

DOI: 10.5281/zenodo.20023294

MAPPING THE RESEARCH LANDSCAPE OF VIRTUAL TEAMS AND LEADERSHIP: A BIBLIOMETRIC APPROACH

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Received: 02/04/2026

Accepted: 23/04/2026

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ABSTRACT

This bibliometric study provides a detailed examination of the evolving research landscape surrounding virtual teams and leadership, focusing on identifying key trends, influential works, and emerging themes. By analyzing a substantial number of academic publications, the study identifies critical research gaps and areas of focus within the field. Harzing's Publish or Perish software was used to extract bibliometric indicators, while VOSviewer was employed to map citation networks. The findings emphasize the significant role of leadership in shaping employee outcomes, promoting strategic alignment, and facilitating organizational adaptation within digital environments. The study underscores the importance of leadership models such as transformational, shared, and e-leadership in maintaining team performance and engagement in remote settings. Despite these insights, the study acknowledges its limitations, particularly its reliance on English-language publications and specific databases, potentially limiting the inclusion of diverse perspectives. The study concludes by advocating for further interdisciplinary research, integrating insights from psychology, technology, and organizational behavior to create more comprehensive leadership frameworks for managing virtual teams in the rapidly changing digital workplace.

KEYWORDS: Virtual Team, Leadership, Bibliometrics, Transformational Leadership, Remote Work.

1. INTRODUCTION

The rise of virtual teams has significantly transformed organizational dynamics, presenting unique challenges that reshape leadership roles. As remote work becomes increasingly prevalent, effective leadership in virtual teams is critical for ensuring productivity, engagement, and cohesion among team members. Leaders are now tasked with navigating the complexities of digital communication, maintaining trust, and fostering collaboration without the advantages of face-to-face interactions (Radulovic & Epitropaki, 2020). This shift has prompted a surge of academic interest in exploring the relationship between leadership approaches and the performance of virtual teams, as leadership practices are pivotal in overcoming the hurdles associated with remote work environments (Han & Hazard, 2022).

Virtual teams depend heavily on technology for communication and collaboration, which alters traditional leadership dynamics (Farid et al., 2020). Leaders must not only be proficient in utilizing digital tools but also excel in fostering trust and motivation within a non-physical workspace (Handke et al., 2019). Research indicates that transformational leadership styles, characterized by vision, support, and motivation, are particularly effective in virtual settings, as they help bridge the gaps created by distance (Wattanatinnachot, 2021). Furthermore, leaders who emphasize clear communication, adaptability, and emotional intelligence are better equipped to guide their teams toward success, cultivating a sense of shared purpose despite geographical dispersion (Lyubovnikova et al., 2015). The importance of shared leadership has also been highlighted, as it enhances team satisfaction and performance by distributing leadership responsibilities among team members, which can be especially beneficial in virtual contexts (Sanchez et al., 2023).

A bibliometric analysis of the literature surrounding virtual team leadership reveals valuable insights into the evolution of this field and the trends that have shaped its development. By mapping influential works, authors, and emerging themes, researchers can better understand the connection between leadership and virtual team performance while identifying gaps and future research directions (Ab Wahad et al., 2023). This structured approach to knowledge accumulation aids both scholars and practitioners in enhancing leadership strategies tailored for virtual environments. The findings suggest that shared leadership not only addresses the challenges faced by virtual teams but also directly

contributes to their effectiveness (Kashive et al., 2022). Moreover, the integration of authentic leadership styles has been shown to positively impact team performance, emphasizing the need for leaders to foster high-quality interpersonal relationships within their teams (Han et al., 2021).

The structure of this article begins with a comprehensive literature review, followed by the methodology section. The methodology section provides a clear and detailed explanation of the data collection and analysis methods, ensuring transparency and rigor (Sundarasan et al., 2024). The results section presents the findings of the bibliometric analysis, highlighting key trends in publications and thematic clusters within the literature. In the discussion, these findings will be interpreted within the broader context of current knowledge, identifying gaps in the research and proposing recommendations for future studies. In the conclusion, these findings are interpreted within the wider context of current research, addressing gaps and offering suggestions for future studies. The conclusion wraps up the article by summarizing the key insights and outlining their practical implications for both academic researchers and professionals, especially those interested in improving leadership in virtual teams.

2. LITERATURE REVIEW

Virtual teams, defined as groups of individuals collaborating toward shared goals across different physical locations, have become increasingly prevalent in modern organizations. This shift necessitates a transformation in leadership practices, as traditional co-located team dynamics differ significantly from those of virtual teams (Faizuddin et al., 2022). The reliance on digital communication technologies, such as video conferencing and collaborative platforms, is essential for effective collaboration, yet it presents unique challenges for leaders who must influence and guide team members without the benefit of in-person interactions (Radulovic & Epitropaki (2020); Zhang et al., 2021). Leadership, as articulated by Northouse, involves influencing a group toward achieving common goals, a process that is particularly complex in virtual environments due to the mediation of digital technologies (Karaköse et al., 2022).

Effective leadership in virtual teams requires adaptation to the nuances of remote work, where building trust, facilitating communication, and ensuring accountability are more challenging due to physical distance (Robert & You, 2017). Transformational leadership has been identified as

particularly effective in these contexts, as it inspires and motivates team members by articulating a clear vision and fostering a sense of purpose (Sanchez et al., 2023). This leadership style is crucial in creating unity and direction, especially when team members may experience feelings of isolation (Nuratri, 2022). Additionally, the role of emotional intelligence in virtual leadership cannot be overstated; leaders must navigate interpersonal dynamics sensitively and respond to team members' emotional states to maintain motivation and engagement (Mysirlaki & Paraskeva, 2020).

Despite the growing body of research on virtual team leadership, significant gaps remain. One notable gap is the limited understanding of how leadership effectiveness evolves over time in virtual contexts, particularly across different sectors (Ziek & Smulowitz, 2014). Much of the existing literature focuses on short-term projects, leaving the long-term impacts of virtual leadership on team performance, cohesion, and member well-being underexplored (Mansel & Einion, 2019). Furthermore, while transformational leadership has received considerable attention, other models such as servant leadership and shared leadership in virtual contexts remain less studied (Alam et al., 2023). The influence of cross-cultural dynamics in virtual teams is another underexplored area, as cultural diversity introduces complexities that leaders must navigate, including varying communication styles and work ethics (Purvanova & Kenda, 2018).

To address these gaps, a bibliometric analysis of the existing literature on virtual teams and leadership can provide valuable insights. This method systematically examines patterns in academic literature, including publication trends and citation networks, to map key research areas and identify emerging themes (Frich et al., 2014). By analyzing the most influential studies and authors, this analysis aims to uncover how virtual leadership is discussed across different industries and cultures, thereby offering a holistic view of its evolution (Shamon, 2023). The objectives of this research include identifying dominant themes in virtual team leadership, highlighting gaps in the literature, and guiding future research directions.

3. METHODS

The rise of virtual teams has prompted significant academic interest in understanding the dynamics of

leadership within these contexts. This bibliometric analysis aims to systematically review the literature on virtual teams and leadership, utilizing the Scopus scientific database as the primary source of data. The analysis encompasses various types of publications from 2013 to 2023, reflecting the growing body of research in this area. Scopus was selected for this analysis because Scopus offers a wider range of sources than Web of Science (Hallinger & Kovačević, 2019).

The bibliometric analysis was conducted on May 30, 2024, employing the keyword search string "virtual teams AND leadership" within the Scopus database. The initial search yielded 551 records. Following a rigorous screening process, 223 records were excluded due to irrelevance or duplication, resulting in a final dataset of 328 records for further analysis. This systematic approach ensures that the analysis focuses on relevant and high-quality research outputs.

