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Bibliometric Analysis of Barriers to Telework in Industrial Companies

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Abstract

Telework has received considerable interest as a contemporary work organization method, especially in knowledge-intensive sectors. Nevertheless, its implementation in industrial companies is still limited owing to several operational barriers. This research performs a bibliometric analysis to examine the literature on telework barriers in industrial companies. A total of 2570 records were obtained from Web of Science and Scopus databases (2016–2025), of which 234 publications were included. Bibliometric analysis was performed using Python. Analysis shows a sharp increase in telework-related publications from 2016 and beyond, peaking in 2022 and 2025. Hybrid work patterns, industry variations, and long-term implications on productivity and security need to be examined in greater depth.

Keywords
Telework, Barriers, Industrial companies, Bibliometric analysis, Python.

1. Introduction

Telework, or more popularly, remote work, has become one of the modern approaches to work organization, based on advances in communication and information technologies. Benefits related to teleworking include increased flexibility, reduced commuting time and expenses, cost savings, and better work-life balance(Allen et al., 2015). However, although telework finds wide application in industries such as information technology, its application within industrial companies and manufacturing is still relatively scarce(Fontaneda et al., 2023). These sectors involve different operational characteristics and comprise physical tasks requiring special equipment that are not easily teleworked, hence introducing considerable barriers to telework (Orzeł & Wolniak, 2022). The current study represents an exploratory investigation into the landscape of telework research through a bibliometric analysis whereby 2570 records were collected from Web of Science and Scopus databases for publications between 2016 and 2025, and, after inclusion and exclusion criteria were applied, 234 papers.

Furthermore, the aspects under review in the analysis are subject areas, publication trends over time, prevailing keywords, leading authors, and the geographical distribution of research activity. Identifying the barriers to teleworking(IWANIUK et al., 2021). The literature points to several well-known impediments, including inadequate access to required technology (Wahl et al., 2024), insufficient infrastructure (Numano et al., 2019), and various complications in the provision of effective collaboration and remote communication (Lee et al., 2024). Moreover, challenges such as data security concerns (Mihailović et al., 2021), employee well-being issues(Kasperska et al., 2024)

.Unsuitable home workplaces discourage telework adoption (Cuerdo-Vilches et al., 2021). This situation requires adequate remedies pertinent to the needs of the industrial companies.

Consequently, results of bibliometric analysis with Python indicate growth in telework research, with significant spikes in 2022 and 2024. This testifies to the ever-growing interest of scholars in the topics of teleworking, particularly within industrial contexts. The most popular terms give evidence of interest in the operational and technological issues of teleworking and its influence on organizational structure, employee welfare, and productivity. In the same vein, the concentration of research activities in some broad areas acts as a pointer to global attention to opportunities and challenges introduced by the adoption of teleworking across industries.

In particular, the present contribution highlights some of the leading authors who have been rewarded in the area for their valuable contributions to developing teleworking research. The findings indicate that teleworking research enjoys a growing centrality in academic and practical discourse, given that practice and barriers pose high industrial interest. Thus, this stream of literature has shown that the flow is increasingly wide, reflecting the relevance of teleworking in current work environments when industries seek solutions to many challenges arising from continuously developing work habits and technologies.

This paper is organized as follows: Following the introduction, Section 2 describes the methodology, discussing in detail the process of bibliometric analysis against the background of the literature review process flowchart. These include data collection procedures, inclusion/exclusion criteria, and processes employed in the bibliometric analysis to obtain emerging trends within the literature. Section 3 presents the findings, such as the primary results of the bibliometric analysis using Python, with a particular focus on telework trends across industries. Section 4 presents the findings in detail, addressing the research questions and investigating the potential implications of telework. Section 5 concludes the paper with suggestions for further research.

2. Methodology

This part describes the methodology used in this study, which employs a bibliometric analysis for the identification of industrial companies' telework barriers. Analysis is made from a literature review process, after which studies on telework adoption were screened through broad scientific database searches. This kind of method allowed for the identification of dominant trends, contributors, and emergent themes to the discipline. The research has been conducted through the following questions:

Q1: What are the leading trends in research on the challenges of telework for industries up to 2025?

Q2: Which countries, journals, and keywords have been the leading contributors to the literature on the challenges of telework for industrial companies during this time?

Q3: What are the most frequently cited barriers to telework in the literature?

2.1. Data collection

Given the robustness and comprehensive coverage of the research data, both Web of Science with Scopus databases were selected to serve as main sources. However, the purpose of using both is to bring a more comprehensive aspect into view in terms of literature, capturing a wide range of publications, citations, and trends of research. This approach minimizes the possibility of losing major studies and strengthens the reliability of the bibliometric analysis.

