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Virtual Team Performance Research: A Bibliometric Analysis Using VOSviewer

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Abstract

The study aims to use bibliometric analysis to highlight worldwide research patterns and future directions for virtual team performance during the last three decades (1996–2024). The study employs bibliometric analysis to examine co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation analysis in 180 articles extracted from the Scopus database. It does this by using performance analysis and scientific mapping. The most prolific authors, the most significant papers, countries, and organizations were examined, as well as the volume of scientific publications. VOSviewer was employed in the study as a performance analysis and science mapping tool. The most productive years were 2012, 2022, and 2023 with 15 publications for each. And the most impactful institutes and countries are the University of North Carolina in USA, and the country is France, respectively. Similarly, the most influential journal is “Academy of Management Journal”, furthermore, the most cited article is “The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction”. The study also identified three thematic clusters of Research on virtual team performance, the three theme groupings are virtual team, virtual team performance, and Geographically Distributed Team. The present study offers an overview of recent research on the performance of virtual teams. It also suggests possible lines of inquiry for additional research in this field. The current research contributes to filling the knowledge gaps in current studies on the performance of virtual teams through a comprehensive review using bibliometric analysis.

Keywords: Virtual Team Performance, Remote Team Performance, E-Team Performance, Digital Team Performance, Distributed Team Performance

Introduction

Organizations nowadays frequently use virtual teams (Handke *et al*., 2020; Kanse *et al*., 2023; Alkoud *et al.,* 2023a). Due to lockdowns brought on by the COVID-19 pandemic, the utilization of virtual teams has increased. Several have argued that virtual teamwork is the "new normal" and will not go away now that the majority of the limitations caused by the epidemic have been lifted (Alexander *et al*., 2021; Chamakiotis *et al*., 2021; Kanse *et al*., 2023). Even while virtual teams are frequently used in business, the COVID-19 pandemic has made virtual work

a constant (Abelsen *et al*., 2021; Caligiuri *et al*., 2020; Wakaizumi *et al*., 2021; Alkoud *et al*., 2023b). Therefore, studying such teams is one of the most intriguing subjects in modern management (Liska, 2022). Due that virtual teams may overcome time and space constraints, they are commonly used (Kashive *et al*., 2022; Alkoud & Qatamin, 2023b). In addition, as public sector working methods become more decentralized and globalized, virtual teams (VTs) and virtual workspaces for staff members are emerging as solutions (Elyousfi, *et al*., 2021; Alkoud & Qatamin, 2023a).

The concept of team performance has been discussed in previous studies. The term "team performance" describes how well a group is thought to have produced a physical product, a choice, a strategy, or any other output that is approved by those who receive or evaluate it. This includes competitiveness, productivity, quality, and customer satisfaction (Yoo *et al*., 2022; Cohen *et al*., 1997; Hackman, 1987). There are several ways to look at team performance. Hackman (1986) proposed that the three key elements affecting a team's effectiveness are learning, cohesion, and production. On the other hand, Rosen and Dietz (2017) suggested that learning results, such as the increase in knowledge, skills, and competencies, and task outcomes, such as error rates, completion times, and member satisfaction, are the primary team outcomes. According to Berber *et al*. (2020), team performance and the long-term sustainability of teams were favorably correlated with elements such as team innovativeness, the caliber of teamwork, and team chemistry.

Research Motivation

Previous studies indicate that studies on the performance of virtual teams are still at an early stage and need more research. The empirical literature on performance management in virtual team environments is scarce (Moosa & Mthombeni, 2023). Moreover, there is a gap in the literature about online team performance, despite the fact that business educators have long studied the dynamics and efficacy of teams working in person (Gopinath & Saleem, 2020; DeLong *et al*., 2022). Hence, the present study offers additional scientific contributions toward the conceptualization of worldwide research patterns and forthcoming research avenues concerning virtual team performance by employing bibliometric evaluation.

Despite recent studies on the topic of virtual teams, a significant amount of research on virtual teams is still needed (Toro *et al*., 2020; Gonçalves *et al*., 2023). For example, previous bibliometric research has focused only on certain aspects of virtual teams, such as studying conflict in virtual teams (Caputo *et al*., 2023) and difficulties and barriers in virtual teams (Morrison-Smith and Ruiz, 2020). There are no bibliometric studies specifically on the performance of virtual teams. To fill this gap, a comprehensive analysis of the performance of virtual teams is the goal of the current study. Furthermore, several previous research focused on virtual teams in earlier periods (pre-2020) such as the study of Gilson *et al*. (2015) and Abarca *et al*. (2020), but did not include the post-COVID-19 era, which has seen a notable change in the use of virtual teams in the workplace. As a result, the goal of the current study is to fill this gap by conducting a comprehensive investigation covering research on the performance of virtual teams from 1996 to 2024, and thus this study monitors the transformations in research on the performance of virtual teams after the era of COVID-19.

Research Contribution

The current study makes several contributions to the literature on the performance of virtual teams. First, the current research examines one specific aspect of virtual teams, which is the performance of virtual teams, as no bibliometric study has ever been conducted on it. Second, it is a systematic review and shows how the field has evolved in the performance of virtual teams in the workplace over time (1996-2024). Third, the research highlights the prominent elements in research on the performance of virtual teams in workplaces, such as authors, organizations, journals, and countries, and also highlights the most important articles in this field. Fourth, the current research outlines the cognitive foundations of virtual teams' performance in the workplace and thematic clusters of virtual teams' performance in the workplace. Fifth, the "period 1996-2024" identifies the topics influencing research on virtual team performance in the workplace.

Finally, the current research presents future directions of research on the performance of virtual teams in the workplace, which constitute topics that researchers can address in their future research. Thus, the current study provides an additional scientific contribution to conceptualizing global research trends and future research directions on the performance of virtual teams in the workplace using bibliometric analysis. This is to enrich research on the performance of virtual teams and fill the gaps in previous research that did not address this issue from a comprehensive perspective.