To analyze the relationships among the identified publications, VOSviewer software was employed. VOSviewer is a sophisticated tool specifically designed to construct citation maps and visualize networks within scientific literature. It enables researchers to measure the total strength of links between articles, which represents the degree of interconnection based on shared citations. In this context, stronger links indicate that the articles are frequently cited together, suggesting a thematic relationship. This approach is especially valuable for identifying clusters of research focused on related topics, such as virtual teams and leadership. By using this method, it becomes possible to trace intellectual linkages and thematic developments across the field (Waltman et al., 2010).

In addition to VOSviewer, Harzing's Publish or Perish software was employed to assess the impact of specific authors and publications. This tool provides a range of bibliometric indicators, including citation counts, h-indices, and other relevant metrics that facilitate the evaluation of research influence. By integrating the insights from both VOSviewer and Publish or Perish, this study aims to present a comprehensive overview of the most influential authors and works in the domain of virtual teams and leadership. The methodological flow of this bibliometric analysis is illustrated in Figure 1, which outlines the steps involved in the data collection and analysis process.

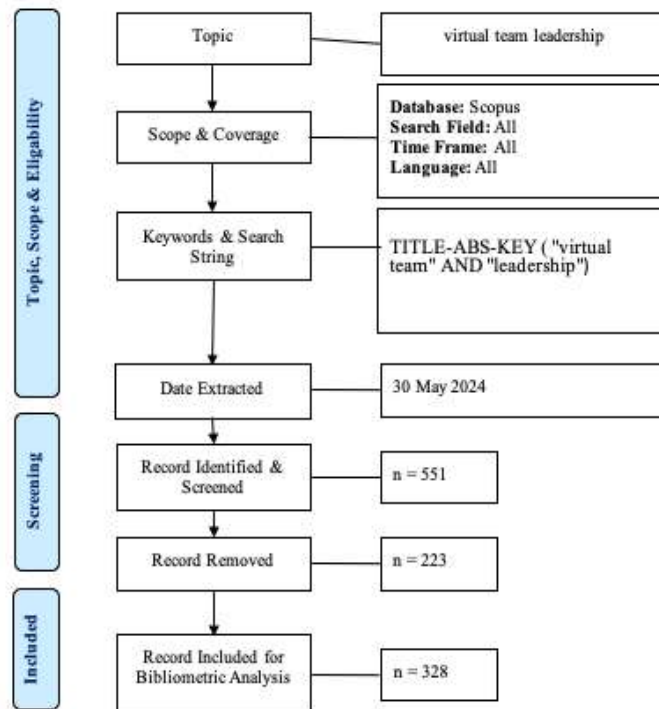


Figure 1: Prisma Flow Diagram.

Source: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Plos Med* 6(7): E1000097. Doi:10.1371/Journal. Pmed1000097

4. RESULTS

In conducting the analysis of the academic works extracted during the search process, the following attributes were considered: document and source types, language of documents, subject area, year of publication, the top 10 countries that contributed to the publication, the most active source titles, citation metrics, top 20 highly cited articles, and keyword analysis. These attributes were utilized to gain a comprehensive understanding of the trends and patterns in the literature on the financial literacy.

4.1. Document And Source Types

Table 1 presents the distribution of document types in the bibliometric analysis of virtual teams and leadership, offering insights into the nature and formats of publications in this field. The majority of the research output is represented by journal articles, with a total of 170 publications, accounting for 51.83% of the total documents. This indicates that peer-reviewed articles are the predominant medium for disseminating research on virtual teams and leadership, likely due to their rigorous standards and widespread recognition in academic circles.

Conference papers represent the second-largest category, with 81 publications, or 24.70% of the total. This suggests that conferences are also a significant platform for sharing emerging findings and fostering discussions on virtual team leadership, especially given the rapidly evolving nature of this field. Book chapters, with 41 publications (12.50%), also play a notable role, reflecting the presence of more in-depth, specialized discussions within edited volumes on the topic.

Smaller contributions include review articles (24 publications, 7.32%), which offer critical assessments and syntheses of existing literature, and books (6 publications, 1.83%), which typically provide comprehensive, in-depth treatments of virtual team leadership. Other document types such as conference reviews (3 publications, 0.91%), notes (2 publications, 0.61%), and editorials (1 publication, 0.30%) constitute a very small percentage of the total, indicating that these formats are less common in the scholarly discussion of this topic. Overall, the table illustrates a strong preference for peer-reviewed articles and conference papers in the dissemination of research on virtual teams and leadership.

Table 1: Document Type.

Document Type	Total Publications (TP)	Percentage (%)
Article	170	51.83
Conference Paper	81	24.70

Book Chapter	41	12.50
Review	24	7.32
Book	6	1.83
Conference Review	3	0.91
Note	2	0.61
Editorial	1	0.30

Simultaneously, Table 2 presents an analysis of the different source types in the latest citation dataset which publications on virtual teams and leadership have been drawn, highlighting the predominant channels through which research is disseminated in this field. The most significant source type is journals, accounting for 195 publications or 59.45% of the total. This dominance of journal publications underscores the preference for peer-reviewed articles as the primary medium for scholarly communication, reflecting the emphasis on rigorous evaluation and the high credibility associated with journals within the academic community.

Conference proceedings represent the second-largest source type, with 74 publications or 22.56%. This indicates that conferences play an important role in the dissemination of research findings, particularly for emerging and rapidly evolving topics such as virtual team leadership, where scholars can present preliminary results and engage with peers in

real-time discussions. Books, with 39 publications (11.89%), also contribute significantly, suggesting the presence of more extensive, in-depth explorations of virtual teams and leadership within monographs or edited volumes.

Book series, which account for 17 publications (5.18%), represent another important source type, often focusing on ongoing research in niche areas within the broader field. Trade journals, with only 3 publications (0.91%), play a relatively minor role, reflecting the more academic focus of the dataset, as trade journals are typically oriented toward practitioners and industry professionals rather than researchers. Overall, Table 2 illustrates the predominance of academic journals and conference proceedings as the key platforms for the dissemination of scholarly research on virtual teams and leadership, while also highlighting the role of books and book series in providing more comprehensive treatments of the subject.

Table 2: Source Type.

Source Type	Total Publications (TP)	Percentage (%)
Journal	195	59.45
Conference Proceeding	74	22.56
Book	39	11.89
Book Series	17	5.18
Trade Journal	3	0.91

4.2. Year Of Publications/Evolution of Published Studies

Table 3 presents an overview of the distribution of publications based on the year of publication in the latest citation dataset of the distribution of publications on virtual teams and leadership over the years, shedding light on significant trends in research activity. The data reveals that research output has notably intensified in recent years, with a concentration of publications from 2020 onward. The highest number of publications occurred in 2021, with 47 publications, representing 14.33% of the total dataset. This surge is likely attributed to the global shift towards remote work triggered by the COVID-19 pandemic, which prompted increased scholarly interest in virtual leadership and its effectiveness during this period.

In 2023, research output remained strong, with 46 publications (14.02%), highlighting ongoing interest

and contributions to the field. Similarly, 2022 saw 42 publications (12.80%), further reinforcing the academic community's sustained focus on virtual teams and leadership. The consistent level of research across these recent years suggests that the subject remains highly relevant, driven by evolving workplace dynamics and technological advancements that have accelerated the adoption of virtual work environments.

