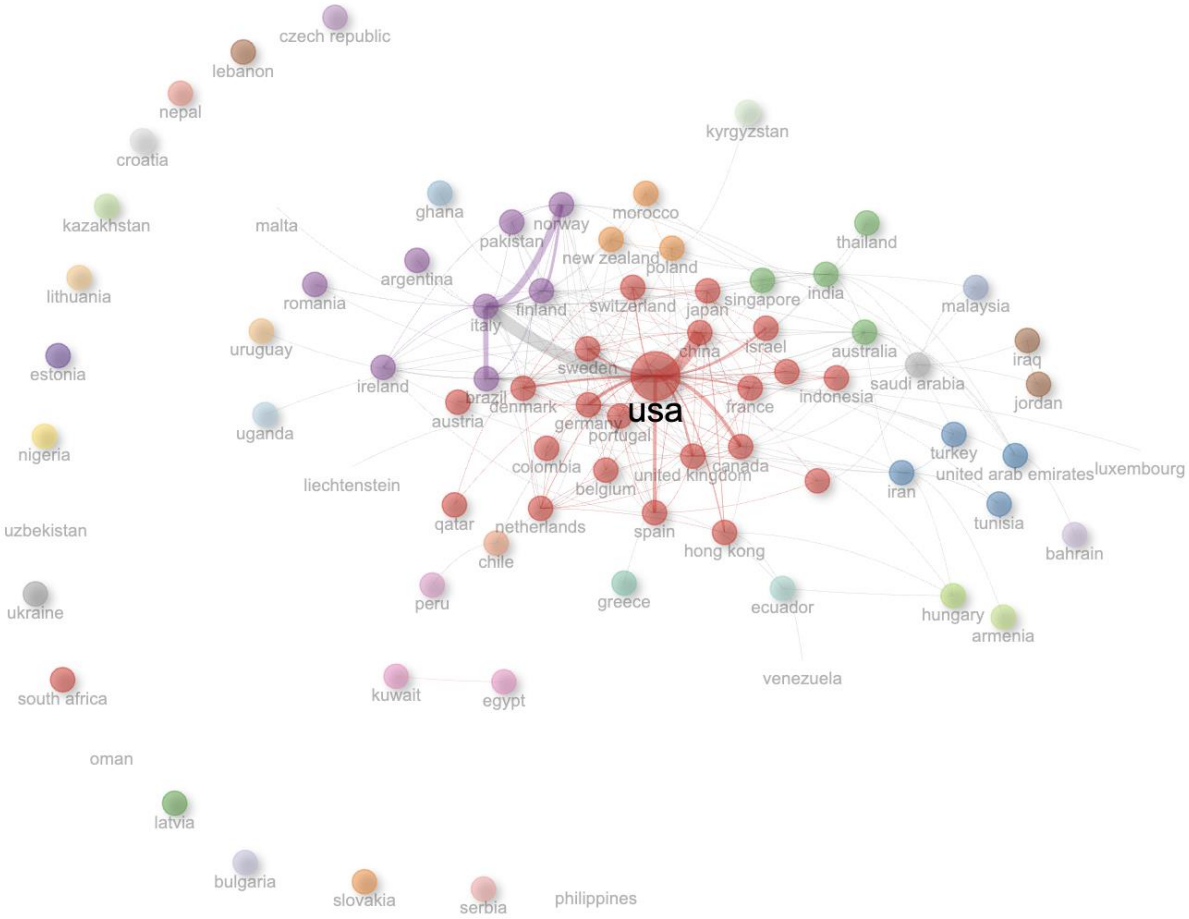
Country	TP	TC	NCP	C/P	C/CP	*h*	*g*
United States	811	21622	524	26.66	41.26	70	102
Brazil	322	2198	233	6.83	9.43	11	11
Germany	257	7007	174	27.26	40.27	19	19
Italy	238	5582	198	23.45	28.19	36	36
India	187	853	110	4.56	7.75		
Indonesia	127	394	82	3.10	4.80		
China	115	1340	94	11.65	14.26	6	6
Finland	111	1340	77	12.07	17.40	4	4
Spain	97	1155	68	11.91	16.99	7	7
South Korea	86	860	66	10.00	13.03	1	1
United Kingdom	73	847	57	11.60	14.86	6	6
Netherlands	71	3582	50	50.45	71.64	13	13
Norway	68	612	48	9.00	12.75	4	4
Sweden	65	1613	53	24.82	30.43	14	14
France	61	1409	47	23.10	29.98	6	6
Iran	61	445	45	7.30	9.89	2	2
Canada	53	6104	43	115.17	141.95	10	10
Japan	52	194	23	3.73	8.43	1	1
Portugal	49	403	31	8.22	13.00	2	2
Thailand	45	199	37	4.42	5.38		

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication; h=h-index; and g=g-index.

