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Measuring scientific interest in the issues of virtual project teams - bibliometric analysis

Abstract

Research background and purpose: The virtualization of work, the development of information and communication technologies have significantly transformed the way projects are organized and implemented, leading to the growing importance of virtual teams in various economic sectors. Although this practice is becoming increasingly common, the scientific literature is still characterized by a limited number of theoretical and empirical studies on the management of virtual project teams. These issues became particularly important during the COVID-19 pandemic, which accelerated digitalization processes and highlighted the role of remote work in organizations.
Design/methodology/approach: The aim of the study was a bibliometric analysis of scientific output related to virtual team and project management, enabling the identification of publication dynamics, key research centers, authors, and key topic areas. The research material comprised 410 articles by 1,200 researchers, published in 373 sources in 61 countries between 1993 and 2025, obtained from the Web of Science database. The analysis was conducted using descriptive and bibliometric methods.
Findings: The obtained results indicate a systematic development of research on virtual teams, with the number of publications remaining relatively stable since 2006. While studies emphasize the importance of team member competencies, communication, and project success factors, the analyzed literature does not identify a uniform methodology or model for selecting members of virtual project teams.
Value added and limitations: The research conclusions indicate a clear cognitive gap regarding practical tools and models for managing virtual project teams. The study's selection of a single database remains a limitation, which limits the comprehensiveness of the literature analyzed. Nevertheless, the study contributes to the systematization of existing knowledge, providing a foundation for further research on the theory and practice of managing projects implemented in a virtual environment.

Keywords: *virtual team, project management, bibliometric analysys*

JEL Classification: M12, O22, O33

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1. Introduction

The specific nature of project teams is characterized by transcending functional, and sometimes even organizational boundaries. However, the literature on the subject is sparse in terms of both theoretical and empirical descriptions (Jagoda, 2017). As I. Harniak (2008) notes, "thanks to this form of work delivery, a hypothetical office specializing in financial, legal, or technical support (help desk) services, etc., may consist of a larger number of multi-aisle teams operating in different time zones, allowing for 24/7 customer service" (Harniak, 2008). Virtual work is only possible through the use of modern ICT devices and knowledge of a common language among the individuals employed in virtual teams. Currently, virtual teams are a component of many types of organizations, but their initial development was closely linked to companies operating in the outsourcing sector. Global outsourcing companies operating according to these principles include Deloitte, Infosys, and Capgemini. Their outsourcing centers are geographically dispersed (California, Sweden, Poland, India, China, Mexico) to allow for savings in areas such as labor costs, lease costs and taxes. Furthermore, these entities also have broader access to human resources. The use of virtual project teams dispersed worldwide allows them to ensure continuity of service to global clients (Trippner-Hrabi & Stroińska, 2015).

Originally, the concept of outsourcing was limited to outsourcing only services that were not essential to the company and could be provided by other specialized companies (Thuong, 2019). This approach originates from the 20th century, where H. Ford stated in 1923 that "If there is something we cannot do more efficiently, cheaper, and better than our competitors, there is no point in doing it. We should hire someone to do it better than we can" (Radziszewski, 1998). Nowadays, companies often delegate not only services of minor importance to the company, but also complex core business activities to other specialized and competent international teams. Companies that want to achieve market success must constantly invest in and implement new R&D projects. These innovations are rooted in the use of specialized knowledge from various fields. It would be unprofitable and unfeasible for an organization to have all the necessary international experts within its structures (Trippner-Hrabi & Stroińska, 2015). Outsourcing companies are often used to create virtual teams to implement such projects. They organize these teams for the project and deliver the finished product to the client. The popularity of such solutions in business practice is driving increasing investment by companies in the development of both consulting and outsourcing services, as combining them within a single company significantly increases its credibility in the market through a simple association: those who professionally handle specific business processes know best how to optimize them (Trippner, 2014).

In the context of virtualization, the outbreak of the COVID-19 pandemic undoubtedly proved to be an additional catalyst, accelerating digitalization processes

in SMEs. Research conducted in this area has clearly shown that the majority of SMEs declare an increased importance of using digital tools and prioritizing them (Youssef et al., 2023).

The aim of conducting a bibliometric analysis of concepts related to virtual teams and projects is to systematically examine how the growing global virtualization of work and the popularization of teams operating in a digital environment are reflected in scientific activity. The dynamic development of information and communication technologies and the growing scale of work virtualization have contributed to significant changes in the organization and implementation of team tasks. The bibliometric analysis aims to identify directions of research development in this field, determine publication dynamics and identify key authors, institutions, and journals that play a leading role in shaping scientific discourse. From a cognitive perspective, the bibliometric analysis provides a basis for assessing how the process of work virtualization and the growing popularity of distributed teams translate into research activity and the evolution of theoretical paradigms in management and organizational sciences. From a practical perspective, the results can significantly contribute to identifying research gaps and defining potential directions for further study, contributing to the development of both the theory and practice of managing projects implemented in virtual environments. This study presents the adopted research methodology, which includes data extraction and selection, followed by descriptive and bibliometric analysis. The analysis was conducted using the Web of Science (WoS) database, using a sample of 410 articles by 1,200 researchers, published in 373 source titles in 61 countries worldwide between 1993 and 2025. The study answered the following research questions: How has the discussed idea evolved over time? What fields of knowledge does the studied idea pertain to? Which countries and research centers are leading in relation to the studied idea? Are there any researchers who stand out scientifically in relation to the studied idea? Does the number of citations to publications in the studied field indicate researcher interest in the discussed idea? How do publications from Poland compare to other countries in the indicated area? What topics are discussed in the context of the discussed idea? Does the bibliometric analysis indicate a research gap in the discussed area? In conclusion, theoretical and practical implications in the area of management are presented, as well as limitations of the study and potential directions for further analysis.

2. The concept of a virtual project team

Considering the contemporary demands placed on modernly managed organizations, it is important to note that the team has become the basic unit in implemented projects. Instead of individual responsibility for specific work elements, a team-based division

of responsibilities is introduced to achieve the established goal. All team members combine their efforts, knowledge and skills. West emphasizes that for organizations to be innovative, their teams must be innovative as well (Nicholas & Steyn, 2008). For this reason, virtual project teams are becoming increasingly common. Numerous scholars have attempted to define virtual teams. If a team, as defined by Kutzenbach and Smith (Nordenflycht, 2010), is a small group of people whose relationships are related to the achievement of a specific goal, does not function in direct physical proximity and communicates via information technology, it is defined as a virtual team (Markowska, 2004). Similarly, Lipnack and Stamps (2000) define a virtual team as a group consisting of two or more people who interact and communicate primarily through ICT tools. They also identify the separation of team members in time or space as a defining criterion for a virtual team. What distinguishes a virtual team from other teams is not the degree of use of communication technology itself, but the degree to which communication and collaboration within these teams is determined by technology. A traditional team can at any time forgo ICT tools, whereas a virtual team is completely dependent on them. It is assumed that virtual teams can work despite distance, time differences and organizational constraints (Curseu, Schalk, & Wessel, 2008). Thanks to ongoing globalization and the development of ICT systems, virtual teams are developing very dynamically and are considered to be among the newest generation of teams (Grajewski, 2007). According to Goodbody (2005), virtual teams are becoming an indispensable element of the global economy. The opportunities created by the Internet, which eliminate geographical barriers to acquiring specialized workforce with desired competencies, mean that virtual teams may become the organizational system for project management in the future (Michalczyk, 2013). A virtual project team is an organizational unit consisting of a group of people separated in time or space, established on the basis of subject-specific specialization, for the duration of the project, to carry out project tasks, and using ICT tools for mutual communication (Barnowska & Saniuk, 2017). Abarca et al. (2020) describe virtual teams as groups of individuals distributed across different locations who collaborate to achieve shared objectives. Hung et al. (2021) emphasize the creation of virtual teams as a way to overcome spatial and temporal constraints and address communication barriers, while Caputo et al. (2023) highlight interdependent collaboration among geographically dispersed coworkers. Despite these efforts, the literature still notes the lack of a comprehensive definition of the virtual team construct (Chudoba et al., 2005; Ebrahim et al., 2009; Zheng et al., 2024). Nevertheless, common elements emerge across definitions, including geographic dispersion, shared goals, and the use of information and communication technologies (ICTs), reflecting the core characteristics of virtual teams (Abi Saad and Agogué 2023; Caputo et al., 2023; Chaudhary et al., 2022, Purvanova & Kenda, 2022; Kimura, 2024; Abakpa & Dvouletý, 2025).