Research Question

The present study employs a thorough bibliometric analysis to address several research questions (RQs) related to virtual team performance. This will help to bridge the gaps in earlier research that did not fully address this issue. Hence, the following research aims to answer the following questions.

- ***RQ1.*** *What is the current trend of research in virtual team performance?*
- ***RQ2.*** *Which are prominent authors, organisations, and countries of virtual team performance?*
- ***RQ3.*** *Which are the Most Influential Journals (MIJ) on virtual team performance?*
- ***RQ4.*** *Which are the Most Influential Articles (MIA) on virtual team performance?*
- ***RQ5.*** *What are the Knowledge foundations of virtual team performance?*
- ***RQ6.*** *What are the thematic clusters of virtual team performance?*
- ***RQ7****. What are the Influential topics in the "period of 1996–2024" on virtual team performance?*
- ***RQ8****. What is the future direction of research on virtual team performance?*

Bibliometric Research Method

Defining the Appropriate Search Terms

For a study on virtual team performance (VTP), papers from the Scopus database were chosen based on inclusion and exclusion criteria that are shown in Table 1. The search for the study was done on June 24, 2024, using only the Scopus database. Papers released in the years 1996–2024 were taken into account. With an emphasis on "virtual team Performance" related terms like "Remote Team Performance ", "E-Team Performance ", "Digital Team Performance ", "Distributed Team Performance ", "Online Team Performance ", "Virtual Collaboration Team Performance ", "Networked Team Performance ", "Telecommuting Team

Performance", " Virtual Workforce Performance". Specific search terms were selected to find pertinent publications, as a result, 180 articles matched the search criteria.

Table 1 lists the requirements for articles to be included or excluded from a study on the performance of virtual teams. The "Scopus" database was used for the research, and on June 24, 2024, a search was carried out with a concentration on articles from 1996 to 2024. It contained terminology for different Synonyms of “virtual team performance”. Accordingly, 205 articles that were pertinent were found. There were only 181 because only books, book chapters, conference papers, and articles were included. After limiting the analysis to sources in English-language, a total of 180 articles were included.

Table 1
Article Inclusion and Exclusion Criteria

Selection criteria		**Exclude**	**Include**
Database	“Scopus”		
Date of Search	24 June 2024		
Period of Publications	1996-2024		
Search term	TITLE-ABS-KEY ("virtual team Performance " OR "Remote Team Performance “ OR "E-Team Performance " OR "Digital Team Performance " OR "Distributed Team Performance " OR "Online Team Performance " OR "Virtual Collaboration Team Performance " OR "Networked Team Performance " OR "Telecommuting Team Performance" OR " Virtual Workforce Performance") Top of Form		205
Subject area	all	-	205
Publication Type	“Article”, “Conference paper”, “Book chapter”, “Book”	24	181
Language screening	“Include documents published in English only”	1	180

The previous table shows that there are criteria that have been set for searching the Scopus database, and these criteria are specifically as follows: TITLE-ABS-KEY ("virtual team Performance " OR "Remote Team Performance " OR "E-Team Performance " OR "Digital Team Performance " OR "Distributed Team Performance " OR "Online Team Performance " OR "Virtual Collaboration Team Performance " OR "Networked Team Performance " OR "Telecommuting Team Performance" OR " Virtual Workforce Performance") AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "bk")) AND (LIMIT-TO (LANGUAGE , "English")).

Data Collection

Scopus was utilized to gather the data since it has a significant amount of double-blind, peer-reviewed articles published in journals with high impact factors (Groff *et al*., 2020). To arrive at the final total of 180 articles in Table 1, we used a thorough procedure. The Keywords are “virtual team Performance” , "Remote Team Performance ", "E-Team Performance ", "Digital

Team Performance ", "Distributed Team Performance ", "Online Team Performance ", "Virtual Collaboration Team Performance ", "Networked Team Performance ", "Telecommuting Team Performance", " Virtual Workforce Performance".

Since the resulting bibliographic data must be audited after applying search criteria, data collected or downloaded from Scopus or any other online database needs to be reviewed and audited. So we had to follow a number of steps to verify the data. This led us to follow the recommendations of Donthu *et al*. (2021) and Zubik and Cater (2015) on data visualization and interpretation as well as searching for bibliographic data.

To improve their analysis and conclusions, the authors removed some terms that appeared in the article's "titles, abstracts, and keywords" by using the "natural language processing" feature of the VOSviewer software. For instance, we singularized a lot of plural nouns, such as teams to team. There are other ways to combine related ideas as well; for instance, the term "organization" is created by fusing the terms "organization" and "organization." Ultimately, a number of these cleaning techniques support the uniformity of topic assessment.

Selecting the Techniques for Analysis

A suite of tools known as bibliometric analysis quantifies text and data using quantitative techniques (Mishra *et al*., 2018; Goyal and Kumar, 2021). With the use of this technique, new data can be extracted from literature reviews for use in the next investigations (Suominen *et al*., 2016; Groff *et al*., 2020). To achieve this, it is necessary to write and publish topic biographies, identify trends in a field of study, and assess research publications that serve as a guide for understanding the subject's current state (Gao *et al*., 2021; Hossain *et al*., 2022). Scholars analyses the biographical data using bibliometric analysis approaches such as authorship, citation, bibliographic coupling, co-citation, and co-word analysis (Donthu *et al*., 2021).

Findings

This study employs two types of bibliometric analytic techniques: performance analysis and scientific mapping. While performance analysis largely takes into account the contributions made by research components, science mapping concentrates on the relationships between research parts (Donthu *et al*., 2021). The performance analysis and science mapping methods that are available will be explained in the following subsections.