Brazil follows with 322 publications, 2,198 total citations, and a C/P of 6.83. Germany, Italy, and India also make substantial contributions, each with distinctive citation and impact metrics. Notably, the table provides insights into the global distribution of startup research, showcasing the diverse engagement of countries in this academic domain. Additionally, the h-index and g-index are included to gauge the overall impact and productivity of each country's publications within the startup research landscape. The information is valuable for understanding the international footprint and influence of countries in the field of startup studies.

Figure 4 suggests that the associated figure provides a visual representation of a network showcasing collaborations or co-authorship relationships between different countries within the specified context. In other words, the figure likely presents a graphical depiction of how authors from various countries have collaborated on research or publications related to the topic at hand. The visualization map could include nodes representing countries and edges indicating instances of collaboration or joint authorship, providing insights into the international collaborative landscape in the field under consideration.

Figure 4: Network visualisation map of the co-authorship by countries



4.6 Publications by Source Titles

Table 12 provides information on the most active source titles based on total publication in the context of startup-related research. The table includes details such as the total publications (TP), number of cited publications (NCP), total citations (TC), citations per

publication (C/P), citations per cited publication (C/CP), h-index, and g-index for each source title. Noteworthy titles include "Electronic Engineering Times" with 59 publications and an h-index of 1, "Lecture Notes in Business Information Processing" with 52 publications and an h-index of 14, and "Small Business Economics" with 27 publications and an h-index of 16, indicating their significance in terms of productivity and impact.

Table 12: Most active source titles based on total publication

Source Title	TP	NCP	TC	C/P	C/CP	*h*	*g*
Electronic Engineering Times	59	1	1	0.02	1.00	1	1
Lecture Notes in Business Information Processing	52	41	761	14.63	18.56	14	27
Economist (United Kingdom)	42	0	0	0.00	0.00	0	0
Small Business Economics	27	24	1684	62.37	70.17	16	27
Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE	19	8	16	0.84	2.00	3	3
Technological Forecasting and Social Change	18	15	611	33.94	40.73	9	18
Journal of Business Venturing	17	16	2523	148.41	157.69	12	17
Fundamentals of Software Startups: Essential Engineering and Business Aspects	17	13	58	3.41	4.46	5	6
Research Policy	17	17	950	55.88	55.88	11	17
International Journal of Entrepreneurial Behaviour and Research	16	14	358	22.38	25.57	8	16

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication; h=h-index; and g=g-index.

In contrast, Table 13 focuses on the most powerful source titles based on total citation, offering insights into the impact of these sources within the field.

Table 13: Most powerful source titles based on total citation

Source Title	TP	NCP	C	/P	C/CP	*h*	*g*
Strategic Management Journal	9	8	335	15.00	354.38	5	9
Journal of Business Venturing	17	16	523	48.41	157.69	12	17
Small Business Economics	27	24	584	2.37	70.17	16	27
Research Policy	17	17	50	5.88	55.88	11	17
California Management Review	11	11	55	7.73	77.73	8	11
Lecture Notes in Business Information Processing	52	41	51	4.63	18.56	14	27
Journal of Business Research	14	13	39	9.21	53.00	10	14
Journal of Business Venturing Insights	13	12	53	0.23	54.42	5	13
Technological Forecasting and Social Change	18	15	11	3.94	40.73	9	18
Business Horizons	5	5	19	03.80	103.80	4	5

Notes: TP=total publications; NCP=number of cited publications; TC=total citations; C/P= citations per publication; C/CP= citations per cited publication; h=h-index; and g=g-index.

Titles such as "Strategic Management Journal" with 9 publications and an h-index of 5, "Journal of Business Venturing" with 17 publications and an h-index of 12, and "Small Business Economics" with 27 publications and an h-index of 16 stand out for their high

total citations and influence. The table provides a comprehensive overview of the citation metrics, emphasizing the impact of these source titles in the realm of startup research.