It should be emphasized that the concept of a virtual team can also be considered more broadly as one of the three basic types of virtual enterprises, where virtual teams are defined as teams most often created in large corporations, dealing with specific tasks, composed of specialists and experts performing various functions within the structure of a traditional enterprise (Pinoczek, 2019).

3. Methods

The aim of this study was to conduct a bibliometric analysis of the scientific literature on virtual teams and project management, enabling the identification of publication dynamics, leading research centers, key authors, and principal thematic areas. The examination of the role of virtual project teams within the broader context of project management, as well as the analysis of the interrelations between these concepts, represents a stage in the process of developing a methodology for planning virtual project teams. Accordingly, particular attention was devoted to confirming the need for establishing such a methodology.To achieve this goal, a bibliometric analysis was used, developed using the dynamic Systematic Literature Network Analysis (SLNA) method introduced by Colicchia and Strozzi (2012). This method involves conducting a systematic literature review (SLR), analyzing it, and visualizing the bibliographic network. The analysis results in the scientific and objective identification of trends in key issues that influence the development of knowledge in a given field. A systematic literature review (SLR) and definition of the scope of the study can be conducted in three steps (Strozzi et al., 2017):

1. Identification of the scope of the analysis.
2. Identification and localization of keywords, document type, language, and databases.
3. Selection, evaluation, and synthesis of the existing collection of completed, peer-reviewed, and registered scientific papers in the analyzed database, developed by researchers, scientists, and practitioners.

Following these steps allows for the identification of a set of scientific publications necessary for quantitative research, identified in an open, systematic, comprehensive, and replicable manner, yielding consistent results (Fink, 2010).

The next step is the analysis of the identified set of scientific papers, which involves analyzing citation networks and keywords. Keywords indicate the contribution of the publication's authors to the development of research in the field under study. A visualization of the network of connections is created by citing previous scientific publications. Citation analysis is a reliable indicator of the evaluation of scientific publications and their importance. Citations have been recognized as determining the influence of a cited work on the author's new scientific work. It should be noted

that, according to many researchers, a highly cited scientific work does not always reflect scientific impact and high quality of the publication (Drabek, 2011). However, the assumption that a high number of citations indicates a high substantive level of a scientific work is valid, as citation and keyword analysis reveals shifts in the directions of researchers' interests.

The Web of Science database, provided by Clarivate Analytics, was used for research purposes. It is an interdisciplinary research platform that captures the content of over 12,000 high-impact journals and over 160,000 conferences worldwide. The WoS database covers literature from most scientific disciplines and includes a range of databases and tools necessary for establishing bibliometric indicators, parametric assessment, and creating bibliographies. It is also one of the most widely used databases and citations for scientific purposes. According to some researchers, WoS has a smaller coverage compared to Scopus (Zhao & Strotmann, 2015), but Scopus's main drawback is the quality of its data, which is not "pure," meaning that some publications are not clearly identified.

The presented results were obtained on May 25, 2025, in the Web of Science database using the phrase "Virtual team" AND Project. A search was conducted for scientific publications from 1993-2025 that contained the phrase "virtual team" AND Project in their title, source title, abstract, keywords, and PLUS keywords (a keyword category defined in the WoS database). The study encompassed publications in all languages, without applying language restrictions, however, most publications were in English, reflecting its predominant role in scientific communication within the investigated field. The analysis was limited to peer-reviewed works, including journal articles, conference proceedings, and chapters in monographs. Data processing, citation network analysis, and visualization were performed using VOSviewer software.

3.1. Quantitative indicators for publications from the research area

As a result of preliminary work related to the literature analysis, a set of keywords was identified that will be used to collect metadata obtained from selected scientific databases. This work resulted in the identification of a set of keywords for collecting data obtained from the WoS database. It should be emphasized that keyword identification is a critical step in bibliometric analysis. Its results may change if different keywords are used.

The first step of the bibliometric analysis was to identify a key term that would allow for limiting the set of results – for this study, this was the phrase "virtual team". The number of publications in the area of virtual team research is presented in Figure 1.

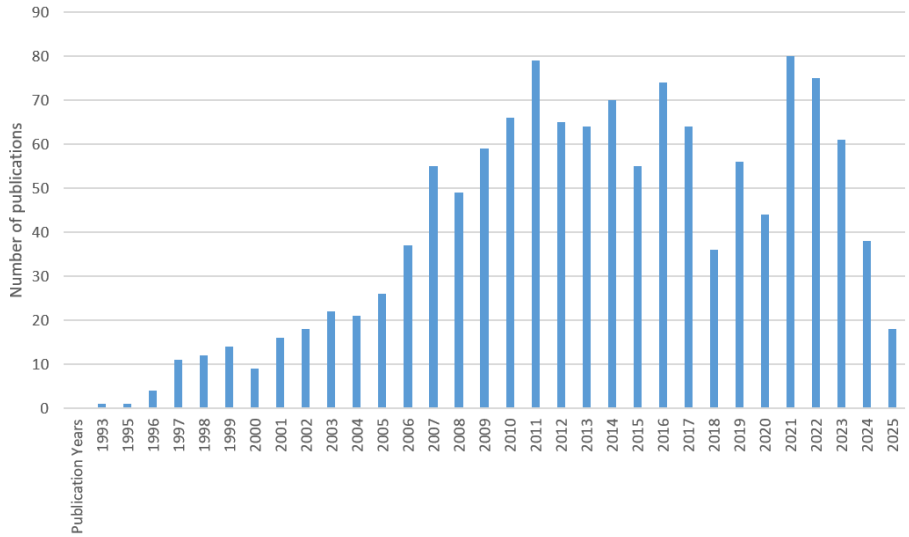

Figure 1. **Number of publications in the area of research on virtual design teams from the WoS database**

Source: own study

The presented results were obtained on May 25, 2025, in the Web of Science database using the phrase "virtual team." A search was conducted for scientific publications from 1993-2025 that contained the phrase "virtual team" in their title, source title, abstract, keywords, and PLUS keywords (a keyword category defined in the WoS database). The initial search for the defined basic concept of "virtual team" included 1,300 references, excluding supplementary words and identifying the publication type. In the next stage, concepts related to keywords related to the dissertation's research area were also identified. The initial search included the phrase "project management," but this significantly limited the number of results obtained. Analysis of the resulting search results was used to determine the next phrase. Analyzing the articles retrieved by searching for the phrase "virtual team," particularly their keywords, it was noted that phrases of interest to this study included: virtual team project management, virtual team projects, virtual team project supervision, virtual team concept in projects, etc. Analysis of the obtained records revealed that the appropriate phrase related to the research area was the word "project." This narrowing of the research area allowed for the discovery of articles whose subject matter broadly encompasses a variety of formulations revolving around project and project team management. Another search was conducted. The total number of articles retrieved for the phrase "Virtual team"

AND Project, was 417 (Table 1). The search results were exported, and a local database was created, which was saved on an external computer storage device and used for further analysis.

Table 1. **Initial search results for the keywords "Virtual team" AND Project**

Zestaw słów kluczowych	Wyniki wyszukiwania (liczba dokumentów)
"Virtual team" AND Project	417

Source: own study

In the next stage of the analysis, the resulting set of solutions was narrowed to selected types of scientific publications. The analysis focused on publications that had undergone peer review: articles from scientific journals, articles presented as conference proceedings, and chapters in monographs. The resulting database was also analyzed to exclude any duplicate records. The search yielded a total of 410 scientific publications containing the phrase "Virtual team" AND Project (Table 2).

Table 2. **Initial search results for: "Virtual team" AND Project after narrowing the search to selected publication types**

Keyword Set	Search Results (number of documents)
"Virtual team" AND "Project"	410

Source: own study

As a result of the conducted activities, basic statistics relating to the created bibliometric database were presented (Table 3). A total of 410 scientific publications, authored by 1,200 scientists, were collected for analysis. These publications were published in a total of 373 source titles – scientific journals, conference proceedings, and chapters of monographs. The authors of the identified and analyzed scientific publications come from 61 countries and represent a total of 661 research institutions and centers worldwide.