The keywords were (("barriers" OR "challenges" OR "boundaries") AND ("telework" OR "remote work" OR "telecommuting") AND (“industrial companies" OR "manufacturing firms" OR “industrial organizations")). The search in both databases was performed using an "All Fields" option for comprehensiveness. Thereafter, 218 records were obtained from Scopus and 672 from the WoS database. The refinement of results entailed including only those records that met the criteria outlined in Table 1.

Table 1. Inclusion and exclusion criteria

	Criteria	**Justifications**
Inclusion	Publication (2016-2023)	Emphasis on recent studies to capture current trends and findings.
	English Language	Ensures broad accessibility and relevance in academic publications.
	Peer-Reviewed Journals Conference Papers	Focus on high-quality, validated research
	Studies on Barriers to Telework in Industrial Companies	Includes both theoretical and empirical papers to cover diverse perspectives.
Exclusion	Non-Peer-Reviewed Publications	Excludes working papers, technical reports, book chapters, and reviews to maintain high-quality standards.
	Lacking generalization or broader applicability	Enhancing the overall impact and usefulness of the analysis

After applying the filtering criteria, the search results were narrowed down to 138 papers in Scopus and 96 papers in the Web of Science.

2.2. Data Analysis: methods and tools

Bibliometric analysis, a quantitative approach to the assessment of scientific research presented by Pritchard (Pritchard A, 1969), has since become a widely accepted standard. One of the most basic tools in this approach, co-citation analysis, has been employed since 1973 to trace the structural properties of scientific communication and its interdisciplinary linkages (OSAREH, 1996). Co-word analysis, presented in 1983, examines the process of evolution of terminology within scientific publications (Ding et al., 2001). This technique lets researchers trace emerging trends and tendencies using keyword and cluster analysis.

The data were collected from two large databases, Web of Science and Scopus, for the bibliometric analysis of telework. Python with pandas, matplotlib, and PyBibx libraries were applied to the filtering of data, while co-citation and co-keywords were used to provide insights into developments, collaborations, and emerging research areas (Pereira et al., 2025). The analysis framework is illustrated in Figure 1.

To achieve a bibliometric analysis, the three-stage process was utilized. Stage one involved the retrieval of the articles from Scopus and Web of Science, through a full keyword search using terms associated with barriers ("barriers," "challenges," "boundaries",) telework ("telework," "remote work," "telecommuting") and the industrial sector ("industrial companies," "manufacturing firms," "industrial organizations"). The first stage provided 1,572 articles sourced from Scopus and 998 articles sourced from Web of Science. In the second phase, particular inclusion and exclusion criteria were applied to facilitate the relevance and quality of articles. In total, there were 138 articles retrieved from Scopus and 96 articles retrieved from Web of Science. The third and final stage of preparing the dataset by the study objectives.

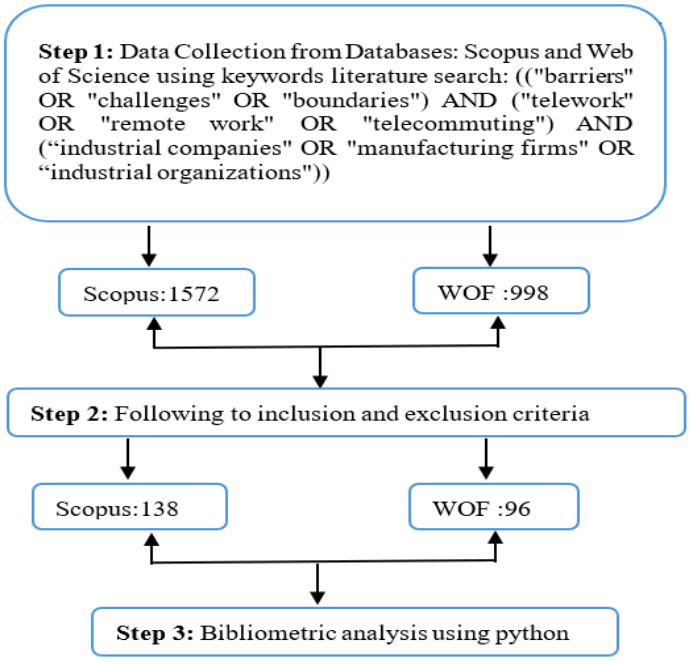

Figure 1. Literature review process

3. Results And Discussion

3.1. Results

Authors

A collaboration network of authors in the research field is presented in Figure 2. Authors are depicted as nodes, and name clustering and closeness represent the strength of their collaborative connection. The inner cluster depicts highly interconnected authors, such as Alain Rallet, Yvonne Lücke de Luis Carnicer, and Laurent Prolhac, representing high co-authorship and high collaboration network intensity. In contrast, several smaller, more dispersed clusters—such as those containing the other hand, several loose, smaller clusters, such as those involving S.C. Payne and T.W. Greer or Xi Wen Chan and Y. Lott, are indicative of more separated research groups from the core network. Separated clusters indicate individual research or specialized subfields within the area.