4.7 Highly Cited Documents

Table 14 presents the top 20 highly cited articles in the field of startup-related research, providing insights into the impactful contributions within the literature. Each entry includes the article number, authors, title, total citations (TC), and average citations per year (C/Y). The most highly cited article, with 1797 total citations, is "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology" by Baum et al. (2000), which has an impressive average of 74.88 citations per year. Other notable articles include "Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups" by Baum and Silverman (2004) with 865 total citations, Shan et al. (1994) with 797 total citations, and "Startups in times of crisis – A rapid response to the COVID-19 pandemic" by Kuckertz et al. (2020) with 567 total citations. The table provides valuable information on the influential articles in the startup research domain, offering a glimpse into the key themes and research directions that have significantly impacted the field over the years.

Table 14: Top 20 highly cited articles

No.	Authors	Title	TC	C/Y
1	Baum et al. (2000)	Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology	1797	74.88
2	Baum and Silverman (2004)	Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups	865	43.25
3	Shan et al. (1994)	Interfirm cooperation and startup innovation in the biotechnology industry	797	26.57
4	Kuckertz et al. (2020)	Startups in times of crisis – A rapid response to the COVID-19 pandemic	567	141.75
5	Bosma et al. (2004)	The value of human and social capital investments for the business performance of startups	529	26.45
6	Davila et al. (2003)	Venture capital financing and the growth of startup firms	488	23.24
7	Ensley et al. (2006)	The importance of vertical and shared leadership within new venture top management teams: Implications for the performance of startups	486	27.00
8	Ghezzi and Cavallo (2020)	Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches	307	76.75
9	Weiblen and Chesbrough (2015)	Engaging with startups to enhance corporate innovation	287	31.89
10	Kanze et al. (2018)	We ask men to win and women not to lose: Closing the gender gap in startup funding	270	45.00
11	Almeida et al. (2003)	Startup size and the mechanisms of external learning: Increasing opportunity and decreasing ability?	245	11.67

12	Åstebro et al. (2012)	Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy	227	18.92
13	Castrogiovanni (1996)	Pre-startup planning and the survival of new small businesses: Theoretical linkages	225	8.04
14	Spender et al. (2017)	Startups and open innovation: a review of the literature	221	31.57
15	Reynolds (2000)	National panel study of U.S. business startups: Background and methodology	216	9.00
16	Davila and Foster (2005)	Management accounting systems adoption decisions: Evidence and performance implications from early-stage/startup companies	215	11.32
17	Kohler (2016)	Corporate accelerators: Building bridges between corporations and startups	212	26.50
18	Leong et al. (2017)	Nurturing a FinTech ecosystem: The case of a youth microloan startup in China	189	27.00
19	Benson and Ziedonis (2009)	Corporate venture capital as a window on new technologies: Iumplications for the performance of corporate investors when acquiring startups	189	12.60
20	Nanda and Rhodes-Kropf (2013)	Investment cycles and startup innovation	184	16.73

Notes: TC=total citations; C/Y= citations per year

4.8 Co-occurrence Analysis of Author's Keywords

Table 15 outlines the top author's keywords in startup-related research, providing valuable insights into the prominent themes and focal points within the literature. The table includes the author keywords, total number of publications (TP) associated with each keyword, link strength (LS) representing the strength of connections among keywords, and the percentage (%) of the total publications. The most prevalent keyword is "Startups," appearing in 422 publications, with a notable link strength of 1825, constituting 7.64% of the total publications. Following closely is "Entrepreneurship" with 196 publications, a link strength of 914, and a percentage of 3.55%. "Innovation" is another significant keyword, appearing in 96 publications (1.74%), and "Venture Capital" is highlighted in 60 publications (1.09%). Other noteworthy keywords include "Software Startups" (57 publications, 1.03%), "Lean Startup" (55 publications, 1.00%), "Open Innovation" (33 publications, 0.60%), "Business Model" (31 publications, 0.56%), and "Human Capital" (22 publications, 0.40%). The table further delineates various keywords related to business models, ecosystems, dynamic capabilities, entrepreneurial finance, case studies, accelerators, product development, and digital startups. This comprehensive overview of top author's keywords provides a nuanced understanding of the key concepts and areas of focus within startup research, reflecting the diverse and dynamic nature of the field.