Performance Analysis

The contributions that different research components have made to a certain issue are examined through performance analysis. The descriptive aspect of the analysis is what sets apart bibliometric studies (Donthu *et al*., 2020; Donthu *et al*., 2021). Since performance analysis is a common technique in reviews to offer the performance of numerous research constituents (e.g., authors, institutions, nations, and journals), this study will analyse these sorts of performance.

Publication Trend

Figure 1 illustrates the publication trends in the area of virtual team performance. Preliminary research trends indicate that the use of virtual team performance was not previously common

before (1996), when the journey of research in this area was begun by (Jarvenpaa and Ives, 1996; Hacker and Kleiner, 1996; Cano and Kleiner, 1996). The number of publications in the field of virtual team performance began to increase significantly in 2007 (7 publications) and 2008 (11 publications) and reached its peak in 2012 (15 publications) as shown in Figure 1.

The number of publications about the performance of virtual teams began to decline from 2013 (7 publications) to reach its lowest point in 2015 (3 publications). The number of publications fluctuated between 2012 and 2020. However, from the year 2020, which is the beginning of the spread of COVID-19, publications on the performance of virtual teams began to gradually increase, with the number of 10 publications in 2021 and 15 publications in 2022 and 2023. It is worth noting that the year 2024 did not have many publications, because the current research was conducted on 24 June 2024, and the opportunity is still available to publish more research on the performance of virtual teams in the year 2024.

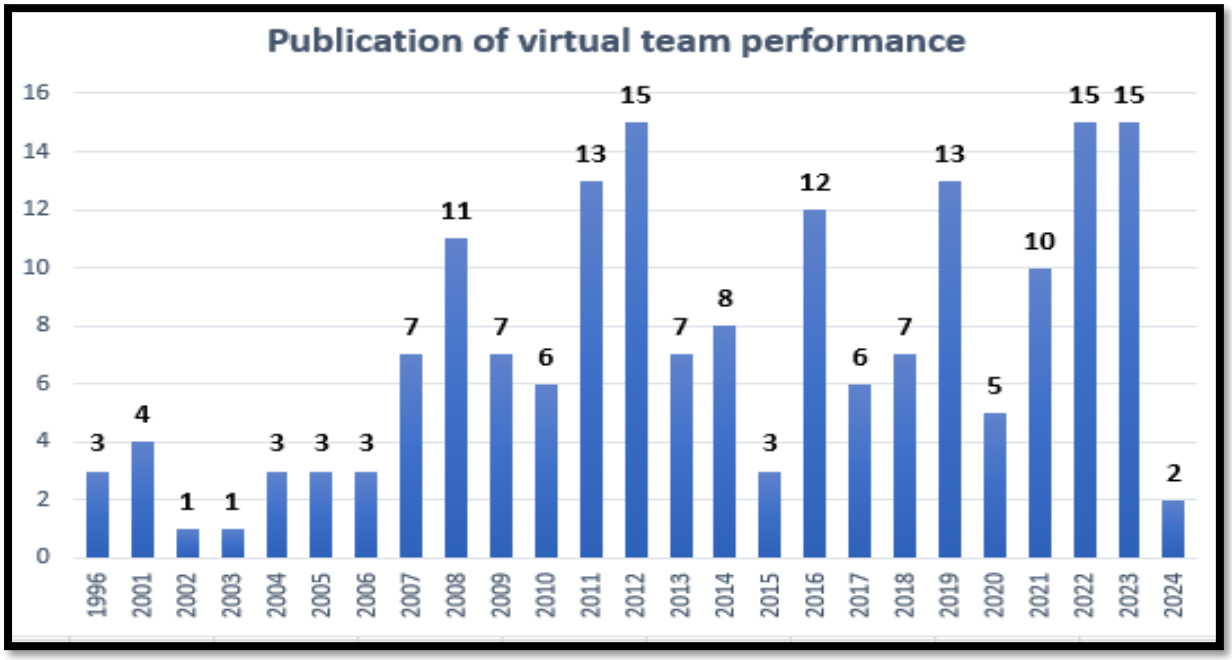

Figure 1: Publication of virtual team performance from 1996 to 2024

Prominent Authors, Organisations, and Countries of Virtual Team Performance

The authors, organizations, and nations that are well-known for their work on virtual team performance are listed in Table 2. Except for Ferreira, Pedro Gustavo Siqueira who has four publications, all of the writers on this list have made substantial contributions and have only two publications each. The total number of citations (TC) for each author's work is also included in the table. With 196 citations, Blake Ives is in first place, followed by Haydee M. Cuevas (179), Caroline Aubé (159), and Vincent Rousseau (159). With 151 citations each, Clint A. Bowers, Stephen M. Fiore, and Eduardo Salas are among the other noteworthy authors. The researchers' impact and influence in the area of virtual team performance are displayed in the table.

The University of North Carolina and the Georgia Institute of Technology are important universities; they have both made numerous contributions and have high citation counts (702 and 643, respectively). The University of Maryland, the University of California,

and the Robert H. Smith School of Business are a few other renowned universities whose citation counts (618) demonstrate their considerable influence. Furthermore, organizations with citation counts of 544, such as the National Cancer Institute, Virginia Commonwealth University, and Johns Hopkins University, are indicative of their significant research output. Global interest in the study of virtual team performance is demonstrated by the inclusion of international contributions from Ryerson University in Canada and Chulalongkorn University in Thailand.

With 83 publications and 210 citations, the United States is at the top in this scientific field, demonstrating its significant influence. China comes in second with 14 publications but a lower citation count of 47, while France has more citations (459), even though it has fewer publications (12). Canada (11 articles, 43 citations), Brazil (9 publications, 45 citations), and the United Kingdom (8 publications, 87 citations) are some of the other noteworthy contributors. Malaysia, Australia, and Germany all contribute significantly as well. Furthermore, although their contributions have been minor, nations including Hong Kong, Sweden, South Africa, the Netherlands, Spain, Norway, Taiwan, Turkey, Thailand, South Korea, and Panama have made a noteworthy impact on the field of virtual team performance study.