Earlier years, particularly 2016, also reflect significant research activity with 37 publications (11.28%), indicating an early interest in the topic. However, a decline in the number of publications is observed as we move further back in time. For instance, 2019 and 2015 each recorded around 21-22 publications (6.40% to 6.71%), while 2017 saw the lowest output with just 13 publications (3.96%). This gradual increase in research from 2020 onwards underscores the growing importance of virtual teams and leadership, particularly in response to the

contemporary challenges posed by the global rise of remote work. The distribution of publications based

on the year of publication also can be seen in Figure 2.

Table 3: Year Of Publications.

Year	Total Publications	Percentage (%)
2023	46	14.02
2022	42	12.80
2021	47	14.33
2020	34	10.37
2019	21	6.40
2018	18	5.49
2017	13	3.96
2016	37	11.28
2015	22	6.71
2014	21	6.40

Documents by year

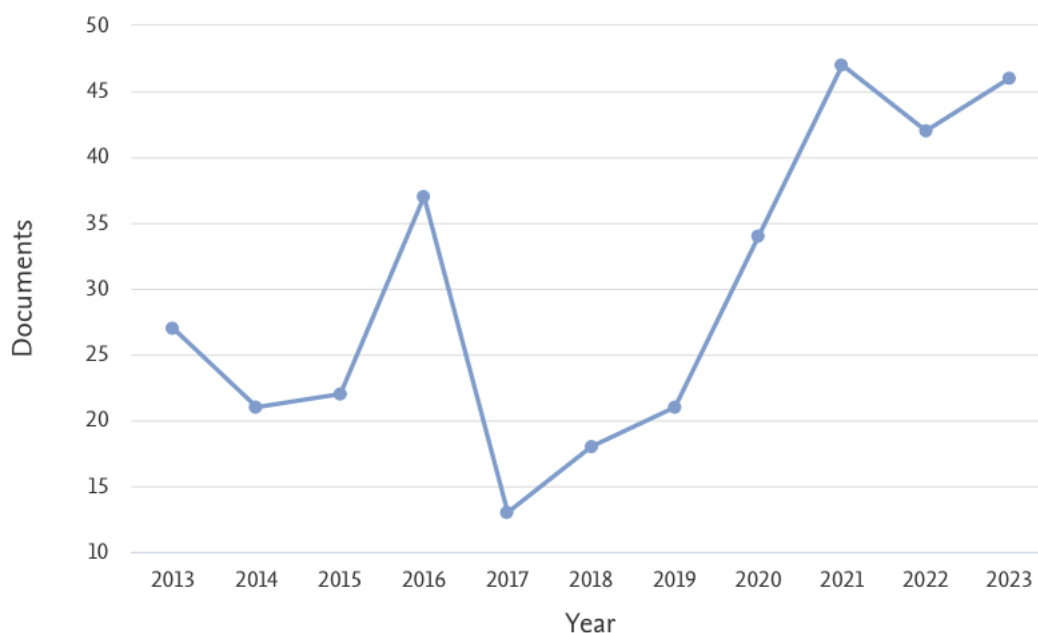


Figure 2: Document By Year.

4.3. Languages Of Documents

Table 4 provides information on the languages used for publications in the latest citation dataset. The table displays the total number of publications and their corresponding percentages for each language revealing that English is overwhelmingly the dominant language in this field. Out of the total publications, 318 were published in English, accounting for 96.07% of the dataset. This strong dominance reflects English’s role as the primary language for global academic communication, especially in fields like business, leadership, and organizational studies.

Other languages are represented to a much lesser

extent, with German accounting for 8 publications (2.42%), followed by Spanish with 3 publications (0.91%). French and Portuguese are minimally represented, each with just 1 publication (0.30%). The relatively low presence of non-English publications suggests that while research on virtual teams and leadership is global, English remains the preferred medium for disseminating knowledge in this domain, making it more accessible to a broader international academic audience.

This distribution highlights the importance of English in connecting researchers worldwide but also indicates a potential opportunity for expanding multilingual research to capture diverse perspectives from non-English-speaking regions.

Table 4: Languages Used for Publications.

Language	Total Publications*	Percentage (%)
English	318	96.07
German	8	2.42
Spanish	3	0.91
French	1	0.30
Portuguese	1	0.30
		100

*One Document Has Been Prepared in Dual Languages

4.4. Subject Area

Table 5 provides a detailed breakdown of the subject areas covered in publications related to virtual teams and leadership, reflecting the interdisciplinary nature of the research. The largest share of publications, 150 in total (25.04%), falls under Business, Management, and Accounting. This is unsurprising, as virtual teams and leadership are highly relevant topics in organizational studies, where businesses seek to adapt to evolving work environments and leadership models.

Social Sciences also make a significant contribution, with 102 publications (17.03%), emphasizing the human and societal dimensions of virtual teams, including communication, group dynamics, and leadership behaviors. Computer Science, with 90 publications (15.03%), highlights the importance of technology in enabling virtual teams, underscoring the role of digital tools and systems in facilitating remote collaboration. Engineering (53

publications, 8.85%) and Psychology (50 publications, 8.35%) further demonstrate the diverse applications of virtual leadership, from technical project management to understanding individual and group psychology in remote settings.

Other subject areas, such as Economics (6.84%), Decision Sciences (6.01%), and Medicine (2.84%), contribute smaller but still notable shares, reflecting the relevance of virtual teams and leadership across various industries. Even areas like Arts and Humanities (2.00%), Environmental Science (2.00%), and Energy (1.34%) are represented, indicating the broad applicability of virtual leadership beyond traditional business and technical fields. The remaining subject areas, while contributing fewer publications, demonstrate that virtual teams and leadership have touched nearly every corner of academia, from Earth Sciences to Neuroscience, showing the expansive impact of these topics in today's research landscape.

Table 5: Subject Area.

Subject Area	Total Publications	Percentage (%)
Business, Management and Accounting	150	25.04
Social Sciences	102	17.03
Computer Science	90	15.03
Engineering	53	8.85
Psychology	50	8.35
Economics, Econometrics and Finance	41	6.84
Decision Sciences	36	6.01
Medicine	17	2.84
Arts and Humanities	12	2.00
Environmental Science	12	2.00
Mathematics	12	2.00
Energy	8	1.34
Nursing	4	0.67
Earth and Planetary Sciences	3	0.50
Physics and Astronomy	3	0.50
Neuroscience	2	0.33
Biochemistry, Genetics and Molecular Biology	1	0.17
Chemistry	1	0.17
Health Professions	1	0.17
Pharmacology, Toxicology and Pharmaceutics	1	0.17

4.5. Most 20 Active Source Titles

Table 6 presents the 20 most active source titles in the latest citation dataset, providing information on

the total number of publications and their corresponding percentages for each source title on virtual teams and leadership, showcasing the diversity of outlets contributing to this field. The

Proceedings of the Annual Hawaii International Conference on System Sciences leads with 9 publications (3.6%), emphasizing its role as a prominent forum for discussing system sciences, including topics like virtual teams and leadership. *Frontiers in Psychology* follows with 8 publications (3.2%), underscoring the significant psychological aspects of virtual teamwork, such as group dynamics, leadership behaviors, and individual motivations.

The *Human Resource Management International Digest* also features prominently, with 7 publications (2.8%), reflecting the relevance of virtual teams in human resource management, particularly in addressing how organizations adapt to remote work environments. *Leadership Quarterly* and *Sustainability Switzerland* both contributed 5 publications each (2%), highlighting key areas where leadership and sustainability intersect with virtual team management.