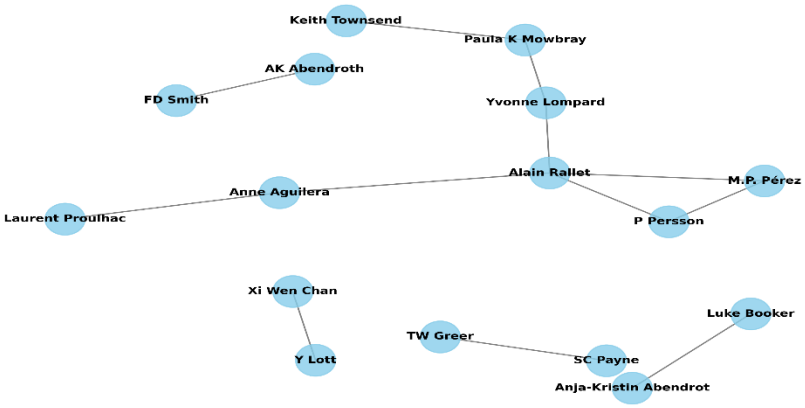

Figure 2. The Authors' network of leading researchers in studies

- **Keywords**

The network graph presented in Figure 3 captures a unified view of the primary concepts and their connections in the landscape of remote work research. In the diagram, the nodes are the main concepts contained in the important themes, i.e., "Working from Home," "Telecommuting," "Hybrid Work," and "Work-Life Balance," with the connections between the topics indicated by the edges. Generally, thicker edges give an impression of the resources, and the interdisciplinary nature of the research emphasis represents the diversity of fields, issues, sub-issues, topics, and perspectives.

Overall, the central strength of the relationships suggests that the concepts "Challenges," "Effectiveness," and "Barriers" are relatively strong associations with the two clusters, "Remote Work" and "Telecommuting." This inevitably suggests agreements and convergence across, as opposed to distinction in current studies on remote work policy and its effects. The graph also indicates that there is a node for "Pandemic," asserting the significant impact of COVID-19 on what is being researched right now about remote work dynamics. Relatively speaking, the graph delineates subject areas and abstractions of the collaborated premises while coupling specific barriers—technological, psychological, and organizational—with the notion of remote work.

For instance, the terms "challenges" and "barriers" may have implied technological and psychological issues to address, respectively, when crossing connections, also to work-life balance and organizational flexibility. Each has their authored barriers as to what significant work may encompass, supporting a skill in synthesizing all of that thinking around telework in an industrial company context to explore barriers between current teleworking and to ultimately establish an informed workplace ambient workplace.