The information on well-known writers, institutions, and nations that have contributed to the field of virtual team performance study is shown in Table 2, with an emphasis on the total citations (TC) and number of publications (TP).

Table 2
Prominent Authors, Organisations, and Countries of Virtual Team Performance

Author	**TP**	**TC**	**Institution**	**TP**	**TC**	**Country**	**TP**	**TC**
Ives, Blake	2	196	University of North Carolina. US	2	702	France	12	459
Cuevas, Haydee M.	2	179	Georgia Institute of Technology. US	2	643	Hong Kong	2	266
Aubé, Caroline	2	159	Robert H. Smith School of Business. US	1	618	United States	83	210
Rousseau, Vincent	2	159	Georgia Institute of Technology. US	1	618	Malaysia	5	136
Bowers, Clint A.	2	151	University of North Carolina. US	1	618	Germany	6	127
Fiore, Stephen M.	2	151	University of Maryland. US	1	618	Sweden	2	101
Salas, Eduardo	2	151	University of California. US	1	618	United Kingdom	8	87
Lin, Chieh-Peng	2	130	North Carolina State University.US	1	607	South Africa	3	81
Cogliser, Claudia C.	2	109	Johns Hopkins University. US	1	544	Netherlands	4	79

Hoegl, Martin	2	103	National Cancer Institute.US	1	544	Spain	3	60
Muethel, Miriam	2	103	Virginia Commonwealth University .US	1	544	China	14	47
Robert, Lionel P.	2	71	U.S. Department of Veteran's Affairs. US	1	544	Norway	3	47
Turel, Ofir	2	59	United Healthcare.US	1	544	Taiwan	7	47
Zhang, Yi	2	39	Chulalongkorn University. Thailand	1	511	Turkey	2	46
Ferreira, Pedro Gustavo Siqueira	4	28	Temple University. US	1	511	Brazil	9	45
Da Costa, Sergio E. Gouvea	2	27	Ryerson University. Canada	1	184	Canada	11	43
Egan, Rich	2	20	Simon Fraser University. Canada	1	184	Australia	6	31
Fjermestad, Jerry	2	20	University of Houston. US	1	165	Thailand	1	31
Milewski, Allen	2	20	Southern Illinois University. US	1	165	South Korea	3	29
O'sullivan, Patrick	2	20	Cornell University. US	1	165	Panama	1	27
Note(S): TC = Total Citations, **TP** = Total Number Of Article(S) Publications								

Most Influential Journals (MIJ) on Virtual Team Performance

The most influential journals (MIJ) on virtual team performance are listed in the table along with information about their total citations (TC), total publications (TP), and publishing activity for four different time periods (1996–2000, 2001–2010, 2011–2020, and 2021–2024). Especially active in the early 2000s and 2010s, the "Academy of Management Journal" stands out with 2 publications and a noteworthy 1225 citations. With one publication each, "American Psychologist" and "MIS Quarterly: Management Information Systems" have received 544 and 511 citations, respectively, and were mostly active between 2011 and 2020. With consistent contributions since 2001, "Group and Organization Management" has 4 publications and 377 citations. "Team Performance Management" is noteworthy for its continuous output from 2001 until 2024, with 7 publications and 175 citations. The "Information Systems Journal," "Information Technology & People," and "IEEE Transactions on Professional Communication" are a few other eminent periodicals that have made major contributions over time. This distribution illustrates how the focus on virtual team performance has changed over time and how different academic venues have continued to be interested in it.

Table 3
Most Influential Journals (MIJ) on Virtual Team Performance

Journal	TP	TC	1996-2000	2001-2010	2011-2020	2021-2024
Academy of Management Journal	2	1225	-	2	1	-
American Psychologist	1	544	-		1	-
Mis Quarterly: Management Information Systems	1	511	-	1	-	-
Group And Organization Management	4	377	-	1	3	-
Information Systems Journal	1	184	-	1	1	-
Team Performance Management	7	175	-	1	3	3
Information Technology & People	1	165	-	1	-	-
Group Dynamics	1	152	-	1	-	-
Theoretical Issues in Ergonomics Science	1	148	-	1	-	-
Human Resource Management Review	1	130	-	-	1	-
Technological Forecasting and Social Change	1	107	-	-	1	-
IEEE Transactions on Professional Communication	2	106	-	-	2	-
Journal of European Industrial Training	1	89	-	1	-	-
Human Relations	1	84	-		1	-
Journal of the Association for Information Science and Technology	1	71	-	-	-	1
Journal of Global Information Technology Management	1	64	-	1	-	-
Behaviour and Information Technology	2	63	-	2	-	-
Computers in Human Behavior	1	60	-	-	1	-
Journal of International Management	1	52	-	1		-
Project Management Journal	1	51	-	-	1	-
Note(s): TC = total citations, **TP** = total number of article(s) publications						

Most Influential Articles (MIA) on Virtual Team Performance
Table 4 highlights the authors, titles, and total citations (TC) of the most influential articles (MIA) on virtual team performance. The work "The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction" by Kirkman (2004) has 618 citations, making it the most cited work. The work "Getting it together: Temporal coordination and conflict management in global virtual teams" by Montoya-Weiss (2001), which has received 607 citations, comes in close second. Rosen (2018) made a 544-citation contribution titled "Teamwork in healthcare: Key discoveries enabling safer, high-quality care."