Several specialized sources, such as *Collaborative*

Communication Processes and Decision Making in Organizations and *International Journal of E-Collaboration*, each with 4 publications (1.6%), reveal the importance of collaboration and decision-making processes in virtual settings. Additionally, sources like *Lecture Notes in Computer Science* and the *Proceedings of the European Conference on Knowledge Management* demonstrate the technical and knowledge management dimensions of virtual teams, further illustrating the interdisciplinary nature of the field.

Other notable sources include *Human Resource Management Review* and *Small Group Research*, each with 3 publications (1.2%), highlighting the continuing interest in both human resource strategies and the social science aspects of team performance. Overall, this table reflects the broad range of academic disciplines contributing to the understanding of virtual teams and leadership, from psychology and management to computer science and collaboration technologies.

Table 6: Most 20 Active Source Title.

Source Title	Total Publications	Percentage (%)
Proceedings Of The Annual Hawaii International Conference on System Sciences	9	3.6
Frontiers In Psychology	8	3.2
Human Resource Management International Digest	7	2.8
Leadership Quarterly	5	2
Sustainability Switzerland	5	2
Collaborative Communication Processes and Decision Making in Organizations	4	1.6
Cross Cultural Interaction Concepts Methodologies Tools and Applications	4	1.6
International Journal of E Collaboration	4	1.6
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	4	1.6
Proceedings Of the European Conference on Knowledge Management ECKM	4	1.6
Advances In Intelligent Systems and Computing	3	1.2
Human Resource Management Review	3	1.2
Information Technology and People	3	1.2
Journal Of Leadership Studies	3	1.2
Proceedings Of the ACM Conference on Computer Supported Cooperative Work CSCW	3	1.2
Small Group Research	3	1.2
Team Performance Management	3	1.2
Zentralblatt Fur Arbeitsmedizin Arbeitsschutz Und Ergonomie	3	1.2
2014 International Conference on Collaboration Technologies and Systems Cts 2014	2	0.8
2016 International Annual Conference of the American Society For Engineering Management Asem 2016	2	0.8

4.6. Keywords Analysis

The network visualization map in Figure 3, Figure 4 and the data in Table 7 provide a comprehensive overview of the most frequently co-occurring keywords in research on virtual teams and leadership. This network map, generated using VOSviewer, visually illustrates how certain keywords cluster together, indicating the interconnectedness of key concepts in this research field. The dominant presence of "virtual teams" at the

center of the map, with 131 total occurrences (10.12%), highlights the central focus of the research. Closely linked to it are keywords like "leadership" (100 occurrences, 7.72%) and "virtual team" (83 occurrences, 6.41%), reflecting the strong relationship between these concepts.

Human resource management also plays a significant role in the literature, as indicated by its occurrence 36 times (2.78%), emphasizing its relevance in managing dispersed teams. The

appearance of keywords like "e-leadership" (25 occurrences, 1.93%), "global virtual teams" (24 occurrences, 1.85%), and "COVID-19" (23 occurrences, 1.78%) points to how the shift to virtual work, especially during the pandemic, has reshaped leadership dynamics across global teams. Notably, concepts like "trust" (22 occurrences, 1.70%) and "communication" (19 occurrences, 1.47%) are also frequently discussed, underlining the importance of fostering trust and effective communication within virtual teams to ensure performance.

Further insights can be drawn from the inclusion of "team performance" (21 occurrences, 1.62%) and

"shared leadership" (19 occurrences, 1.47%), which suggest that scholars are increasingly interested in exploring leadership beyond the traditional hierarchical model. Keywords related to human dynamics, such as "human" (27 occurrences, 2.08%) and "students" (16 occurrences, 1.24%), indicate the human-centric challenges and educational contexts being researched. Overall, this network map and keyword analysis show that research on virtual teams and leadership covers a broad range of topics, focusing on key themes like trust, leadership models, global team management, and the impacts of the COVID-19 pandemic on virtual work environments.

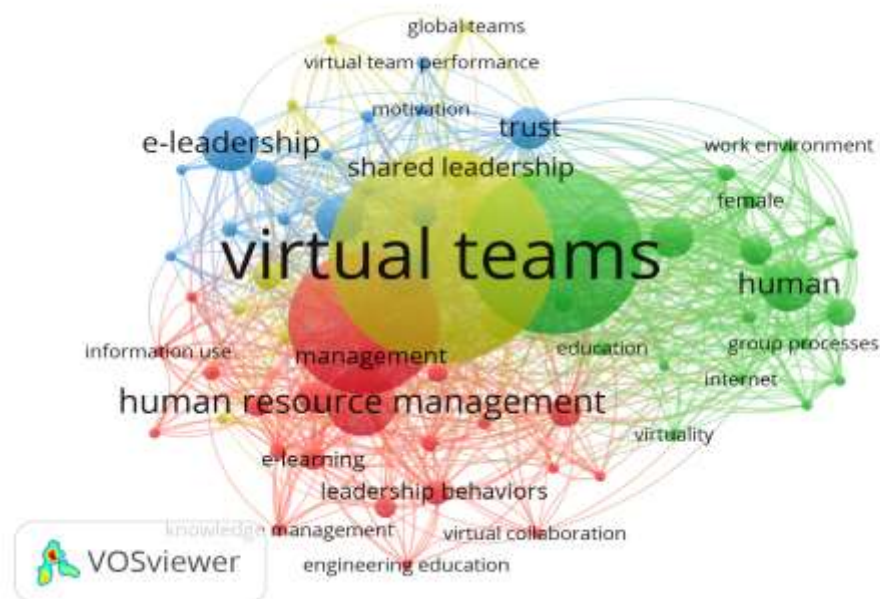


Figure 3: Network Visualization Map of the Co-Occurrence of All Keywords.

Table 7: Top 20 Keywords.

Author Keywords	Total Publications	Percentage (%)
Virtual Teams	131	10.12
Leadership	100	7.72
Virtual Team	83	6.41
Human Resource Management	36	2.78
Human	27	2.08
E-leadership	25	1.93
Global Virtual Teams	24	1.85
COVID-19	23	1.78
Trust	22	1.70
Team Performance	21	1.62
Teamwork	21	1.62
Virtual Leadership	21	1.62
Communication	19	1.47
Shared Leadership	19	1.47
Students	16	1.24
Article	15	1.16
Virtual Reality	15	1.16
Humans	14	1.08
Management	14	1.08
Performance	14	1.08



Figure 4: Word Art Of the Keywords.
Geographical Distribution of Publications - Most Influential Countries.

The network visualization map in Figure 5 and Table 8 provides an in-depth look at the most influential countries contributing to research on virtual teams and leadership. The United States clearly leads the field with 118 publications, accounting for 28.85% of the total. This reflects the U.S.'s strong emphasis on research and development in remote work, particularly in the wake of the global shift toward virtual work environments. The presence of American institutions, industries, and large-scale adoption of virtual teams has propelled this country to the forefront of research in this area.

Germany follows with 30 publications (7.33%), representing significant European contributions to this field. Other European countries, such as the United Kingdom (16 publications, 3.91%), Spain (13 publications, 3.18%), and Finland, France, and Norway (each with 11 publications, 2.69%), also play vital roles, demonstrating Europe's broad interest in

virtual leadership research. India, with 18 publications (4.40%), highlights the growing importance of virtual teams in the context of outsourcing and global IT services, especially as India serves as a hub for international virtual collaboration.