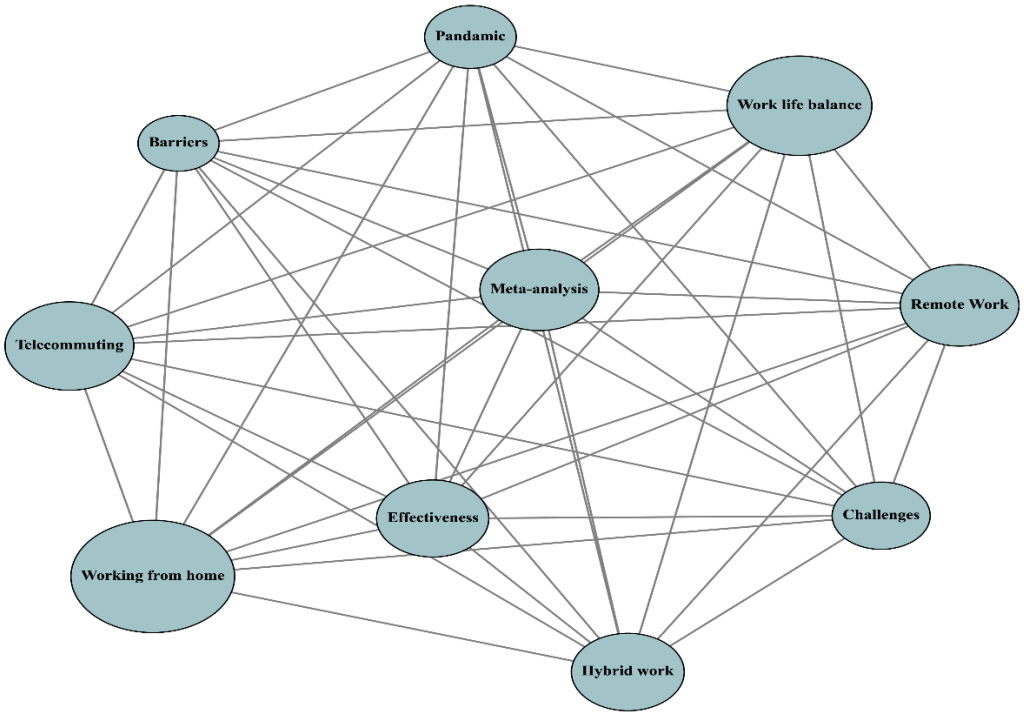

Figure 3. Trending keywords

- **Yearly publications**

The pattern for the quantity of papers published in Scopus and WoS between 2016 and 2025 is shown in Figure 4. The publications of each year are plotted against the number of publications: a blue line with circle markers for Scopus, and an orange line with square markers for WOS.

Every year, Scopus has shown that publication numbers were continually increasing, showing an upward trend from 7 papers in 2016 to 22 in 2025. Web of Science (WOS) shows publication numbers follow a similar trend from 5 to 18 papers between 2016 and 2025; however, there is a little more fluctuation in the WOS numbers (the decreased publications in 2017 are an example). The years from 2019 to 2021 for both databases show the upper trend of ever-increasing publication output.

However, from 2022 to 2025, there was a marked jump in publication numbers in both databases. Several forces could jointly drive all these also to a sustained growth in publication numbers, including the expansion of interdisciplinary research areas such as telework and digital transformation, the COVID-19 pandemic acting as a catalyst, a focus on institutional-level productivity of research, indexing variations, and an overall increasing breadth and depth in the spread of research in those years.

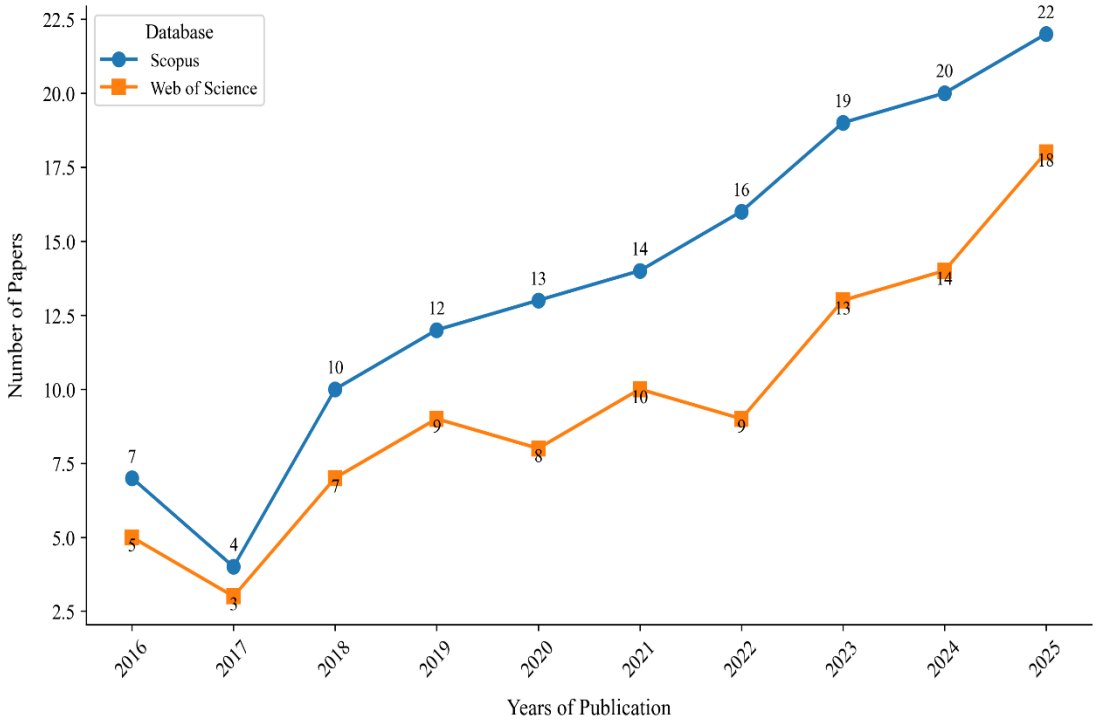

Figure 4. Annual publication trends in Scopus and WOF (2016-2025)