Other noteworthy publications with 511 and 184 citations, respectively, are Kanawattanachai (2007) on knowledge coordination and Bjørn (2009) on virtual team collaboration. Furthermore, the field has been greatly impacted by the team processes and effectiveness studies conducted by Piccoli (2004), Aubé (2005), and Fiore (2003). The list also includes a number of other publications that further our understanding and enhance the functioning of virtual teams, such as those by Hoch (2017) on the makeup of teams' personalities, Peters (2009) on trust and diversity, and others. The diversity of virtual team

topics covered in these articles—coordination, trust, leadership, and technology, for example—reflects the breadth of the field's research.

There are other publications that have made important contributions about the performance of virtual teams, such as Baruch (2012); Maynard (2014); Horwitz (2006); Cogliser (2012); Malhotra (2014); Paul (2016); Hunsaker (2008); Robert (2018); Algesheimer (2011); Gurung (2006). Table 4 shows the most influential articles (MIA) on virtual team performance with mention of authors and number of citations.

Table 4
The Most Influential Articles (MIA) on Virtual Team Performance

Author(s)	**Title**	**TC**
Kirkman (2004)	"The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction"	618
Montoya-Weiss (2001)	"Getting it together: Temporal coordination and conflict management in global virtual teams"	607
Rosen (2018)	"Teamwork in healthcare: Key discoveries enabling safer, high-quality care"	544
Kanawattanachai (2007)	"The impact of knowledge coordination on virtual team performance over time"	511
Bjørn (2009)	"Virtual team collaboration: Building shared meaning, resolving breakdowns and creating translucence"	184
Piccoli (2004)	"Virtual teams: Team control structure, work processes, and team effectiveness"	165
Aubé (2005)	"Team goal commitment and team effectiveness: The role of task interdependence and supportive behaviors"	152
Fiore (2003)	"Distributed coordination space: Toward a theory of distributed team process and performance"	148
Hoch (2017)	"Team personality composition, emergent leadership and shared leadership in virtual teams: A theoretical framework"	130
Peters (2009)	"An Examination of the roles of trust and functional diversity on virtual team performance ratings"	124
Baruch (2012)	"All for one, one for all: Coopetition and virtual team performance"	107
Maynard (2014)	"The Role of Shared Mental Model Development in Understanding Virtual Team Effectiveness"	99
Horwitz (2006)	"The promise of virtual teams: Identifying key factors in effectiveness and failure"	89
Cogliser (2012)	"Big Five Personality Factors and Leader Emergence in Virtual Teams: Relationships With Team Trustworthiness, Member Performance Contributions, and Team Performance"	89
Malhotra (2014)	"Enhancing performance of geographically distributed teams through targeted use of information and communication technologies"	84
Paul (2016)	"Global Virtual Team Performance: The Effect of Coordination Effectiveness, Trust, and Team Cohesion"	80
Hunsaker (2008)	"Virtual teams: A leader's guide"	72
Robert (2018)	"Are you satisfied yet? Shared leadership, individual trust, autonomy, and satisfaction in virtual teams"	71
Algesheimer (2011)	"Virtual team performance in a highly competitive environment"	65
Gurung (2006)	"A research framework for the impact of cultural differences on it outsourcing"	64
Note(s): TC = total citations		

Science Mapping

Science mapping looks at the connections among the many research components. The conceptual and structural relationships between research participants are the main focus of the analysis (Baker *et al*., 2021; Donthu *et al*., 2021). Citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis are some of the methods used in science mapping. These methods are essential for shedding light on the bibliometric and intellectual structures of the field when paired with network analysis (Tunger & Eulerich, 2018; Baker *et al*., 2020; Donthu *et al*., 2021). This study will employ bibliographic coupling, co-occurrence bibliometrics, and co-citation analysis.

Knowledge Foundations of Virtual Team Performance through Co-Citation Analysis

Co-citation analysis reveals the semantic relationships between co-cited references, indicating a subject's basic comprehension (Donthu *et al*., 2021). The co-citation map of references that the review corpus's papers cited at least seven times is shown in Figure 2. Figure 2 shows 4 main Clusters including 22 research as the following: Cluster 1 includes 7 research represented in red nodes, and they have highly cited the research of a particular area of virtual team performance, this research was done by Hertel, Ilgen, Jarvenpaa, Marks, Martins, and Townsend. Cluster 2 includes 6 research represented in green nodes, and they have highly cited the research of a particular area of virtual team performance, this research was done by Gibson, Jarvenpaa, Kirkman, Martins, Mayer, and Short. Cluster 3 includes 6 research represented in blue nodes and they have highly cited the research of a particular area of virtual team performance, this research was done by Gilson, Hertel, Kayworth, Kirkman, Liao, and Montoya-Weiss. Cluster 4 includes 3 research represented in yellow nodes and they have highly cited the research of a particular area of virtual team performance, this research was done by Cohen, Lipnack, and Maznevski.