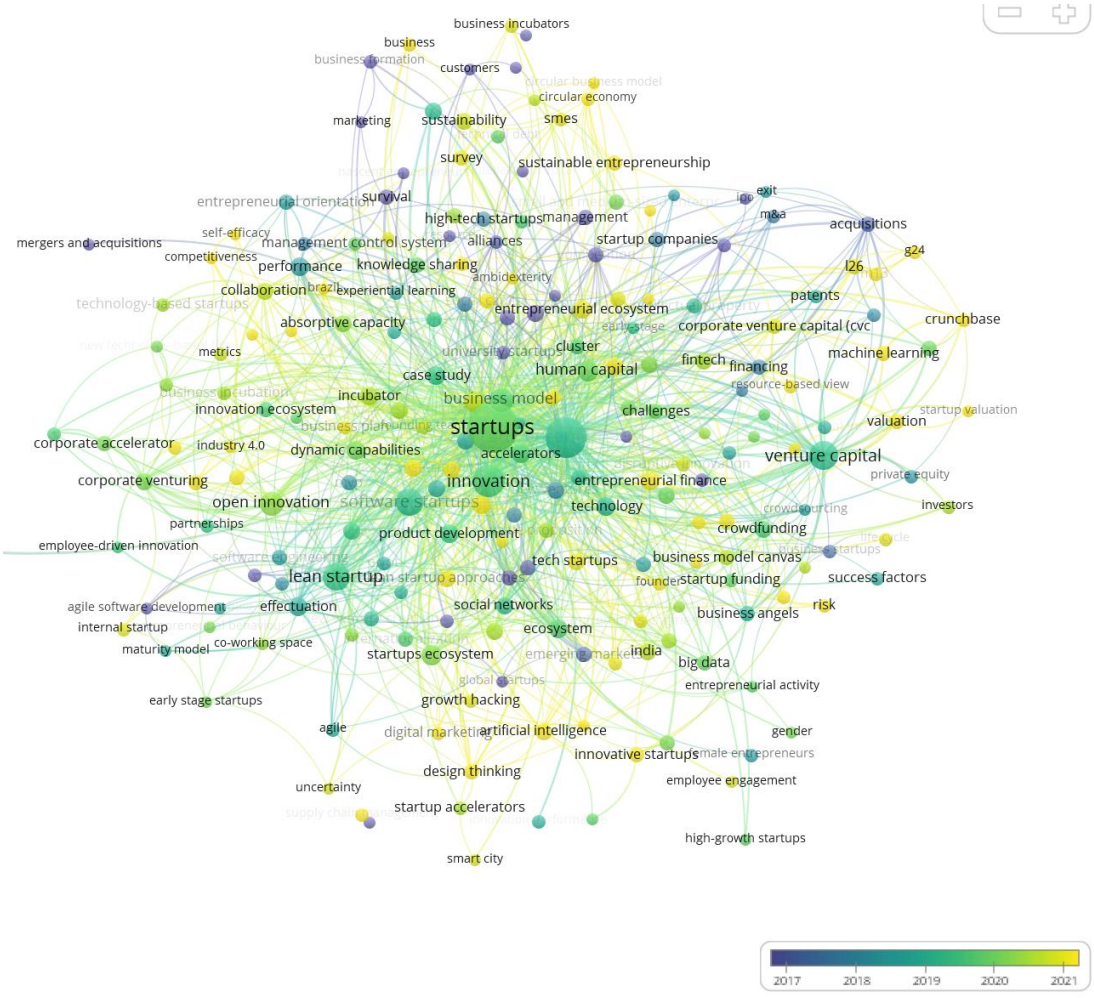
Table 15: Top author's keywords

Author Keywords	Total Publications (TP)	Link Strength (LS)	Percentage (%)
Startups	422	1825	7.64%
Entrepreneurship	196	914	3.55%
Innovation	96	427	1.74%

Venture Capital	60	309	1.09%
Software Startups	57	195	1.03%
Lean Startup	55	238	1.00%
Open Innovation	33	155	0.60%
Business Model	31	136	0.56%
Human Capital	22	101	0.40%
Business Model Innovation	21	84	0.38%
Startups Ecosystem	21	95	0.38%
Dynamic Capabilities	18	71	0.33%
Entrepreneurial Finance	18	80	0.33%
Case Study	17	68	0.31%
Entrepreneurial Ecosystem	17	78	0.31%
Performance	17	70	0.31%
Accelerators	16	82	0.29%
Product Development	16	70	0.29%
Digital Startups	15	63	0.27%
Ecosystem	15	68	0.27%

Figure 5's overlay visualization illustrates the predominant author's keywords related to startups, offering insights into ongoing research trends.