Table 3. **Basic bibliometric indicators of scientific works in the area of research on virtual project teams, for: "Virtual team" AND Project**

Scientific publications from 1993 to 2025
Number of records = 410
Number of researchers = 1,200
Number of source titles = 373
Number of countries = 61
Number of research centers = 661

Source: own study

4. Findings

4.1. The trend of publishing works in the researched field

410 scientific publications were identified that contained in their title, abstract, keywords and/or keywords PLUS the phrases: "Virtual team" AND Project, for which an assessment of changes in researcher interest over time was performed. Figure 2 shows the trend in the number of published scientific papers.

The scientific debate on the issues under study began in the 1990s. A systematic and significant increase in interest in virtual project teams occurred between 2001 and 2010, which translated into a systematic increase in the number of published publications. Between 2011 and 2013, there was a slight decline in the number of published publications, but since 2013, interest in the area has increased again. In 2016, the largest number of publications were published during the period under review, with 30 papers.

The growing academic interest in virtual project teams after 2013 can be attributed to the convergence of technological and organizational transformations. The rapid development of digital collaboration tools and the acceleration of digital transformation processes have made virtual teamwork strategically important (Abakpa & Dvouletý, 2025; Kimura, 2024). At the same time, globalization and the rise of project-based and hybrid work structures have highlighted the need to understand coordination, trust, and leadership in geographically dispersed environments (Caputo et al., 2023; Hung et al., 2021, Tasdemir et al., 2025). Furthermore, the adoption of Agile and hybrid project management approaches has encouraged scholars to explore how these frameworks can be effectively implemented in virtual contexts (Zheng et al., 2024).

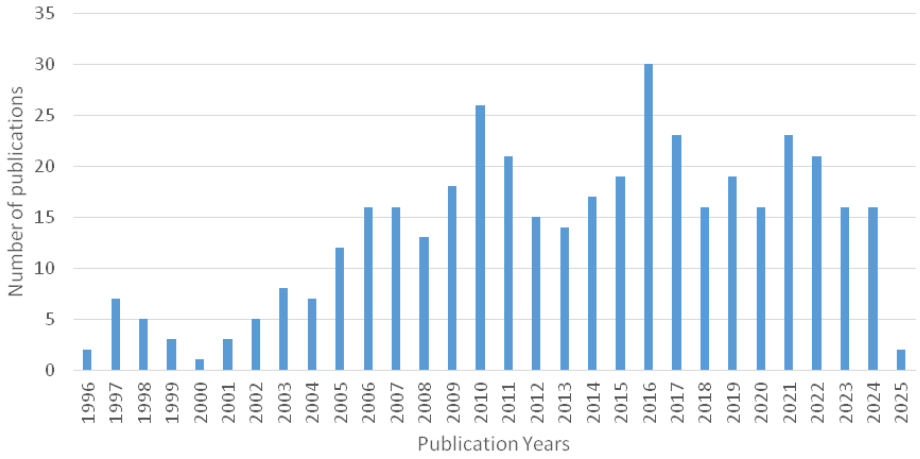

Figure 2. **The trend of publishing scientific papers in the area of research on virtual project teams**

Source: own study

4.2. Publishers and source titles

After organizing the collection, 263 articles from scientific journals (64%), 152 publications published as conference materials (37%), and 12 chapters from monographic books (3%) were identified. Some publications fall into more than one category, therefore the total number of publications indicated in the collection exceeds the number of publications analyzed. Preliminary statistics show that, of the 263 scientific articles published by scientific journals, eleven of them contributed to the publication of 191 identified scientific articles. This represents approximately 73% of all published works of this type. Table 4 summarizes the retrieved source titles in which the identified scientific works appeared. The dominant publisher is Emerald Group Publishing, which published a total of 31 identified scientific publications. Other significant publishers include Taylor & Francis, Elsevier, and Igi Global, which published 27, 26, and 25 scientific publications in the research area, respectively.

Table 4. **Main publishing houses that contributed to the publication of scientific papers in the area of research on virtual design teams**

No.	Source titles	Number of publications retrieved	% of 263 scientific papers from conference proceedings
1	Emerald Group Publishing	31	11.79%
2	Taylor & Francis	27	10.27%
3	Elsevier	26	9.89%
4	Igi Global	25	9.51%
5	Sage	22	8.37%
6	Springer Nature	20	7.61%
7	IEEE	13	4.94%
8	Wiley	9	3.42%
9	Inderscience Enterprises Ltd	6	2.28%
10	Mdpi	6	2.28%
11	Oxford Univ Press	6	2.28%

Source: own study

Preliminary statistics show that seven primary source titles contributed to the publication of 152 conference proceedings. These seven primary source titles were found to have published 94 identified scientific papers, representing approximately 62% of all published papers of this type.

Table 5. **Main source titles that contributed to the publication of scientific papers in conference proceedings in the area of research on virtual design teams**

No.	Source titles	Number of publications retrieved	% of 152 scientific papers from conference materials
1	IEEE	54	35.53%
2	Springer Nature	20	13.16%
3	Elsevier	6	3.95%
4	Assoc Computing Machinery	5	3.29%

5	Assoc Information Systems	3	1.97%
6	Iated-Int Assoc Technology Education & Development	3	1.97%
7	Insticc-Inst Syst Technologies Information Control & Communication	3	1.97%

Source: own study

Table 5 presents a summary of the seven selected source titles in which the identified works appeared. IEEE has been most instrumental in promoting research in this area, publishing a total of 54 scientific publications. Next on the list is Springer Nature, where a total of 20 scientific publications have been published.

In the last selected group of publications, i.e. chapters in a scientific monograph, due to their small number, the scientific works were scattered, hence they were not analyzed according to publishers.

4.3. Scientists conducting research

Based on the Web of Science database, researchers can also be ranked according to the number of published scientific papers indexed by the database. Considering the authors and co-authors and the number of their scientific publications, it is worth emphasizing that a total of 1,200 scientists from around the world have been/are currently engaged in research on virtual project teams for the phrase "Virtual team" AND Project.

Due to the number of publications, three researchers stand out, with their scientific achievements spanning 7, 5, and 4 scientific publications in the researched area, respectively (Table 6). The most active researchers who published in the studied area were: Swartz Stephanie, Harold Daniel oraz Fuller Mark together, and they constitute 0.25% of the studied group of scientists. Furthermore, 25 authors have three publications in the research area, representing 2.08% of the study population, 78 authors have two publications in the research area, representing 6.50% of the study population, and 1,094 scholars have one scientific publication in the research area, representing 91.17% of the study population.

The results presented in Table 6 confirm the law of scientific productivity, which states that a small number of researchers publish a large number of scientific papers, while most scientists can boast a small number of scientific publications (Figure 3). The same is true for the identified scientific papers and their authors in the research area. A group of approximately 91% of researchers can be distinguished who addressed the analyzed topic but published a single scientific paper that was indexed in the Web

of Science database. It should be noted that we do not have information about the researchers' other works, as they were not included in the WoS database. This does not mean, however, that these researchers had no influence on further research directions. This group achieved a combined h-index of 36 citations, and the average citation rate per scientific paper was 17.37.