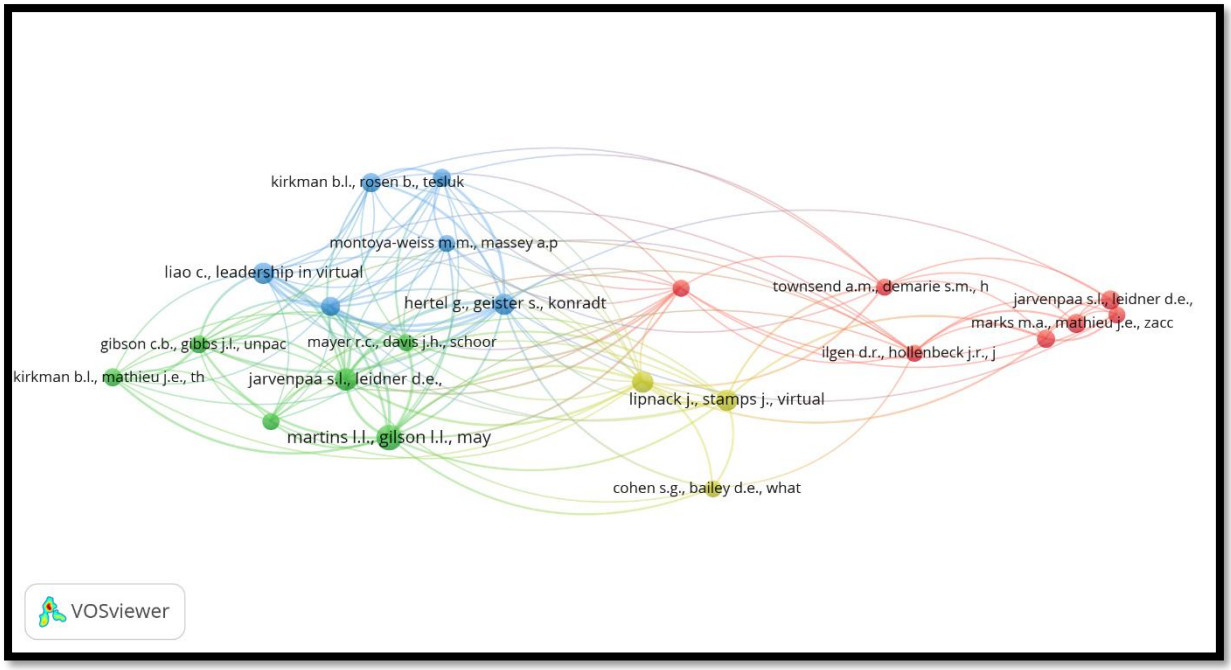

Figure 2: Co-citation of references cited by articles on virtual team performance

Note(s): The size of the nodes indicates the degree of local citations; larger nodes indicate a higher intensity of local citations. The link between nodes represents co-citations. The

connection size indicates the degree of co-citations between nodes; higher intensities of co-citations are indicated by larger linkages.

Thematic and Influence Structure Analysis through Bibliographic Coupling

The study on subject clusters related to virtual team performance is presented in Table 5 through bibliographic coupling. The three theme groupings are Virtual Teams, Virtual Team Performance, and Geographically Distributed Teams. The articles that have the greatest influence on each cluster are also shown in Table 5. Table 5 arranges important publications on virtual team performance into three topic clusters based on the authors, titles, and total citations (TC).

- *Cluster 1: Virtual Team*

Nine articles in this cluster address different facets of virtual teams. Important works include Montoya-Weiss (2001) with 607 citations on temporal coordination and conflict management, and Kirkman (2004) with 618 citations on team empowerment and in-person interaction. Additional noteworthy contributions are made by Aubé (2005) on team goal commitment (152 citations), Piccoli (2004) on team control and effectiveness (165 citations), and Kanawattanachai (2007) on knowledge coordination (511 citations).

- *Cluster 2: Virtual Team Performance*

There are seven articles in this cluster that focus on virtual teams' performance measures and affecting factors. Rosen (2018), who examines teamwork in healthcare, leads with 544 citations. Baruch (2012) and Hoch (2017) make significant contributions as well, looking at coopetition, team personality, and leadership in virtual teams, with 107 and 130 citations, respectively. Other significant publications include Robert (2018) on shared leadership and satisfaction (71 citations) and Paul (2016) on coordination effectiveness and team cohesion (80 citations).

- *Cluster 3: Geographically Distributed Team*

Four articles in this smaller cluster deal with teams that are spread out geographically. Bjørn (2009), who discusses virtual team collaboration, stands out with 184 citations. Contributions from Malhotra (2014) and Maynard (2014), who concentrate on the use of information technology and the creation of common mental models, total 84 and 99 citations, respectively. Gurung (2006) offers a paradigm for comprehending cultural variations in IT outsourcing and has 64 citations.

Table 5 lists the authors, titles, and total citations (TC) of significant papers on virtual team performance and groups them into three topic clusters. These clusters demonstrate the breadth of research areas related to virtual team success, including technology utilization, leadership, team dynamics, empowerment, and the difficulties associated with geographical dispersion.

Table 5
Thematic Clusters of Virtual Team Performance

Theme	Author(s)	Title	TC
Cluster-1 (9items) Virtual Team	Aubé (2005)	"Team goal commitment and team effectiveness: The role of task interdependence and supportive behaviors"	152
	Fiore (2003)	"Distributed coordination space: Toward a theory of distributed team process and performance"	148
	Horwitz (2006)	"The promise of virtual teams: Identifying key factors in effectiveness and failure"	89
	Hunsaker (2008)	"Virtual teams: A leader's guide"	72
	Kanawattanachai (2007)	"The impact of knowledge coordination on virtual team performance over time"	511
	Kirkman (2004)	"The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction"	618
	Montoya-Weiss (2001)	"Getting it together: Temporal coordination and conflict management in global virtual teams"	607
	Peters (2009)	"An Examination of the roles of trust and functional diversity on virtual team performance ratings"	124
	Piccoli (2004)	"Virtual teams: Team control structure, work processes, and team effectiveness"	165
Cluster-2 (7 items) Virtual Team Performance	Algesheimer (2011)	"Virtual team performance in a highly competitive environment"	65
	Baruch (2012)	"All for one, one for all: Coopetition and virtual team performance"	107
	Cogliser (2012)	"Big Five Personality Factors and Leader Emergence in Virtual Teams: Relationships With Team Trustworthiness, Member Performance Contributions, and Team Performance"	89
	Hoch (2017)	"Team personality composition, emergent leadership and shared leadership in virtual teams: A theoretical framework"	130
	Paul (2016)	"Global Virtual Team Performance: The Effect of Coordination Effectiveness, Trust, and Team Cohesion"	80
	Robert (2018)	"Are you satisfied yet? Shared leadership, individual trust, autonomy, and satisfaction in virtual teams"	71
	Rosen (2018)	"Teamwork in healthcare: Key discoveries enabling safer, high-quality care"	544
Cluster-3 (4items) Geographically Distributed Team	Bjørn (2009)	"Virtual team collaboration: Building shared meaning, resolving breakdowns and creating translucence"	184
	Gurung (2006)	"A research framework for the impact of cultural differences on it outsourcing"	64
	Malhotra (2014)	"Enhancing performance of geographically distributed teams through targeted use of information and communication technologies"	84
	Maynard (2014)	"The Role of Shared Mental Model Development in Understanding Virtual Team Effectiveness"	99