Countries like China, Italy, and the Netherlands, each contributing 6 publications (1.47%), show a more modest presence but still signify meaningful involvement in this research area. Nations such as Canada, Denmark, Malaysia, and New Zealand, each with 5 publications (1.22%), further illustrate the global relevance of virtual team and leadership studies, with research distributed across various regions. This global distribution reflects the widespread impact of virtual teams and leadership across different industries and geographic regions, making it a critical area of study worldwide.

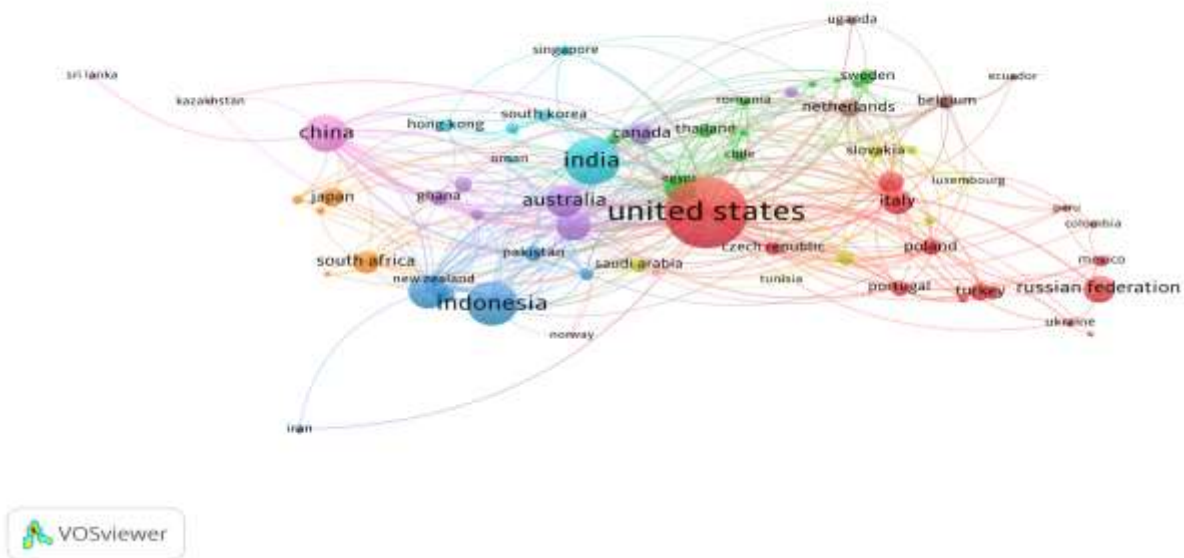


Figure 5: Network Visualization Map of the Most Influential Countries.

Table 8: Top 20 Countries Contributed to the Publications.

Country	Total Publications	Percentage (%)
United States	118	28.85
Germany	30	7.33
India	18	4.40
United Kingdom	16	3.91
Australia	14	3.42
Spain	13	3.18
Finland	11	2.69
France	11	2.69
Norway	11	2.69
China	6	1.47
Italy	6	1.47
Netherlands	6	1.47
Poland	6	1.47
Portugal	6	1.47
South Africa	6	1.47
Canada	5	1.22
Colombia	5	1.22
Denmark	5	1.22
Malaysia	5	1.22
New Zealand	5	1.22

4.7. Authorship

Table 9 provides information on the top 10 most productive authors in the latest citation dataset, presenting the number of documents they have contributed and their corresponding percentages to research on virtual teams and leadership. At the forefront is V. Harth, with six publications, accounting for 2.12% of the total output. This places Harth among the most influential voices in the field, underscoring their significant role in advancing research on virtual teams and leadership dynamics.

Harth's contributions have helped shape key discussions and findings within this evolving area of study.

Following closely is S. Mache, with five publications (1.77%), indicating a strong ongoing commitment to exploring the complexities of virtual leadership. Other leading contributors include H. Daniel, A.C. Kordsmeyer, and N. Panteli, each with four publications (1.41%). These authors have enriched the academic landscape by focusing on various critical aspects, such as team performance,

leadership styles, and effective communication strategies within virtual settings.

Notably, P. Chamakiotis, D.L. Cogburn, B. Doore, J.A. Espinosa, and M. Flammia each contributed three publications (1.06%). While their publication numbers are slightly lower, their work in specialized areas, particularly on virtual collaboration and

leadership models, continues to play a pivotal role in expanding the understanding of leadership in digital environments. Collectively, this group of scholars demonstrates the diversity of perspectives driving the ongoing research on virtual teams and leadership, offering a wide range of insights into both theoretical frameworks and practical applications.

Table 9: Top 10 Most Productive Authors.

Author's Name	No. of Documents	Percentage (%)
Harth, V.	6	2.12
Mache, S.	5	1.77
Daniel, H.	4	1.41
Kordsmeyer, A.C.	4	1.41
Panteli, N.	4	1.41
Chamakiotis, P.	3	1.06
Cogburn, D.L.	3	1.06
Doore, B.	3	1.06
Espinosa, J.A.	3	1.06
Flammia, M.	3	1.06

4.8. Most Influential Institutions

Table 10 presents the top 20 most influential institutions in the latest citation dataset. The table provides information on the total number of publications from each institution and their corresponding percentages on virtual teams and leadership. Leading the list is the University of Central Florida, with 8 publications, representing 2.63% of the total output. This positions the institution as a major contributor to the body of knowledge on virtual teams, reflecting its strong focus on innovation and research in leadership within digital environments.

Following closely are two institutions such as Universitätsklinikum Hamburg-Eppendorf and Handelshøyskolen BI, each with 6 publications (1.97%). These institutions, located in Germany and Norway respectively, emphasize the global nature of research in virtual teams and leadership, illustrating how universities worldwide are responding to the growing importance of virtual collaboration in

various organizational settings.

Pennsylvania State University, Technische Universität München, and Aalto University each have contributed 5 publications (1.64%), further solidifying their roles as key players in the academic exploration of virtual leadership. Their consistent output reflects their active engagement with ongoing developments in virtual workspaces and leadership strategies. Similarly, institutions like the University of Maine, Universidad de Zaragoza, and Texas A&M University, with 4 publications each (1.32%), demonstrate notable engagement in this field.

Other influential universities, including Rice University, Brigham Young University, and Northern Illinois University, each contributed 3 publications (0.99%), adding to the global discourse on virtual leadership. Overall, the table highlights the diverse range of institutions from the United States to Europe that are driving research on virtual teams and leadership, contributing valuable insights that shape both theoretical frameworks and practical applications across different industries and regions.

Table 10: Top 20 Most Influential Institutions.

Institution	Total Publications	Percentage (%)
University of Central Florida	8	2.63
Universitätsklinikum Hamburg-Eppendorf	6	1.97
Handelshøyskolen BI	6	1.97
Pennsylvania State University	5	1.64
Technische Universität München	5	1.64
Aalto University	5	1.64
University of Maine	4	1.32
Universidad de Zaragoza	4	1.32
The University of North Carolina at Greensboro	4	1.32
Texas A&M University	4	1.32
Royal Holloway, University of London	4	1.32
Ehime University	3	0.99

Rice University	3	0.99
Brigham Young University	3	0.99
Colorado State University	3	0.99
Northern Illinois University	3	0.99
University of Piraeus	3	0.99

4.9. Top 20 Sponsorship

Table 11 presents the top 20 sponsorship institutions in the latest citation dataset, providing insights into the funding sources behind the research on financial literacy. These institutions have played a crucial role in supporting and promoting academic studies in this field. At the forefront is the National Science Foundation, which sponsored 7 publications, representing 2.00% of the total output. The significant support from this U.S.-based organization underscores the importance of virtual leadership research within broader scientific and organizational contexts.