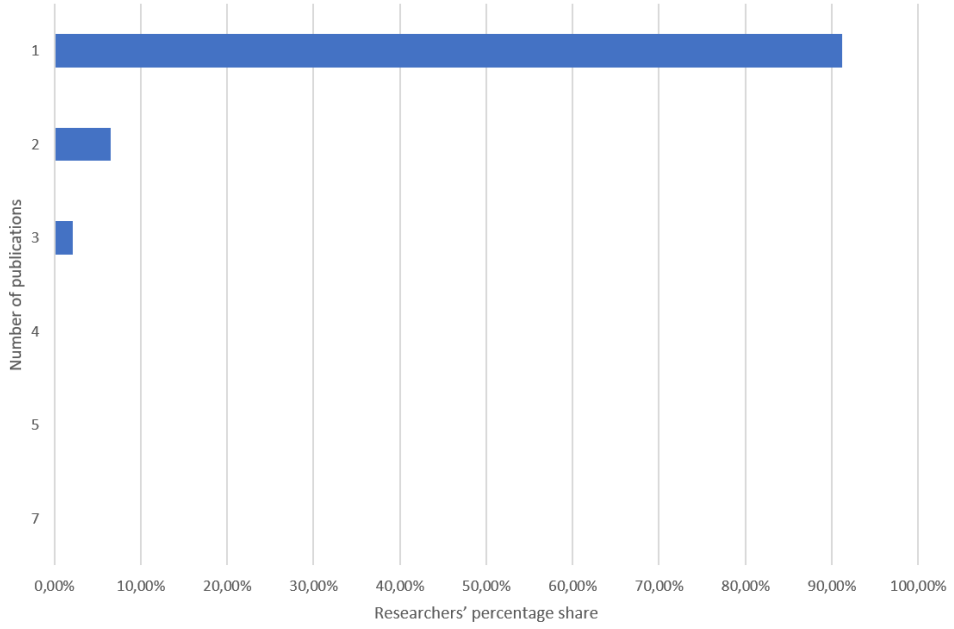

Figure 3. **Research productivity of researchers who conduct research on virtual project teams**

Source: own study

Table 6. **Researchers who are involved in the study of virtual design teams**

No.	Number of authors	Number of published scientific papers
1	1	7
2	1	5
3	1	4

4	25	3
5	78	2
6	1094	1

Source: own study

4.4. Fields of knowledge

The Web of Science database allows for detailed insight into the types of knowledge fields of selected scientific works. For the virtual project team concept, a total of 79 knowledge areas were specified for the phrase "Virtual team" AND Project. Based on the obtained data, we can conclude that the researched topic is characterized by multidisciplinary specificity, which is related to the mutual complementation of issues and concepts from various areas of science.

It should be noted that the total number of scientific works corresponding to individual knowledge areas does not add up to the identified set of 410 scientific publications. This is due to the possibility of classifying a scientific publication simultaneously into several different fields of knowledge. It should also be emphasized that the fields of knowledge presented in the list do not always coincide with the fields or areas of science defined in Poland. Analysis of the data contained in Table 7 indicates that for the set of scientific works identified for the phrase "Virtual team" AND Project, eight leading scientific fields can be distinguished. The most popular group of sciences is Management, for which 99 scientific works were identified. The second leading group of sciences is Computer Science Information Systems. 75 scientific publications were identified for this group. It should be noted that in each of these fields it is possible to additionally indicate the most popular areas of knowledge. As a result of the sharing of scientific achievements across the scientific community, the improvement of research methods, and the universalization of knowledge, we can observe the interpenetration of scientific ideas. It becomes natural for different disciplines to come closer together and interpenetrate each other, creating entirely new, interdisciplinary research areas.

Table 7. **Most popular knowledge areas for identified scientific papers**

No.	Fields of knowledge	Total number of scientific publications
1	Management	99
2	Computer Science Information Systems	75

3	Education Educational Research	58
4	Engineering Electrical Electronic	41
5	Computer Science Software Engineering	40
6	Computer Science Interdisciplinary Applications	37
7	Computer Science Theory Methods	35
8	Business	32

Source: own study

4.5. Research centers

The statistics show that the analyzed set of retrieved scientific papers is dominated by three leading scientific institutions. These are institutions whose scientists have published eight or more scientific papers indexed in the Web of Science database (Table 8).

Table 8. **List of leading research centers**

No.	Number of research centers	Number of published scientific papers according to affiliation
1	1	18
2	1	9
3	1	8
4	4	7
5	2	6
6	6	5
7	20	4
8	38	3
9	89	2
10	499	1

Source: own study

Detailed analysis revealed that two of the three dominant research centers are located in the United States, and the third in Slovenia. Expanding the list of research centers

to include those whose researchers have published at least six scientific publications indexed in the Web of Science database increases the list to nine research centers (Table 9). Among the top nine leading research centers, as many as eight institutions are located in the United States.

Table 9. **List of selected research centers, taking into account geographical location**

No.	Name of the research center	Country	Number of published scientific papers according to affiliation	% of 410 scientific publications
1	University of North Carolina	USA	18	4.39%
2	University of Ljubljana	Slovenia	9	2.20%
3	University System of Georgia	USA	8	1.95%
4	California State University System	USA	7	1.71%
5	East Carolina University	USA	7	1.71%
6	Pennsylvania Commonwealth System of Higher Education	USA	7	1.71%
7	State University System of Florida	USA	7	1.71%
8	Pennsylvania State University	USA	6	1.46%
9	University of Toronto	Canada	6	1.46%

Source: own study

Further analysis of the most important research centers in the study area shows that 18 scientific papers affiliated with the University of North Carolina achieved an h-index of 11, with an average citation rate per paper of 32.39. Nine scientific papers affiliated with the University of Ljubljana achieved an h-index of 4, with an average citation rate per paper of 7.89. Another eight scientific papers affiliated with the University System of Georgia achieved an h-index of 4, with an average citation rate per paper of 13.75.

4.6. Citations of found publications

An important stage of bibliometric data research is citation analysis. It indicates the scale of a given scientific publication's impact. The analyzed set of 410 scientific publications identified for the phrase "Virtual team" AND Project achieved a Hirsch index (h-index) of 36. The average citation rate per scientific paper is 17.37.

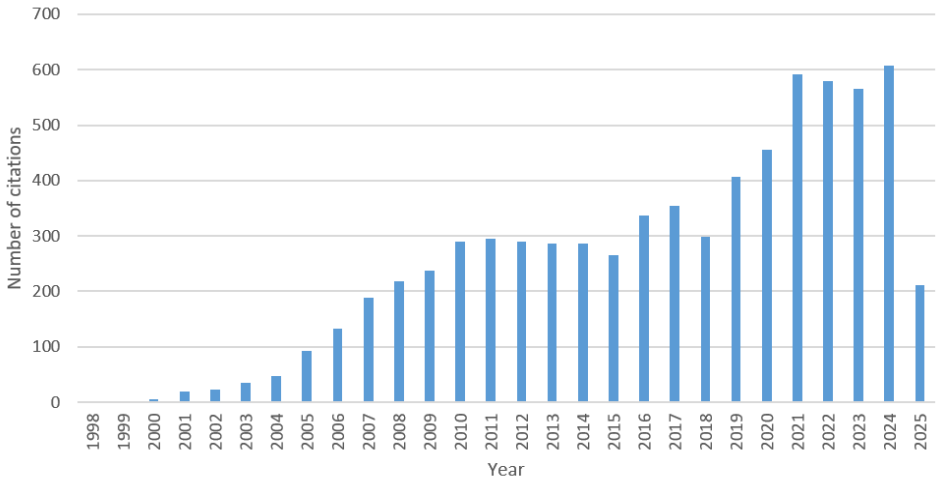

Figure 4. **Number of citations of identified scientific papers in the area of research on virtual project teams**

Source: own study

The retrieved publications were cited a total of 7,123 times, of which 6,717 were cited excluding the authors' own works. An analysis of the number of citations over time indicates a steady increase in interest in the researched area, which peaked between 2021 and 2024, when the number of citations ranged from 566 to 607 (Figure 4). It is important to note that this significant increase in citations from 2021, and the resulting increase in interest in the researched area, was undoubtedly caused by the exceptional global situation – the COVID-19 pandemic that significantly impacted the workflow of many companies. Table 10 presents the ten most frequently cited publications in the researched area (citation counts exceeding 90). It is worth noting that all of the most influential scientific works are collective publications with more than one author.