Figure 5: Overlay visualisation of the author's keywords



The visualization categorizes articles from 2017 to 2021, with colors distinguishing different time ranges. Yellow nodes represent research conducted in 2021 and beyond, purple nodes indicate articles from 2017 and earlier, and green nodes signify research in 2019. This color-coded representation provides a visual understanding of the temporal distribution of prevalent keywords in startup-related literature.

Table 16 and Figure 6 provides an overview of the accumulation number of trends based on the top ten author's keywords in the field of startups from 2009 to 2023. The data reflects the evolving emphasis on specific keywords over the years. Notably, the keyword "Startups" shows a steady increase, reaching 425 occurrences in 2023. "Entrepreneurship" also exhibits a rising trend, reaching 198 occurrences in 2023. Keywords such as "Innovation," "Venture Capital," and "Software Startups" show varying patterns of growth. "Lean Startup" and "Business Model" display an increasing presence, while "Open Innovation" demonstrates a consistent but moderate rise. The trends in "Human Capital" and "Business Model Innovation" showcase relatively steady growth. This comprehensive analysis provides valuable insights into the shifting focus areas within startup-related research, highlighting the increasing attention to specific themes over the years.

Figure 6: Trend of the top ten author's keywords

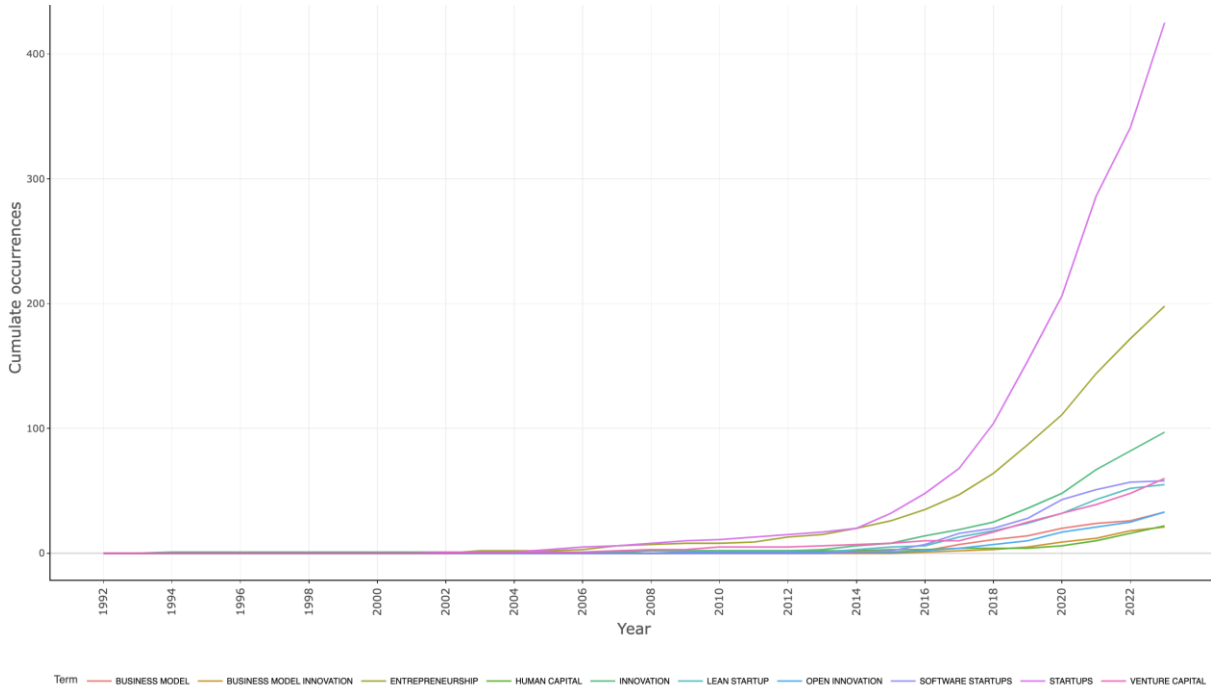


Table 16: Accumulation number of trend based on the top ten author's keywords

Year (20')	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Startups	10	11	13	15	17	20	22	81	88	104	154	206	286	341	425
Entrepreneurship	8	8	9	13	15	20	26	53	74	64	87	111	144	172	198
Innovation	2	2	2	2	3	6	8	11	19	25	36	48	67	82	97
Venture Capital	3	5	5	5	6	7	8	11	11	17	25	32	39	48	60