Following closely are the Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research, Germany) and the European Social Fund, each sponsoring 4 publications (1.14%). This indicates strong European engagement in promoting research on virtual teams, reflecting the region's commitment to addressing the growing needs of digital work environments. The involvement of such organizations highlights the emphasis on advancing knowledge in leadership and

collaboration in virtual settings.

Notably, other key contributors include the National Aeronautics and Space Administration (NASA) and the National Natural Science Foundation of China, each sponsoring 3 publications (0.86%). These contributions demonstrate a global interest in virtual team research, with a focus on industries and sectors ranging from space exploration to technological innovation.

Institutions like the Japan Society for the Promotion of Science and Fundação para a Ciência e a Tecnologia have also made contributions, each sponsoring 2 publications (0.57%), further showcasing the international commitment to supporting research in this area. Other notable sponsors, such as the Alfred P. Sloan Foundation, Boeing, and the Army Research Institute for the Behavioral and Social Sciences, have each supported 1 publication (0.29%). This broad range of sponsors reflects the interdisciplinary and cross-sectoral interest in understanding and optimizing virtual leadership, highlighting its relevance to both academic and applied fields.

Table 11: Top 20 Sponsorship.

Institution	Total Publications	Percentage (%)
National Science Foundation	7	2.00
Bundesministerium für Bildung und Forschung	4	1.14
European Social Fund	4	1.14
National Aeronautics and Space Administration	3	0.86
National Natural Science Foundation of China	3	0.86
Fundação para a Ciência e a Tecnologia	2	0.57
Japan Society for the Promotion of Science	2	0.57
Riksbankens Jubileumsfond	2	0.57
Academy of Finland	1	0.29
Alcon Research Institute	1	0.29
Alfred P. Sloan Foundation	1	0.29
Army Research Institute for the Behavioral and Social Sciences	1	0.29
Army Research Laboratory	1	0.29
Boeing	1	0.29
Center for Clinical and Translational Sciences, University of Texas Health Science Center at Houston	1	0.29
Directorate for Social, Behavioral and Economic Sciences	1	0.29
Eidgenössische Technische Hochschule Zürich	1	0.29
European Commission	1	0.29
Gobierno de Aragón	1	0.29
Hong Kong Polytechnic University	1	0.29

4.10. Highly Cited Articles

Table 12 presents the top 20 most cited publications in the latest citation dataset, providing

valuable insights into the field of virtual team and leadership. The table includes the authors, title, year of publication, and citation information for each article on virtual teams and leadership, providing a

clear picture of the academic works that have made the most significant impact in this research area. The leading article, authored by Gilson et al. (2015), titled *Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities*, has garnered 570 citations, averaging 63.33 citations per year. This paper stands as a seminal work, offering a comprehensive review and identifying key research opportunities in virtual teams over the past decade. Its high citation count reflects its foundational role in shaping the direction of future studies.

Following closely is Hoch and Kozlowski's (2014) work on *Leading Virtual Teams: Hierarchical Leadership, Structural Supports, and Shared Team Leadership*, with 382 citations. Their research has had a notable influence, particularly in exploring how different leadership structures affect the performance of virtual teams. Cortellazzo et al.'s (2019) review of leadership in a digitalized world, with 296 citations, reflects the rising interest in understanding how digitalization is transforming leadership practices.

Other impactful papers include Avolio et al.'s (2014) work on *e-leadership transformations* (247 citations), and Contreras et al.'s (2020) study on *e-leadership and teleworking during COVID-19*,

which has rapidly accumulated 201 citations. The latter paper's high average of 50.25 citations per year underscores the immediate relevance of research on remote leadership during global disruptions like the pandemic.

The figures following the table, particularly Figures 6 through 8, provide network visualization maps that depict the citation patterns across different countries and documents. These maps offer a visual representation of how research outputs are interconnected globally, illustrating the collaborative nature of virtual team research and highlighting the key documents driving the most citations. The global reach of these studies, as seen in the country-based citation map, demonstrates the widespread interest in understanding and improving virtual team leadership across diverse contexts. The document-based citation maps further highlight the pivotal works that are shaping ongoing discussions in this critical area of study.

Together, the table and figures provide a clear view of the most influential research, the key players in the field, and how scholarly contributions are interlinked across countries and documents, emphasizing the global and interdisciplinary nature of research in virtual teams and leadership.

Table 12: Highly Cited Articles

No.	Authors	Title	Year	Cites	Cites per Year
1	L.L. Gilson, M.T. Maynard, N.C. Jones Young, M. Vartiainen, M. Hakonen	Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities	2015	570	63.33
2	J.E. Hoch, S.W.J. Kozlowski	Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership	2014	382	38.2
3	L. Cortellazzo, E. Bruni, R. Zampieri	The role of leadership in a digitalized world: A review	2019	296	59.2
4	B.J. Avolio, J.J. Sosik, S.S. Kahai, B. Baker	E-leadership: Re-examining transformations in leadership source and transmission	2014	247	24.7
5	F. Contreras, E. Baykal, G. Abid	E-Leadership and Teleworking in Times of COVID-19 and Beyond: What We Know and Where Do We Go	2020	201	50.25
6	S. Bartsch, E. Weber, M. Büttgen, A. Huber	Leadership matters in crisis-induced digital transformation: how to lead service employees effectively during the COVID-19 pandemic	2021	189	63
7	C. Liao	Leadership in virtual teams: A multilevel perspective	2017	143	20.43
8	L. Larson, L.A. DeChurch	Leading teams in the digital age: Four perspectives on technology and what they mean for leading teams	2020	142	35.5
9	J.E. Hoch, J.H. Dulebohn	Team personality composition, emergent leadership and shared leadership in virtual teams: A theoretical framework	2017	129	18.43
10	S.A. Newman, R.C. Ford	Five Steps to Leading Your Team in the Virtual COVID-19 Workplace	2021	108	36
11	R.C. Ford, R.F. Piccolo, L.R. Ford	Strategies for building effective virtual teams: Trust is key	2017	92	13.14
12	V. Garro-Abarca, P. Palos-Sanchez, M. Aguayo-Camacho	Virtual Teams in Times of Pandemic: Factors That Influence Performance	2021	89	29.67
13	N.S. Hill, K.M. Bartol	Empowering Leadership and Effective Collaboration in Geographically Dispersed Teams	2016	87	10.88
14	P. Chamakiotis, N. Panteli, R.M. Davison	Reimagining e-leadership for reconfigured virtual teams due to Covid-19	2021	81	27

15	L.P. Robert, S. You	Are you satisfied yet? Shared leadership, individual trust, autonomy, and satisfaction in virtual teams	2018	69	11.5
16	J.L. Gibbs, A. Sivunen, M. Boyraz	Investigating the impacts of team type and design on virtual team processes	2017	69	9.86
17	S. Krumm, J. Kanthak, K. Hartmann, G. Hertel	What does it take to be a virtual team player? The knowledge, skills, abilities, and other characteristics required in virtual teams	2016	61	7.63
18	A. Serban, F.J. Yammarino, S.D. Dionne, S.S. Kahai, C. Hao, K.A. McHugh, K.L. Sotak, A.B.R. Mushore, T.L. Friedrich, D.R. Peterson	Leadership emergence in face-to-face and virtual teams: A multi-level model with agent-based simulations, quasi-experimental and experimental tests	2015	60	6.67
19	S.D. Charlier, G.L. Stewart, L.M. Greco, C.J. Reeves	Emergent leadership in virtual teams: A multilevel investigation of individual communication and team dispersion antecedents	2016	60	7.5
20	J. Eisenberg, C. Post, N. DiTomaso	Team Dispersion and Performance: The Role of Team Communication and Transformational Leadership	2019	58	11.6