Table 10. **Ten most cited scientific papers**

No.	Author	Publication title	Year	Number of citations	Average number of citations/year
1	Jarvenpaa, Leidner	Communication and trust in global virtual teams	1999	1455	53.12
2	Gilson, Maynard, Young, et.al.	Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities	2015	484	44.00
3	Kayworth, Leidner	Leadership effectiveness in global virtual teams	2001	346	13.84
4	Sarker, Sahay	Implications of space and time for distributed work: an interpretive study of US-Norwegian systems development teams	2004	176	8.00
5	Massey, Montoya--Weiss, Hung	Because time matters: Temporal coordination in global virtual project teams	2003	151	6.57
6	Schmidt, Montoya-Weiss, Massey	New product development decision-making effectiveness: Comparing individuals, face-to-face teams, and virtual teams	2001	138	5.52
7	Taras, Bryla, Caprar, Dan, Ordenana, et.al.	A Global Classroom? Evaluating the Effectiveness of Global Virtual Collaboration as a Teaching Tool in Management Education	2013	128	9.55
8	Gassmann, von Zedtwitz,	Trends and determinants of managing virtual R&D teams	2003	128	5.57
9	Furst, Reeves, Rosen, Blackburn	Managing the life cycle of virtual teams	2004	110	5.00
10	Webster, Wong	Comparing traditional and virtual group forms: identity, communication and trust in naturally occurring project teams	2008	95	5.28

Source: own study

The most frequently cited publication in the field of virtual project team research is the collective work by Jarvenpaa Sirkka L. and Leidner Dorothy E., "Communication and Trust in Global Virtual Teams," published in 1999. This article has achieved an impressive 1,455 citations, underscoring its fundamental importance in developing the discipline and establishing the basic research paradigms for communication and trust in global virtual teams (Jarvenpaa & Leidner, 1999). The second most cited work is Gilson Lucy L., Maynard M. Travis, Young Nicole C. Jones, Vartiainen Matti, and Hakonen Marko, "Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities," published in 2015, which has been cited 484 times. Its significance lies in its synthetic review of a decade of research on virtual teams and the identification of the main themes and opportunities for development in this area (Gilson, Maynard, Young, Vartiainen, & Hakonen, 2015). The third most cited work is the article by Kayworth T.R. and Leidner D.E. entitled "Leadership Effectiveness in Global Virtual Teams" from 2001, cited 346 times, which analyzes in detail the role of leadership in the effectiveness of distributed teams and identifies key competencies of leaders in a virtual environment (Kayworth & Leidner, 2001). Sarker and Sahay (2004) achieved 176 citations for their article "Implications of space and time for distributed work: an interpretive study," which examines the challenges of time and space differences in international teamwork, emphasizing the importance of cultural context and communication. Massey, Montoya-Weiss, and Hung (2003) "Because time matters: Temporal coordination in global virtual project teams" was cited 151 times during the study period. The authors focus on time coordination in virtual teams and its impact on the effectiveness of global projects. Schmidt, Montoya-Weiss, and Massey (2001) "New product development decision-making effectiveness: Comparing individuals, face-to-face teams, and virtual teams" achieved 138 citations. The article compares the decision-making process in traditional and virtual teams, highlighting differences in work effectiveness. Taras, Bryla, Caprar, Dan, Ordenana, et al. (2013), in their publication "A Global Classroom? Evaluating the Effectiveness of Global Virtual Collaboration as a Teaching Tool in Management Education," assess the effectiveness of using global virtual teams as a teaching tool in management education. This article was cited 128 times during the period under review. Gassmann, von Zedtwitz (2003), in their publication "Trends and determinants of managing virtual R&D teams," analyzes factors influencing the management of virtual R&D teams and the main trends in this field. The article was cited 128 times during the period under review.

The identified scientific publications comprised a total of 5,218 works, of which 5,080 articles remained after excluding self-citations. Most of these were based on the literature from scientific journals – a total of 3,951 items – while citations from conference proceedings accounted for 894 publications. The analysis focused exclusively on journals and conference proceedings indexed in the Web of Science

database, ensuring the international and interdisciplinary nature of the study. It is worth emphasizing that the number of citations and publications is still subject to dynamic changes due to the ongoing publication process and the indexing of new articles.

Citation analysis allows not only to identify the most influential works and authors in the researched area but also to understand the evolution of scientific knowledge in the management of virtual project teams. The emerging patterns indicate that both communication and trust, as well as leadership and effectiveness in global virtual teams, remain central research issues that have shaped the development of this field for years.

4.7. Countries and regions

For the studied group of 410 identified scientific publications, the statistics show a clear predominance of authors from the USA in terms of publications regarding the phrase "Virtual team" AND Project. Authors from this country published a total of 158 works, which constitutes 38.54% of the total number of publications in the analyzed collection. This result underscores the dominant role of the USA in developing and shaping the field of virtual team research and also indicates the high level of scientific activity and influential research centers in this country.

Second place in terms of the number of publications is occupied by the United Kingdom, whose authors published 35 papers, representing 8.54% of the total output. China comes in third, contributing 33 publications, or 8.05% of all papers included in the study. These results indicate that while the USA still leads in publication numbers, European and Asian countries are also playing a significant role in the development of virtual team project research.

Poland is also included in the ranking, ranking fourteenth, tied with Taiwan. A total of six scientific publications were identified for Polish affiliations, demonstrating that this country, despite its smaller share in the total number of publications, is also contributing to the development of the research area.

By continental analysis, North America (USA, Canada) accounts for 44.39% of all publications, Europe (UK, Germany, France, Spain, Finland, Ireland) for 29.28%, Asia (China, India) for 11.0%, and Australia for 5.61%. Other countries have a smaller, but still significant, impact on the scientific output in this area.

The analysis also shows that despite the relatively small share of publications from some countries, their presence demonstrates the globalization of research on virtual teams. These countries bring diverse methodological and contextual perspectives, which enrich the development of the entire research area. The ten most active countries are listed in Table 11.

Table 11. **Scientific contributions by country and geographic region**

No.	Country	Number of publications	% of 410 scientific publications
1	USA	158	38.54%
2	England	35	8.54%
3	Peoples R China	33	8.05%
4	Germany	30	7.32%
5	Canada	24	5.85%
6	Australia	23	5.61%
7	France	17	4.15%
8	Spain	15	3.66%
9	Finland	12	2.93%
10	India	12	2.93%
11	Ireland	11	2.68%

Source: own study

4.8. Citations by country

To better illustrate the structure of the citation network and assess the contribution of individual countries to global scientific achievements in the field of virtual project team management, a citation network was developed using VOSviewer software. This tool enables visualization of relationships between publications, authors, and scientific institutions, identifying key knowledge nodes and the level of international collaboration.

Analysis of the presented at Figure 5 pattern indicates that the most frequently cited publications come from the United States, which also ranks first in terms of the number of articles in the field under study (158 publications). An interesting phenomenon is France, which, although only ranked seventh in terms of publications (17 articles), generates a significant number of citations, ranking second in terms of scientific impact. Other countries with highly cited papers include Germany, Finland, the United Kingdom, and China. This highlights the significant role of selected research centers in shaping global knowledge and research trends, regardless of the overall number of publications in a given country.

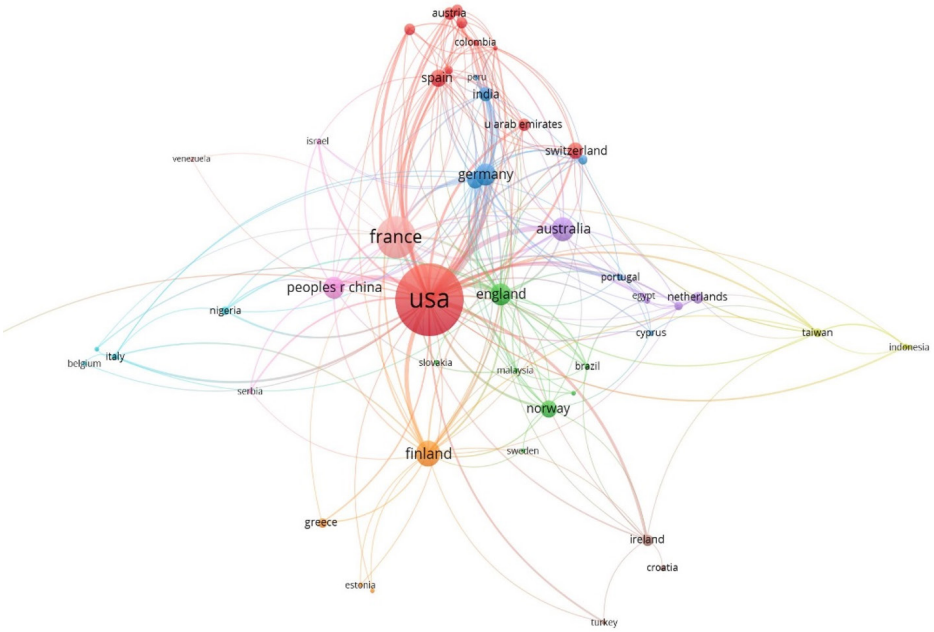

Figure 5. **Citation network by country for identified scientific works in the area of research on virtual project teams**

Source: own study

4.9. Poland compared to other countries

Further analysis revealed that six of the identified scientific works were affiliated with Polish researchers. The identified scientific works were published between 2013 and 2023. Five of the analyzed scientific works were published in scientific articles, and one was published in conference proceedings papers. Publications by Polish researchers were cited 131 times and achieved a combined h-index of 2, with an average citation rate of 21.83 per article. The list of publications is presented in Table 12.