Note(s): TC = total citations

Thematic Trends of Virtual Team Performance through Co-occurrence Analysis by Authors' Keywords

The present study employs co-occurrence analysis to investigate thematic patterns in virtual team performance research, building upon the frameworks and topics provided by co-citation analysis and bibliographic coupling. Keywords from the authors are used in co-occurrence analysis. We apply a temporal filter to those terms to identify the thematic evolution of team performance research topics that are present in at least three articles within our review corpus. The trajectory of virtual team performance research subjects from 1996 to 2024 is depicted in Figure 3. Figure 3 lists the most often addressed subjects from 1996 to 2024 in earlier research on virtual team performance such as virtual teams, team performance, trust, team effectiveness, global virtual teams, distributed teams, leadership, and other topics.

The results of the analysis, as shown in Figure 3, indicate that there are topics in which interest began after the year 2020, and the figure shows that they are in yellow, such as the performance of virtual teams, the performance of the team, and the performance of the global team. It is also worth noting that the size of the nodes in the figure indicates the volume of studies on this topic.

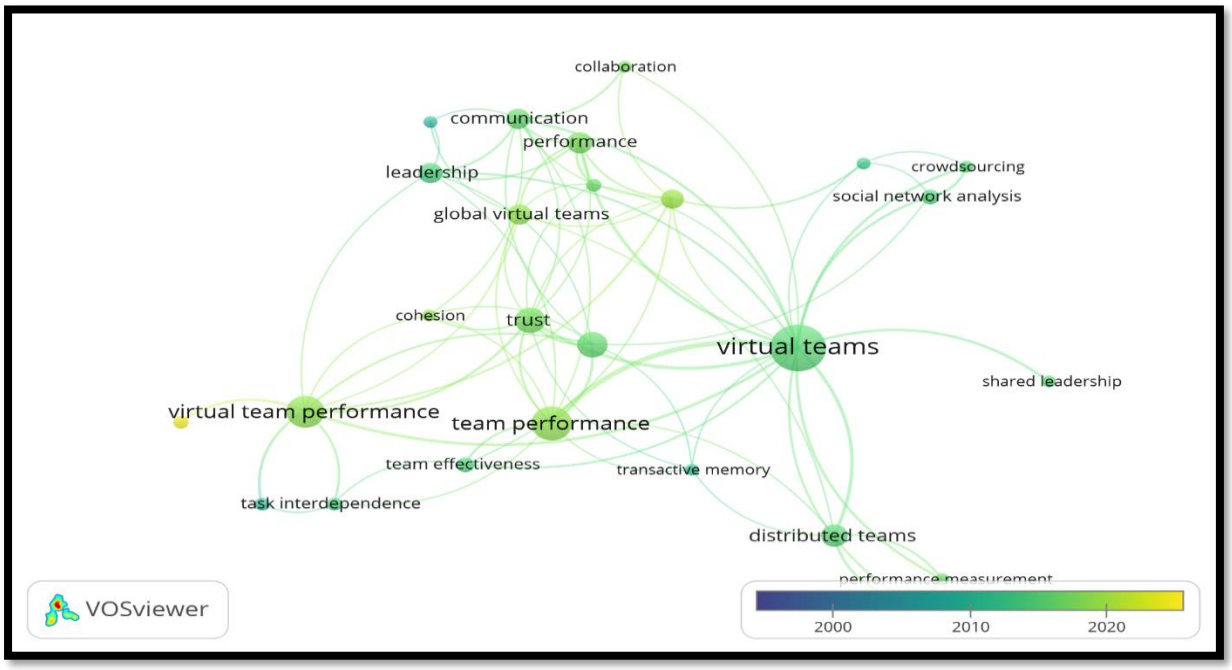

Figure 3: Influential topics on the virtual team performance "period of 1996–2024"

Future Research Directions

Bibliometric analysis makes it possible to present previous studies and future studies on the research topic. Through co-occurrence analysis (Authors' keywords), the most important future topics that researchers can research can be presented as contemporary topics, and previous studies on them are in the early stages.

Figure 4 shows the frequency of terms linked to virtual team performance in the literature based on a co-occurrences analysis. With 47 instances, the word "virtual teams" is the most commonly used, highlighting its crucial significance. There is also a focus on assessing team results, as evidenced by the prevalence of "team performance" and "virtual team

performance," with 25 and 23 instances, respectively. There are fourteen occasions that the terms "virtual team" and "trust" appear together, highlighting the significance of trust in virtual team dynamics. The terms "distributed teams" (11), "performance" (10), "communication," "global virtual teams," and "leadership" (each with 9 occurrences) are also noteworthy since they portray important variables affecting virtual teams. Furthermore, the terms "knowledge sharing" (8), "social network analysis," and "team effectiveness" (both 5) highlight the significance of methodological techniques and information sharing in this field of study.

This indicates that studies on topics such as virtual team performance, team performance, trust, distributed teams, performance, communication, global virtual team, Leadership, knowledge sharing, social network analysis, and team effectiveness are topics on which there are still few studies and constitute knowledge gaps that future researchers can investigate. And highlighting it in the context of the performance of virtual teams.