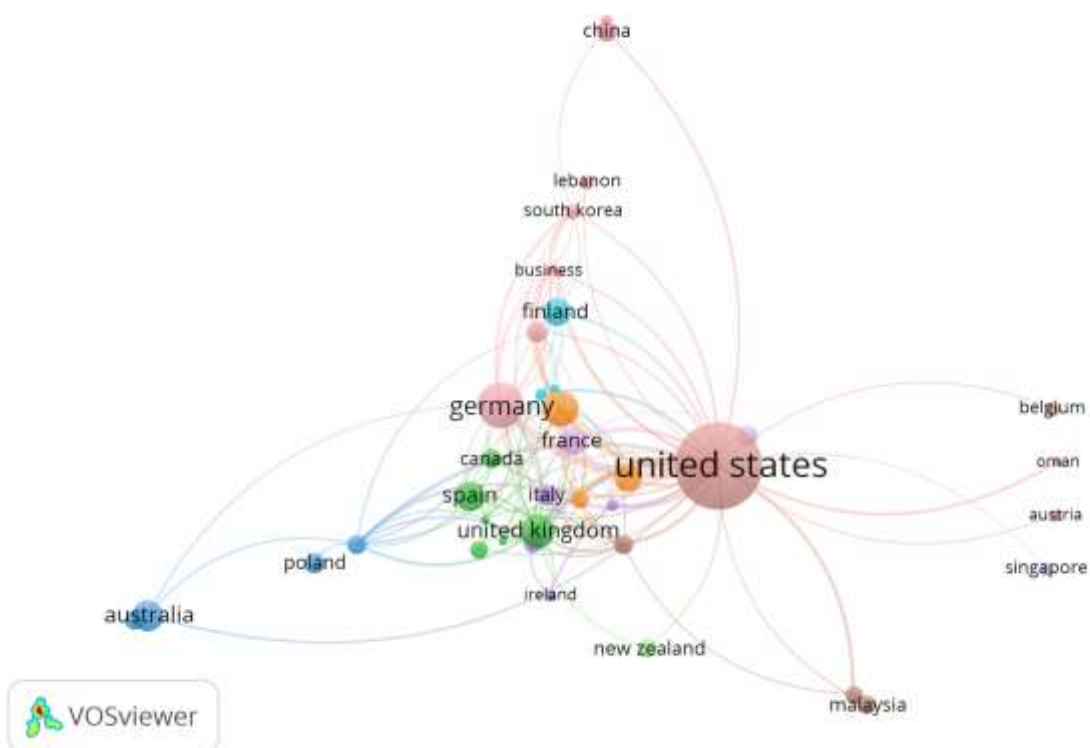
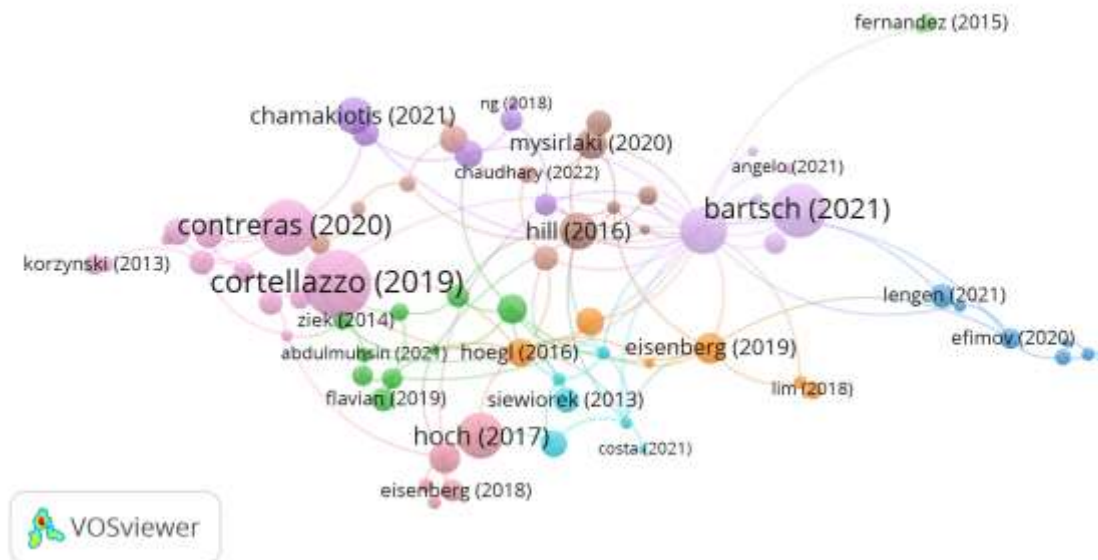
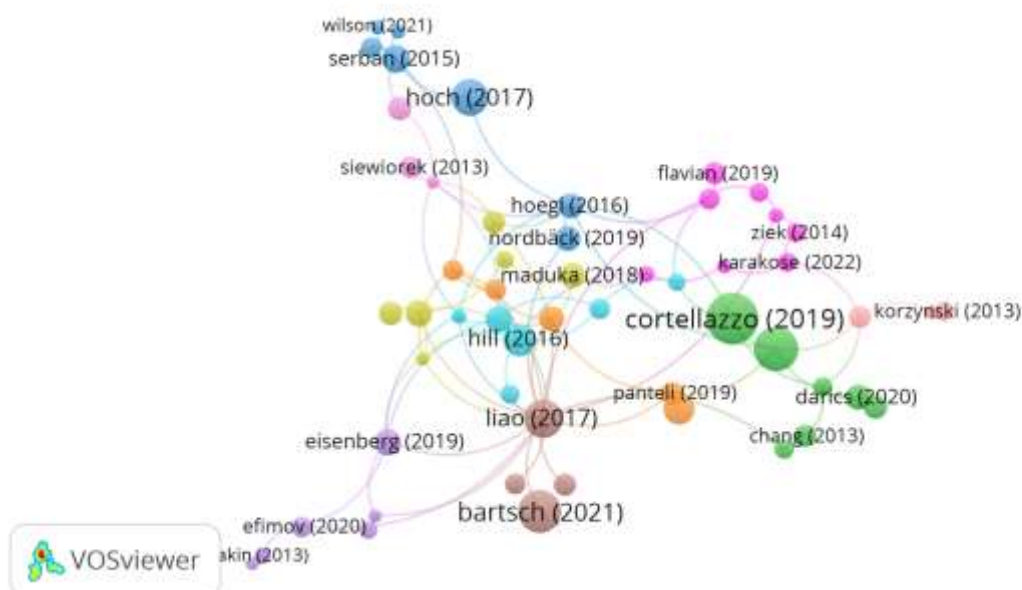


Figure 6: Network Visualization Map of The Citation by Countries.
 Minimum Number of Documents of a Country = 1.
 Minimum Number of Citations of a Country = 5.



**Figure 7: Network Visualization Map of the Citation by Documents.
Minimum Number of Citations of a Document = 5.**



**Figure 8: Network Visualization Map of the Citation by Documents.
Minimum Number of Citations of a Document = 10.**

4.11. Citation Analysis

Table 13 presents a comprehensive overview of the citation metrics for research on virtual teams and leadership from 2013 to 2023, providing insights into the impact and reach of studies published in this area. Over the course of 11 citation years (from 2013 to 2024), a total of 328 papers has been published, collectively receiving 5,630 citations. This demonstrates significant engagement with the

literature, reflecting the growing academic and practical interest in the dynamics of virtual leadership.