Software Startups	0	0	0	0	0	1	2	7	0 1 6	20	28	43	51	57	58
Lean Startup	0	1	1	1	1	3	5	6	1 3	18	24	32	43	52	55
Business Model	0	0	0	0	0	1	1	2	7	11	14	20	24	26	33
Open Innovation	1	1	1	1	1	1	1	2	4	7	10	17	21	25	33
Human Capital	2	2	2	2	2	2	3	3	4	4	4	6	10	16	22
Business Model Innovation	0	0	0	0	0	0	0	1	2	3	5	9	12	18	21

4.9. Co-occurrence analysis of terms based on title and abstract

Table 17 presents a comprehensive overview of keywords based on title fields in startup-related research articles. The table includes the top 50 keywords, along with their respective occurrences. The most frequently used keyword is "Startup," appearing 397 times, followed by "Startups" with 82 occurrences. Other prominent keywords include "Role," "Innovation," "Evidence," and "Impact," reflecting the diverse themes explored in the titles of these articles. Additionally, keywords like "Covid," "Entrepreneurial Ecosystem," and "High Tech Startup" highlight the contemporary relevance and evolving focus areas within startup research. The table provides valuable insights into the recurring themes and topics emphasized in the titles of articles, serving as a resource for researchers and readers interested in the breadth of startup-related literature. The network connecting all the keywords can be referenced in Figure 7.

Table 17: Table of keyword based on title fields

No	Keywords	Occurrences	No	Keywords	Occurrences
1	Startup	397	26	Entrepreneur	16
2	Startups	82	27	Covid	15
3	Role	67	28	Entrepreneurial Ecosystem	15
4	Innovation	38	29	Framework	15
5	Evidence	37	30	High Tech Startup	15
6	Impact	35	31	Open Innovation	14
7	Software Startup	34	32	Survival	14
8	Case	32	33	Growth	13
9	Case Study	31	34	Relationship	13
10	Effect	31	35	Strategy	13
11	Performance	30	36	Determinant	12
12	Development	27	37	Digital Startup	12
13	Lean Startup	27	38	Economy	12
14	Success	23	39	Exploratory Study	12
15	Analysis	20	40	University	12
16	Challenge	20	41	Business Model	11
17	Influence	20	42	Indian Startup	11
18	Factor	19	43	Japan	11
19	India	19	44	Pandemic	11
20	Study	19	45	Startup Performance	11
21	Entrepreneurship	18	46	Value	11
22	Startup Company	18	47	Accelerator	10
23	Tech Startup	18	48	Brazilian Startup	10
24	Technology	18	49	Context	10
25	Startup Firm	17	50	Empirical Study	10

Figure 7: Network visualisation of a term co-occurrence network based on title fields