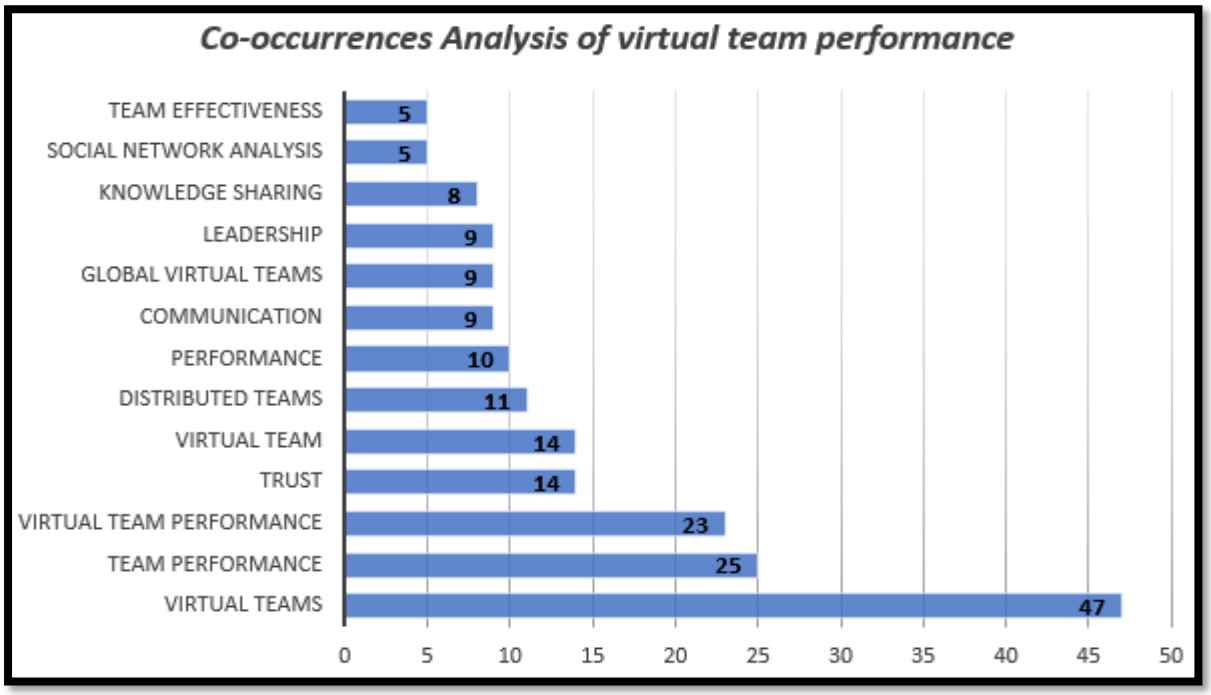

Figure 4: Future research directions on the performance of the virtual team

Theoretical Contributions

The current study makes the following theoretical contributions: It offers a thorough bibliometric mapping of the conceptual framework of studies on the performance of virtual teams. The paper provides an overview of the fundamental theories and new directions in this discipline by highlighting important authors, seminal works, and significant theme groups. Additionally, the analysis identifies gaps in the body of knowledge, pointing to topics that either need more research or have not received enough attention. This promotes the creation of fresh theoretical frameworks and aids in determining the direction of future research.

Furthermore, the research is divided into three primary clusters by the study: performance of virtual teams, geographically dispersed teams, and virtual teams. Understanding the various aspects and theoretical stances that have been used to research

virtual teams is made easier by this classification. The study highlights the theories and concepts that have had the biggest influence on the discipline by listing the most cited publications and well-known writers. Understanding the theoretical foundations that have shaped our current understanding is aided by this insight. The study demonstrates how knowledge from a variety of fields, including information technology, psychology, and management, is integrated into research on virtual team performance, adding richness and diversity to the theoretical framework.

Limitations

It is important to take into account the many limitations of the current study. First, there is a restriction on the data source. The study's data are sourced only from the Scopus database. Although a trustworthy and thorough resource, Scopus may not contain all pertinent papers and publications, therefore missing important studies from other databases such as Web of Science, Google Scholar, or subject-specific repositories. There may be inherent biases in the study of 180 papers with regard to publication choices. Certain selection criteria, such as keywords or citation counts, may have left out pertinent but less cited or differently phrased research. Furthermore, the research's breadth may be constrained by the study's subject focus on three primary clusters: geographically dispersed teams, virtual teams, and virtual team performance. It's possible that other pertinent subjects and subfields related to virtual team performance aren't sufficiently covered. And lastly, there might be linguistic bias. It is possible that significant research published in other languages will be left out of the study if the majority of the papers included are in English. In order to properly evaluate the study's results and direct future research to solve these gaps and biases, it is imperative to acknowledge these limitations.

Conclusion

Using bibliometric analysis, the study intends to highlight global trends in research and future directions for the performance of virtual teams over the last three decades (1996–2024). Using 180 articles that were taken from the Scopus database, the study uses bibliometric analysis to look at co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation analysis. It accomplishes this by applying scientific mapping and performance analysis. The number of scientific publications was analysed, along with the most prolific authors, important papers, countries, and organizations. The study used VOSviewer as a science mapping and performance analysis tool.

The study emphasized several findings, including the fact that, with 15 publications apiece, the most productive years were 2012, 2022, and 2023. And the nations of France and the University of North Carolina in the United States have had the greatest influence, respectively. In a similar vein, the most referenced paper is "The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction," and the most influential publication is "Academy of Management Journal." Additionally, the study found three topical clusters of research on the performance of virtual teams: geographically distributed teams, virtual teams, and virtual team performance. An overview of current research on virtual team performance is provided in this study. It also makes recommendations for potential avenues of investigation for further study in this area. This work advances our knowledge of virtual team performance literature mapping and performance analysis.

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