Table 12. **List of scientific works by researchers with Polish affiliation**

No.	Author	Publication title	Year	Number of citations
1	Taras, Vas; Bryla, Pawel; Caprar, Dan V.; et al.	A Global Classroom Evaluating the Effectiveness of Global Virtual Collaboration as a Teaching Tool in Management Education	2013	128
2	Flak O., Pyszka A.	Evolution From Human Virtual Teams to Artificial Virtual Teams Supported by Artificial Intelligence. Results of Literature Analysis and Empirical Research	2022	2
3	Barnowska B., Kozaryn M.	Benefits from the implementation of project tasks with the use of virtual team	2018	1
4	Ceponiene, Galambos, Haidegger, Mikulowski, Misota, Moravcik, Nagy, Shyshkina, Smolka, Svetsky	The collaborative designing of a personalized LMS using a virtual machine in a cloud environment	2023	0
5	Potcik, Rabczak, Górny, Warmuzek, Kluska-Nawarecka	Virtual teams in the modelling and control of alloys crystallisation processes	2003	0
6	Krawczyk-Bryłka B., Nowicki K.	Team projects as preparation for virtual team collaboration	2020	0

Source: own study

The most frequently cited publication with the affiliation of a Polish researcher was the co-authored publication entitled "A global classroom? Evaluating the effectiveness of global virtual collaboration as a teaching tool in management education", which presents the results of research conducted by students of various universities around the world. It is worth emphasizing that the research leading to the discussed article took place within a virtual, intercultural team. The main conclusion is that social and cultural factors are as important for collaboration within virtual teams as technological aspects (Taras et al., 2013). Importantly, many of the authors of this publication come from different countries, which could naturally influence the reach and frequency of citations.

It should be noted that this analysis only considered journals and conference proceedings indexed in the WoS database, which significantly limited the search

results. The literature analysis conducted and presented in this dissertation indicates that publications in the research area appear in the national literature. However, the bibliometric analysis was performed using the same criteria for all research centers, which may indicate that the issue of virtual project teams in scientific publications in Poland is still in its infancy.

5. Discussion of the bibliometric analysis

The purpose of the bibliometric analysis was to examine and systematize the existing level of interest in knowledge in the area of virtual project team management. For this purpose, quantitative bibliometric analyses were conducted, as well as a content analysis of available scientific publications, focusing on specific issues of interest to researchers worldwide in relation to the research topic.

The analysis provided answers to the following questions:

1. How has the discussed idea evolved over time?
2. What fields of knowledge does the research idea pertain to?
3. Which countries and research centers are leading in relation to the research idea?
4. Are there any researchers who stand out scientifically in relation to the research idea?
5. Does the number of citations to publications in the researched field indicate researcher interest in the discussed idea?
6. How do publications from Poland in the indicated area compare to other countries?
7. What topics are discussed in the context of the research idea? 8. Does the bibliometric analysis indicate a research gap in the discussed area?

As a result of the conducted activities, 410 scientific publications in the research area were identified. These were published as scientific articles, conference proceedings, and chapters of monographs, in a total of 373 source titles.

Based on the analysis, three time periods were distinguished:

1. The period of emergence (1996 - 2000);
2. The definition period (2001 - 2010), during which the foundations of the concept of knowledge are formed and a new scientific paradigm is being formed;
3. The period of maturity and stabilization of the concept (2011 - May 2025), during which the direction of the approach's development is determined, as well as the further development of knowledge and the penetration of the concept with new concepts of information and communication technologies into industry.

Taking into account the number of researchers and the number of their scientific publications, it should be emphasized that a total of 1,200 scientists from all over the world have been/are engaged in research on virtual teams, taking into account the

concept of project management. The two leading researchers in this area are Daniel Harold and Stephanie Swartz.

Analysis of the identified keywords indicates that research on virtual project teams stems primarily from the social sciences, with a particular emphasis on the discipline of Management, and from the discipline of Computer Science, which stems from the fields of engineering, technology, and the exact and natural sciences. The leading countries in research in this area are the United States, Great Britain, and China. Analysis of search results indicates three dominant research centers worldwide: two are located in the USA (University of North Carolina and the University System of Georgia), and the third in Slovenia (University of Ljubljana). The dominant publishing house, which has published a total of 31 scientific publications containing the search phrases, is Emerald Group Publishing. Equally important publishers include Taylor & Francis, Elsevier, and Igi Global, which published 27, 26, and 25 scientific publications in the researched area, respectively. The retrieved publications were cited a total of 7,123 times, of which 6,717 were cited excluding the authors' own works, indicating significant interest in the researched topic. Comparing the number of publications and the number of citations, it can be assumed that the retrieved scientific materials are used in publications on related topics (e.g., remote work or virtual project teams).

The analysis of the selected scientific studies, due to their closest relevance to the subject matter of this study, was conducted primarily in the Web of Science domains of Business, Computer Science, and Management. Most publications fall into more than one category, so they were not divided into categories, but were considered as a single collection. The most frequently addressed issues in the researched area include:

- methods of classifying virtual project teams;
- building/creating virtual project teams and recommended practices in this area;
- productivity and effectiveness of virtual teams;
- effectiveness of leadership in virtual project teams;
- management, coordination, and improvement of virtual teams;
- competency management in virtual teams;
- roles in virtual teams;
- group decision-making;
- communication, trust, and interpersonal relationships in virtual teams;
- knowledge transfer in virtual project teams;
- success factors for projects implemented using virtual teams;
- success factors in managing virtual project teams;
- analysis of errors in projects implemented using virtual teams and their causes;
- the importance of virtual teams in the 21st century.

Additionally, the curated collection includes studies on methods for selecting members of virtual project teams, creating competency models, and models for the functioning of virtual teams. The collection also includes cross-sectional articles on trends in virtual

team management, the benefits of using virtual project teams, the impact of virtual teams on the quality of implemented projects, and ways to support organizations in managing virtual teams.

An analysis of publications with similar thematic scope confirms the conclusions presented in this study, particularly with regard to the main areas of research interest and the need to deepen the understanding of virtual project teams. This stems from the dynamic development of this area and the growing popularity of virtual forms of collaboration in business practice. Gibson et al. (2025) emphasize the need for continuous assessment, systematic feedback, and effective change management. They also point to the need to use the results of previous research as a basis for designing future organizational practices and shaping the characteristics of teams and their members. They thus emphasize the importance of continuous monitoring of research activities in this area and incorporating its findings into subsequent analyses. According to the results of a comprehensive analysis of the evolution of research topics between 1995 and 2023, conducted by Kimura (2024), a growing diversity of topics and a growing number of unique research topics can be observed. Of the sixteen identified topics, approximately half emerged in the 1990s, while the remaining began to be developed after 2000. The topic that saw the greatest increase in research interest between 2020 and 2023 was agile development. The authors' findings consistently indicate that virtual teams offer significant opportunities for multinational enterprises (MNEs), enabling them to access global talent pools and reduce costs. At the same time, they highlight similar challenges, such as managing cultural differences and ensuring effective communication (Gibson, 2025; Kimura, 2024; Feliciano-Cestero et al., 2023; Abakpa & Dvouletý, 2025).