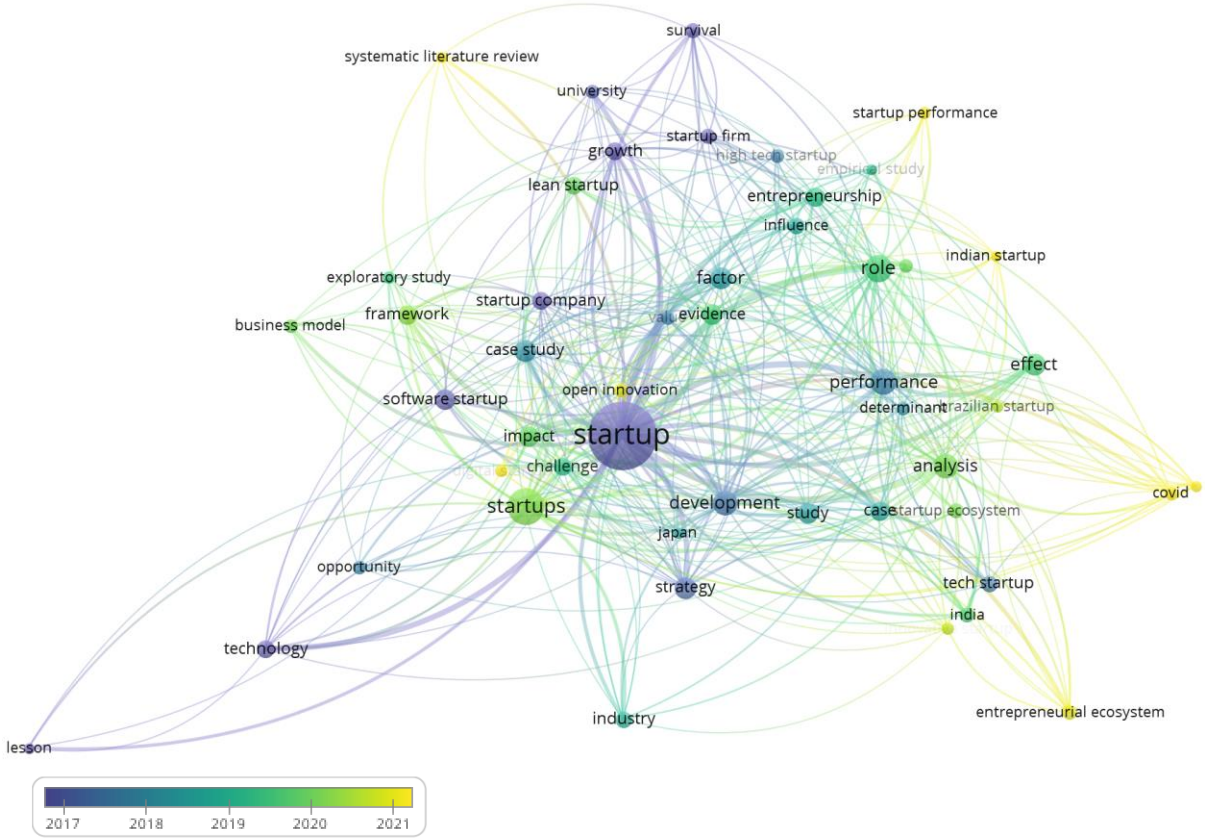


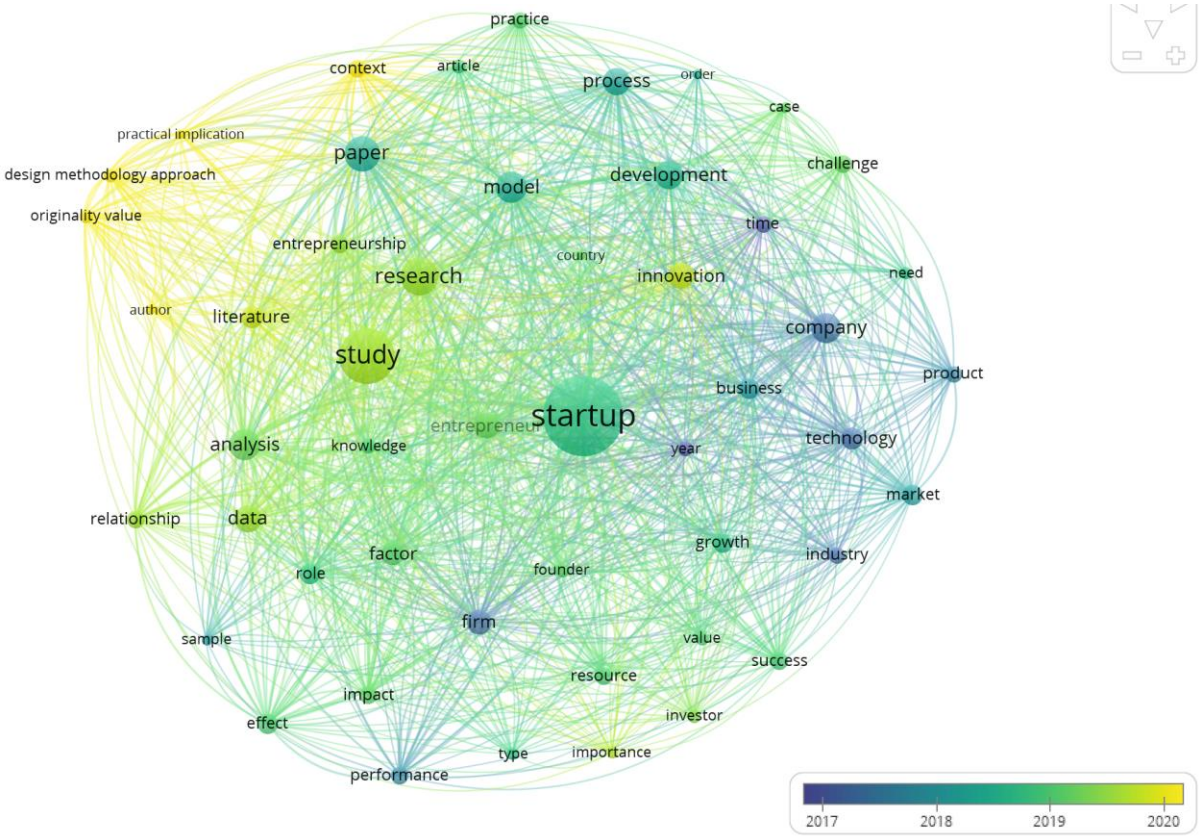
Table 18 provides a detailed overview of keywords based on abstract fields in startup-related research articles, showcasing the top 50 keywords and their respective occurrences. The most frequently used keyword in abstracts is "Startup," appearing 775 times, followed by "Study" with 496 occurrences and "Paper" with 378 occurrences. The table reflects the diverse range of keywords employed in the abstracts, illustrating the multifaceted nature of startup research. Notable keywords include "Innovation," "Entrepreneur," "Development," and "Company," highlighting key thematic areas explored in the abstracts. Additionally, terms such as "Effect," "Impact," and "Growth" underscore the emphasis on outcomes and implications in startup literature. The table serves as a valuable resource for researchers seeking an understanding of the prevalent themes and topics within startup-related research abstracts. The network connecting all the keywords can be referenced in Figure 8.