On average, these publications have garnered 511.82 citations per year, with each paper receiving an average of 17.16 citations. These figures indicate a relatively high level of influence per publication, suggesting that the research has resonated within the academic community and has contributed meaningfully to ongoing discussions. Furthermore,

the data reveals that the citations per author amount to 2,339.86, while each author has contributed to an average of 160.07 papers, underscoring the collaborative and interdisciplinary nature of research in this field.

Two key bibliometric indicators are also provided: the h-index of 35 and the g-index of 68. The h-index measures both productivity and citation

impact, indicating that 35 papers have been cited at least 35 times each. The g-index, which emphasizes the most highly cited papers, is 68, pointing to the substantial influence of the top publications in this domain. Overall, these metrics highlight the considerable academic attention virtual team and leadership research has received, as well as its continued importance in scholarly discussions.

Table 13: Citations Metrics.

Metrics	Data
Publication years	2013-2023
Citation years	11 (2013-2024)
Papers	328
Citations	5630
Citations/year	511.82
Citations/paper	17.16
Citations/author	2339.86
Papers/author	160.07
h-index	35
g-index	68

4.12. Text Analysis

The visualizations in Figures 9, 10, and 11 present term co-occurrence networks generated using VOSviewer, a tool designed to map the relationships between key terms within academic literature. These maps help illustrate the most frequent and interconnected terms found in the titles and abstracts of papers related to virtual teams and leadership.

Figure 9 shows a term co-occurrence network based on titles and abstract fields, using binary counting. This approach means that a term is counted once per document, regardless of how many times it appears in that document. The visualization highlights clusters of related terms, with key terms like "effect," "information," "theory," and "employee" appearing in dense clusters, indicating that these concepts are central to the research. Terms related to "strategy," "covid," and "project" also appear frequently, suggesting that much of the research has focused on the strategies organizations employ, particularly in response to the COVID-19 pandemic, and how this has affected employees and work outcomes.

Figure 10 employs full counting, meaning that every occurrence of a term within a document is counted. This visualization shows a more granular

understanding of the prominence of terms, with some terms like "effect," "theory," and "employee" being even more dominant. This indicates that these themes are not just central to individual documents but are frequently emphasized throughout many papers, reflecting core areas of interest in the study of virtual teams.

Figure 11 focuses solely on title fields, again using binary counting. Here, the central terms include "project," "strategy," and "covid," reflecting a focus on how the pandemic has influenced the management and organization of virtual teams. Terms like "employee," "information," and "theory" remain significant, further reinforcing that research on virtual teams often revolves around practical implications for employee performance and the theoretical frameworks that underpin virtual team dynamics.

Together, these figures depict the academic landscape of virtual team and leadership research, identifying the key areas of focus and showing how the field has evolved in response to major global shifts, such as the COVID-19 pandemic. These maps allow researchers to see the most interconnected concepts, facilitating a deeper understanding of the field's development and potential areas for future exploration.

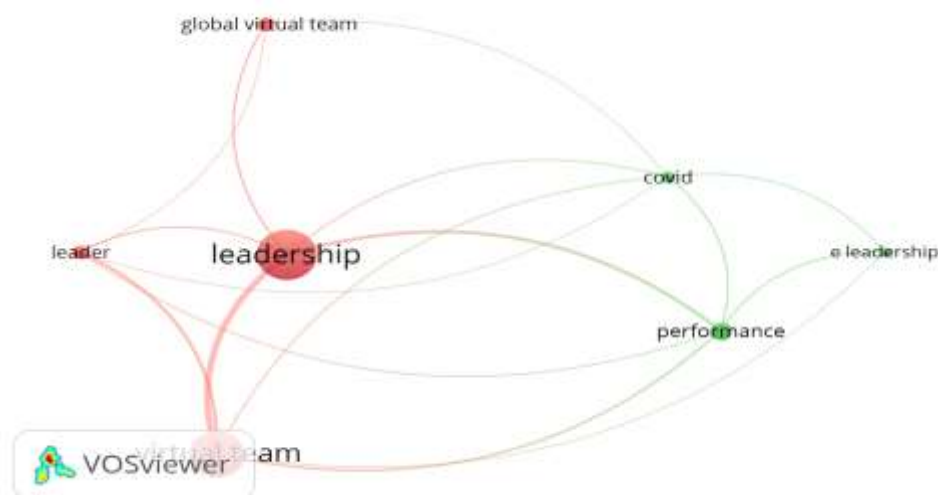


Figure 11: Vosviewer Visualization of a Term Co-Occurrence Network Based on Title Fields (Binary Counting)

5. DISCUSSION

The bibliometric analysis of the research landscape on virtual teams and leadership reveals key trends, influential works, and emerging areas of interest. The literature indicates that research on virtual teams has significantly expanded, particularly in response to global shifts like digital transformation and the COVID-19 pandemic. One critical insight is the essential role leadership plays in the success of virtual teams. Leadership models such as transformational, shared, and e-leadership have become crucial for maintaining team performance, trust, and engagement in remote settings (Radulovic & Epitropaki, 2020; Nuratri, 2022; Zhang et al., 2021). These leadership styles offer structures that are adaptable to the unique challenges of virtual work environments, ensuring that teams remain productive and cohesive.

The co-occurrence network maps from this analysis emphasize the significant impact leadership has on employee outcomes, strategic alignment, and organizational adaptation to digital environments. The visualization highlights a growing focus on how leadership influences virtual team effectiveness (Robert & You, 2017; Kashive et al., 2022). Citation metrics also reinforce the pivotal role of leadership in shaping team dynamics and performance. Foundational works by Gilson et al. (2015) and Hoch and Kozlowski (2014) are identified as key references that continue to shape the field of virtual team leadership (Sanchez et al., 2023; Ab Wahab, 2023). These studies have set the groundwork for further exploration into how leadership can be optimized for virtual team environments.

The analysis also highlights leading institutions and authors, showing that research on virtual teams and leadership is both global and interdisciplinary. Contributions come from various regions and academic fields, reflecting the universal importance of virtual teams and the need for strong leadership strategies across sectors (Han & Hazard, 2022). However, the study notes certain limitations, including its reliance on publications from specific databases, which may exclude research in non-English languages or regional journals, potentially limiting diversity of perspectives (Ziek & Smulowitz, 2014). Additionally, the analysis offers limited qualitative insights into how leadership is practiced across different industries. Future research should focus on the nuances of virtual leadership while encouraging collaboration across disciplines such as psychology, technology, and organizational behavior, to create more holistic leadership frameworks that can guide the management of diverse, geographically dispersed teams in today's evolving digital work environment (Fang et al., 2021; Mashood, 2023).

6. CONCLUSION

The bibliometric study on virtual teams and leadership underscores the critical role leadership plays in driving team success, particularly in remote work environments shaped by global trends. Leadership models, including transformational, shared, and e-leadership, have emerged as essential for fostering team performance, trust, and engagement in virtual settings. This study highlights the interdisciplinary and global nature of virtual team research, reflecting contributions from various

regions and academic fields. However, limitations, such as the reliance on English-language publications and specific databases, indicate that the research may lack diverse perspectives. Future research should focus on expanding interdisciplinary collaboration

and exploring the qualitative dimensions of leadership across different industries to develop more holistic leadership frameworks suited to the evolving digital work environment.

Acknowledgement: The author would like to thank Prince Sultan University for the funding of Article Processing Charges (APC).

Declaration of Funding: There is no funding, sponsorship or any grant in producing this article.

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