6. Conclusions

The bibliometric analysis of scientific works in the area of virtual project team management aims to systematize existing scientific knowledge on the management of virtual project teams. To this end, various quantitative bibliometric analyses were conducted, using software tools that allowed for the presentation of knowledge flow over time, the reconstruction of the effects of scientific productivity over time in the studied area, the identification of pioneers both in terms of countries and scientific institutions, and the presentation of fields and disciplines of science related to the studied keywords. This approach allowed us to obtain an interesting picture of knowledge in the studied area.

The changing global situation caused by the COVID-19 pandemic in 2020 led to a significant increase in interest in the research topic, and the resulting shift in the mindset of employees, employers, and legislators indicates likely further development in research on remote work and the creation and management of virtual project teams.

It should be noted that the issues addressed in the scientific publications in this area are very broad and cover many aspects of managing virtual project teams.

The analyzed collection lacks clearly formulated models and methodologies for selecting members of virtual project teams. At the same time, emerging publications on virtual team management, emphasizing the required competencies of virtual team members and methods of managing them, or on communication in virtual teams and analyzing project success factors, indicate researchers' interest in the discussed topic. No methodology or model was found in the analyzed literature that clearly defines the procedure for selecting members of virtual project teams, confirming the existing research gap in this area. In traditional approaches and models of project team management, team selection focuses primarily on technical qualifications and experience in similar projects. However, in the context of virtual teams, it becomes necessary to incorporate new variables, such as the level of technological competence, adaptation to online collaboration tools, communication preferences, the ability to effectively collaborate asynchronously and build trust in a digital environment, mental resilience, and the ability to self-regulate in conditions of limited face-to-face contact. Addressing this research gap allows for the expansion of existing project management models with elements specific to digital environments and will contribute to their greater relevance in the context of digital transformation in organizations, where virtual forms of collaboration are becoming standard.The most significant criticism of the study may be that bibliometric analysis, as well as indicators of scientific productivity, and citations alone, cannot fully convey the full contribution of scientific work to the area under study. The selection of scientific publications was based solely on the Web of Science database, which, although a widely recognized and interdisciplinary data source, covers only a portion of the global scientific output. This limitation may have influenced the obtained results by excluding publications available in other databases, such as Scopus, IEEE Xplore, or Google Scholar, which may contain works with a different thematic or geographical focus. Therefore, the presented conclusions should be interpreted in the context of the data source used.

Theoretically, the study contributes to identifying the current state of knowledge regarding the concept of managing virtual project teams by analyzing trends and evolving knowledge. The results can provide an important voice in the discussion on the topic in both technical and social sciences. This can help researchers further develop their knowledge in the area under study. Reflection on the methodology for selecting virtual team members contributes to the development of an integrated approach to project management that combines classic management elements with new dimensions of work organization in the digital environment.

The relatively stable number of scientific publications since 2006 demonstrates that this remains a research topic of interest to researchers. It's worth emphasizing that further analyses require clarification and consideration of important factors emerging

in the economic environment that influence the functioning and formation of virtual project teams. Future analyses should specifically consider the impact of artificial intelligence and automation tools on collaboration in virtual teams, the specific nature of hybrid work, and the cultural and cross-cultural factors that influence differences in team communication. Incorporating these aspects would allow for a more comprehensive understanding of the dynamics of contemporary virtual teams and their effectiveness, and will therefore constitute directions for the author's further research.

Declaration of Generative AI and AI-assisted technologies in the writing process

While preparing this work, the author did not use any tool/service.

References

Abakpa, A., & Dvouletý, O. (2025). Navigating the digital era: The role of virtual teams in organizational transformation. *Asia Pacific Journal of Innovation and Entrepreneurship, 19*(3), 208–233. https://doi.org/10.1108/APJIE-08-2024-0166

Abarca, V. M. G., Palos-Sánchez, P. R., & Rus-Arias, E. (2020). Working in virtual teams: A systematic literature review and a bibliometric analysis. *IEEE Access, 8*, 168923–168940. https://doi.org/10.1109/ACCESS.2020.3023546

Abi Saad, E., & Agogué, M. (2023). Creativity in virtual teams: Systematic review, synthesis and research agenda. *Creativity and Innovation Management, 32*(1), 117–140. https://doi.org/10.1111/caim.12540

Barnowska, B., & Saniuk, S. (2017). Korzyści i zagrożenia wynikające z funkcjonowania wirtualnych zespołów projektowych [Benefits and risks arising from the functioning of virtual project teams]. *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania, 1*(43), 5–14. https://doi.org/10.18276/si.2017.43-01

Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective leadership. *Group & Organization Management, 27*(1), 14–49. https://doi.org/10.1177/1059601102027001003

Caputo, A., Kargina, M., & Pellegrini, M. M. (2023). Conflict in virtual teams: A bibliometric analysis, systematic review, and research agenda. *International Journal of Conflict Management, 34*(1), 1–31. https://doi.org/10.1108/IJCMA-07-2021-0117

Chaudhary, M., Chopra, S., & Kaur, J. (2022). Cohesion as a cardinal antecedent in virtual team performance: A meta-analysis. *Team Performance Management: An International Journal, 28*(5/6), 398–414. https://doi.org/10.1108/TPM-02-2022-0017

Chudoba, K. M., Wynn, E., Lu, M., & Watson-Manheim, M. B. (2005). How virtual are we? Measuring virtuality and understanding its impact in a global organization. *Information Systems Journal, 15*(4), 279–306. https://doi.org/10.1111/j.1365-2575.2005.00200

Colicchia, C., & Strozzi, F. (2012). Supply chain risk management: A new methodology for a systematic literature review. *Supply Chain Management: An International Journal, 17*(4), 403–418. https://doi.org/10.1108/13598541211246558

Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science, 12*(3), 346–371. https://doi.org/10.1287/orsc.12.3.346.10098

Curşeu, P., Schalk, R., & Wessel, I. (2008). How do virtual teams process information? A literature review and implications for management. *Journal of Managerial Psychology, 23*(6), 628–652.

Drabek, A. (2011). *Bibliometryczna analiza czasopism naukowych w dziedzinie nauk społecznych* [A bibliometric analysis of academic journals in the field of social sciences]. (Doctoral dissertation). Uniwersytet Śląski. https://rebus.us.edu.pl/handle/20.500.12128/4913

Ebrahim, N. A., Ahmed, S., & Taha, Z. (2009). Virtual R & D teams in small and medium enterprises: A literature review. *Scientific Research and Essays, 4*(13), 1575–1590.

Feliciano-Cestero, M. M., Ameen, N., Kotabe, M., Paul, J., & Signoret, M. (2022). Is digital transformation threatened? A systematic literature review of the factors influencing firms' digital transformation and internationalization. *Journal of Business Research, 157*, 113546. https://doi.org/10.1016/j.jbusres.2022.113546

Fink, A. (2010). *Conducting research literature reviews: From the Internet to paper* (3rd ed.). Sage Publications.

Furst, S. A., Reeves, M., Rosen, B., & Blackburn, R. S. (2004). Managing the life cycle of virtual teams. *Academy of Management Perspectives, 18*(2), 6–20. https://doi.org/10.5465/ame.2004.13837468

Gassmann, O., & von Zedtwitz, M. (2003). Trends and determinants of managing virtual R&D teams. *R&D Management, 33*(3), 243–262. https://doi.org/10.1111/1467-9310.00296

Gibson, C. B., Grushina, S. V., & Takahashi, K. (2025). Global virtual work: A review, integrative framework, and future research opportunities. *Journal of International Business Studies, 56*, 691–719. https://doi.org/10.1057/s41267-024-00789-2

Gilson, L. L., Maynard, M. T., Jones Young, N. C., Vartiainen, M., & Hakonen, M. (2015). Virtual teams research: 10 years, 10 themes, and 10 opportunities. *Journal of Management, 41*(5), 1313–1337. https://doi.org/10.1177/0149206314559946

Grajewski, P. (2007). *Organizacja procesowa. Projektowanie i struktura* [Process-Oriented Organization. Design and Structure]. PWE.

Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. *MIS Quarterly, 27*(2), 265–287. https://doi.org/10.2307/30036531

Goodbody, J. (2005). *Critical success factors for global virtual teams*. Retrieved January 3, 2017, from https://pl.scribd.com/document/40079703/Critical-Success-Factors-for-Global-Virtual-Teams

Harniak, I. (2008). *e-Przedsiębiorczość – telepraca i usługi zdalne* [E-Entrepreneurship: Telework and Remote Services]. Małopolska Agencja Rozwoju Regionalnego.

Hung, S., Cheng, M., Hou, C., & Chen, N. (2021). Inclusion in global virtual teams: Exploring non-spatial proximity and knowledge sharing on innovation. *Journal of Business Research, 128*, 599–610. https://doi.org/10.1016/j.jbusres.2020.11.022

Jagoda, A., & Kołakowski, T. (2017). Zarządzanie projektami na przykładzie japońskiego lidera łańcucha dostaw – studium przypadku [Project Management Illustrated by a Japanese Supply Chain Leader: A Case Study]. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 463*, 158-170.

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science, 10*(6), 791–815. https://doi.org/10.1287/orsc.10.6.791

Kayworth, T. R., & Leidner, D. E. (2001). Leadership effectiveness in global virtual teams. *Journal of Management Information Systems, 18*(3), 7–40. https://doi.org/10.1080/07421222.2001.11045697

Kimura, T. (2024). Virtual teams: A smart literature review of four decades of research. *Human Behavior and Emerging Technologies, 2024*(1), Article 8373370. https://doi.org/10.1155/2024/8373370

Lipnack, J., & Stamps, J. (2000). *Virtual teams: Reaching across space, time, and organizations with technology*. John Wiley & Sons.

Markowska, M. (2004). Modele optymalizacyjne ze zmiennymi binarnymi – problem podziału projektów (case study) [Binary-Variable Optimization Models: A Case Study of the Project Allocation Problem]. *Zeszyty Naukowe Wałbrzyskiej Wyższej Szkoły Zarządzania i Przedsiębiorczości, 2*, 63-72.

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here? *Journal of Management, 30*(6), 805–835. https://doi.org/10.1016/j.jm.2004.05.002

Massey, A. P., Montoya-Weiss, M. M., & Hung, Y. T. (2003). Because time matters: Temporal coordination in global virtual project teams. *Journal of Management Information Systems, 19*(4), 129–155. https://doi.org/10.1080/07421222.2003.11045742

Maznevski, M. L., & Chudoba, K. M. (2000). Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science, 11*(5), 473–492. https://doi.org/10.1287/orsc.11.5.473.15200

Michalczyk, L. (2013). Zespoły wirtualne – analiza przypadku [Virtual' team - case analysis]. *Zarządzanie Przedsiębiorstwem, 16(3), 4-0-45*.

Nicholas, J. M., & Steyn, H. (2008). *Project management for business, engineering and technology: Principles and practice*. Elsevier.

Nordenflycht, A. (2010). What is a professional service firm? Towards a theory and taxonomy of knowledge-intensive firms. *Academy of Management Review, 35*(1), 155–174.

Pinoczek, P. (2019). Współczesne dylematy kierownika projektu w zarządzaniu wirtualnym zespołem projektowym [Contemporary Challenges Faced by Project Managers in Managing Virtual Project Teams]. In M. Lis & J. Zawiła-Niedźwiecki (Eds.), *Organizacja projektowa i zarządzanie projektami* [Project-Based Organization and Project Management] (pp. 87-96). Wydawnictwo Naukowe Akademii WSB.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *The Database for Advances in Information Systems, 35*(1), 6–36. https://doi.org/10.1145/968464.968467

Purvanova, P. K., & Kenda, R. (2022). The impact of virtuality on team effectiveness in organizational and non-organizational teams: A meta-analysis. *Applied Psychology, 71*(3), 1082–1131. https://doi.org/10.1111/apps.12348

Purvanova, R. K., & Bono, J. E. (2009). Transformational leadership in context: Face-to-face and virtual teams. *The Leadership Quarterly, 20*(3), 343–357. https://doi.org/10.1016/j.leaqua.2009.03.004

Radziszewski, P. (1998). Outsourcing. Komputeryzacja bez komputerów [Outsourcing. Computerization without computers].*PCKurier, 21*.

Rosiński, J. (Ed.). (2003). *Zarządzanie projektem. Model najlepszych praktyk* [Managing Projects: A Best-Practice Framework]. IFC Press.

Sarker, S., & Sahay, S. (2004). Implications of space and time for distributed work: An interpretive study of US–Norwegian systems development teams. *European Journal of Information Systems, 13*(1), 3–20. https://doi.org/10.1057/palgrave.ejis.3000485

Schmidt, J. B., Montoya-Weiss, M. M., & Massey, A. P. (2001). New product development decision-making effectiveness: Comparing individuals, face-to-face teams, and virtual teams. *Decision Sciences, 32*(4), 575–600. https://doi.org/10.1111/j.1540-5915.2001.tb00973.x

Strozzi, F., Colicchia, C., Creazza, A., & Noè, C. (2017). Literature review on the 'Smart Factory' concept using bibliometric tools. *International Journal of Production Research, 55*(22), 6572–6591. https://doi.org/10.1080/00207543.2017.1326643

Tasdemir, D. D., Surucu, L., & Bekmezci, M. (2025). The moderating role of leader–member exchange in the effect of role clarity on employee accountability. *Management, 29*(1), 467–491. https://doi.org/10.58691/man/204739

Taras, V., Caprar, D. V., Rottig, D., Sarala, R. M., Zakaria, N., Zhao, F., Jiménez, A., Wankel, C., Lei, W. S., Minor, M. S., Bryła, P., Ordeñana, X., Bode, A., Schuster, A., Vaiginiene, E., Froese, F. J., Bathula, H., Yajnik, N., Baldegger, R., & Huang, V. Z. (2013). A global classroom? Evaluating the effectiveness of global virtual collaboration as a teaching tool in management education. *Academy of Management Learning & Education, 12*(3), 414–435. https://doi.org/10.5465/amle.2012.0195

Thuong, N. (2019). Virtual teams in the digital age. *Hue University Journal of Science: Economics and Development, 128*(5C), 67–80.

Trippner, M. (2014). Wybrane determinanty doboru pracowników do zespołów zadaniowych aktywnym źródłem formułowania polityki marketingowej firmy [Key Determinants in Selecting Employees for Task Teams as a Basis for Shaping Corporate Marketing Policy]. *Przedsiębiorczość i Zarządzanie, 15*(4/2), 9-19.

Trippner-Hrabi, J., & Stroińska, E. (2015). Wykorzystanie zespołów w działaniach outsourcingowych [Application of Teams in Outsourcing Operations]. *Przedsiębiorczość i Zarządzanie, 16*(5/2), 127-137.

Wąsowicz, M. (2008). Wpływ technologii informacyjno-telekomunikacyjnych na zarządzanie projektami w przedsiębiorstwie [The Impact of Information and Telecommunication Technologies on Project Management in Enterprises]. *Studia i Prace Uniwersytetu Ekonomicznego w Krakowie, 1*(2), 616-623.

Webster, J., & Wong, W. K. P. (2008). Comparing traditional and virtual group forms: Identity, communication and trust in naturally occurring project teams. *The International Journal of Human Resource Management, 19*(1), 41–62. https://doi.org/10.1080/09585190701763883

Youssef, M. F., Eid, A. F., & Khodeir, L. M. (2023). Challenges affecting efficient management of virtual teams in construction in times of the COVID-19 pandemic. *Ain Shams Engineering Journal, 14*, 102008. https://doi.org/10.1016/j.asej.2022.102008

Zhao, D., & Strotmann, A. (2015). *Analysis and visualization of citation networks* (Vol. 7). Synthesis Lectures on Information Concepts, Retrieval, and Services. Morgan & Claypool. https://doi.org/10.2200/S00624ED1V01Y201501ICR039

Zheng, S., Yan, M., Liang, Y., Chen, Y., Wei, Q., & Li, S. (2024). Understanding the positive and negative effects of team virtuality: A theoretical review and research agenda. *Human Resource Management Review, 34*(2), 2–18. https://doi.org/10.1016/j.hrmr.2024.101013