Table 18: Table of keyword based on abstract fields

No	Keywords	Occurrences	No	Keywords	Occurrences
1	Startup	775	26	Model	124
2	Study	496	27	Effect	123
3	Paper	378	28	Process	123
4	Research	286	29	Impact	122
5	Entrepreneur	228	30	Resource	121
6	Company	221	31	Time	121
7	Data	192	32	Knowledge	110
8	Innovation	188	33	Year	110
9	Development	174	34	Growth	109
10	Firm	154	35	Investor	109
11	Business	150	36	Founder	108

12	Design Methodology Approach	147	37	Practice	104
13	Literature	147	38	Industry	103
14	Originality Value	146	39	Importance	101
15	Relationship	143	40	Product	101
16	Analysis	141	41	Sample	100
17	Market	139	42	Type	99
18	Role	137	43	Author	98
19	Factor	135	44	Need	97
20	Challenge	133	45	Value	97
21	Technology	133	46	Practical Implication	93
22	Entrepreneurship	132	47	Country	91
23	Article	130	48	Order	91
24	Success	128	49	Performance	91
25	Context	125	50	Case	89

Figure 8: Network visualisation of a term co-occurrence network based on abstract field



5. Conclusion

This research paper utilizes a rigorous bibliometric analysis, employing VOSviewer and R software, to systematically map the historical evolution and current state of Startup research. The analysis delves into various article characteristics such as publication years, types, sources, and contents. Additionally, it uncovers valuable insights into annual publication trends, prolific authors, highly cited papers, leading countries and institutions, noteworthy source titles, prevalent keywords, co-citation networks, collaborative patterns, and evolving keyword landscapes within the field of Startup research. In essence, this pioneering bibliometric analysis contributes significantly to the scholarly discourse, identifying crucial areas for future research. It enhances our

understanding of the multifaceted aspects of Startup, illuminating their historical significance and future trajectories.

This study provides invaluable insights with significant implications for educators, practitioners, academics, and scholars involved in the domains of startup, entrepreneurship, and innovation. Through a meticulous bibliometric analysis of the literature, we have uncovered the dynamic evolution of Startup over the years. However, it is crucial to acknowledge the limitations inherent in this research. One primary constraint is related to the use of keywords for article retrieval. Since our search strategy focused solely on the term "startup," we cannot claim to have captured every published work in the field. Nonetheless, we believe that our selected keywords have effectively encompassed a substantial body of literature on Startup. Another notable limitation is our reliance solely on the Scopus online database for bibliometric analysis, which may have constrained the breadth of our search.

Future scholars are encouraged to diversify databases and use bibliometric techniques for Comprehensive reviews like this one lay a solid foundation for future research endeavors. Prospective researchers are encouraged to expand upon this groundwork by delving into specific Startup-related keywords such as open innovation, lean startup, and venture capital. Furthermore, extending investigations to encompass various terms and contexts, including technological advancements like machine learning and artificial intelligence, holds promise for substantial contributions to the field. Research endeavors employing diverse approaches are likely to enrich our understanding of Startup and its implications.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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