- **Subject area**

The proportion of research fields in papers on barriers to telework among industrial companies is presented in Figure 5. Remote Sensing (34.4%) had the highest overall publication rate regarding telework barriers and therefore illustrates a significant focus on monitoring and data-gathering technologies to inform remote workplaces. This substantial focus is unmistakable; however, it remains underexamined what the implications of there being so much interest in Remote Sensing are, and how directly it relates to telework barriers in practice. For example, it would strengthen the discussion to include examinations of how Remote Sensing informs the monitoring of productivity, the management of distributed teams, and the security aspects of telework.

Environmental Studies (18.6%) and Psychology (18.5%) are similarly noteworthy with substantial shares of the literature seen in these areas given their representation of the environmental conditions of telework, by way of considerations for the environmental effects of telework, and for the psychology of employees encountered with stress, well-being, and work-life balance. In this regard, the discussion does not effectively justify why these areas attracted significant interest in comparison to other scholarships, nor how their findings inform strategies to navigate telework barriers.

The area of Engineering (11.1%) addresses telework barriers about infrastructure and technological issues, for instance, workspace transformation, connectivity, and cybersecurity threats. In this sense, the analysis is limited; there is little evidence regarding the implications of such research for practitioners, more specifically, in regard to industrial organizations engaged in or experiencing telework. Research framed in the viewpoint of Energy (5.8%) recognizes

and addresses energy consumption and sustainability regarding remote working arrangements, but there is limited clarity about how these perspectives contribute to the overall discussion regarding telework barriers.

In Management, 3.7% of articles relate to matters of organizational strategy, leadership challenges, and performance measurement rates while teleworking. Even so, the research has not adequately addressed why the relatively small percentage of Management research exists, and if it contributes to gaps in our understanding of telework. Finally, "Others" (1.3%) represents contributions beyond specific disciplinary boundaries and multiple boundaries concurrently. Although this signifies a potentially rich but fragmented literature, the analysis does not give sufficient detail about the content of these papers and how they might contribute to building knowledge in a more succinct, useful way.

This distribution illustrates the numerous scholarly interests in telework barriers within industrial companies. However, technical and environmental research dominance suggests managerial, organizational, and policy-related research is comparatively low. More comprehensive research design encompassing multiple disciplines could provide a full understanding of the challenge and potential solutions towards effective telework realization within industry contexts.

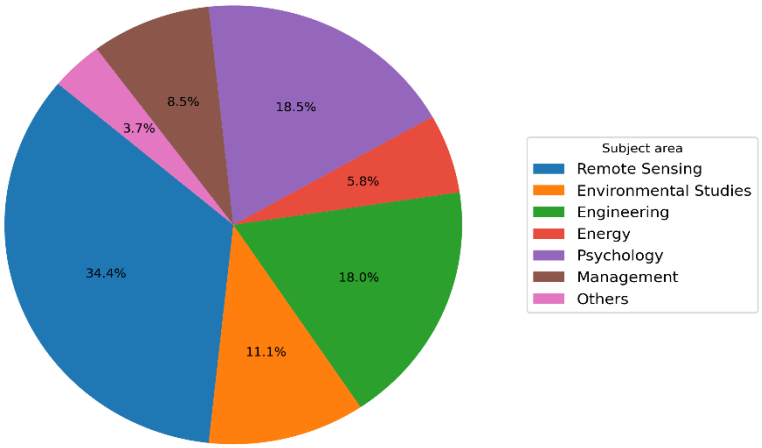

Figure 5. Distribution of subject areas in research on barriers to telework in industrial companies

3.2. Discussion

In the industry, four key themes relating to barriers to telework are: Infrastructure, Security Concerns, Employee Preference, and Technological barriers, presented in Figure 6. Security Concerns have the most weight at 78, while cyber threats and breaches have also been cited as the greatest impediment to implementing remote work in industrial settings. Closely following are Technological, with a rating of 58, indicating limited access to high-end automation tools and weak digital infrastructure as hindrances to smooth remote operations. Infrastructure with a rating of 57 also features prominently as it includes major concerns of digital connectivity, network stability, and limited physical workspace. Employee preferences rated the least critical among the four factors had the least impact, as indicated by the score of 41; despite worker resistance to digital transformation, it is not as important as other technical and security challenges. In general, the findings illustrate the very compelling need to address concerns related to security and technology to enable a smoother transition to telework for industrial sectors.

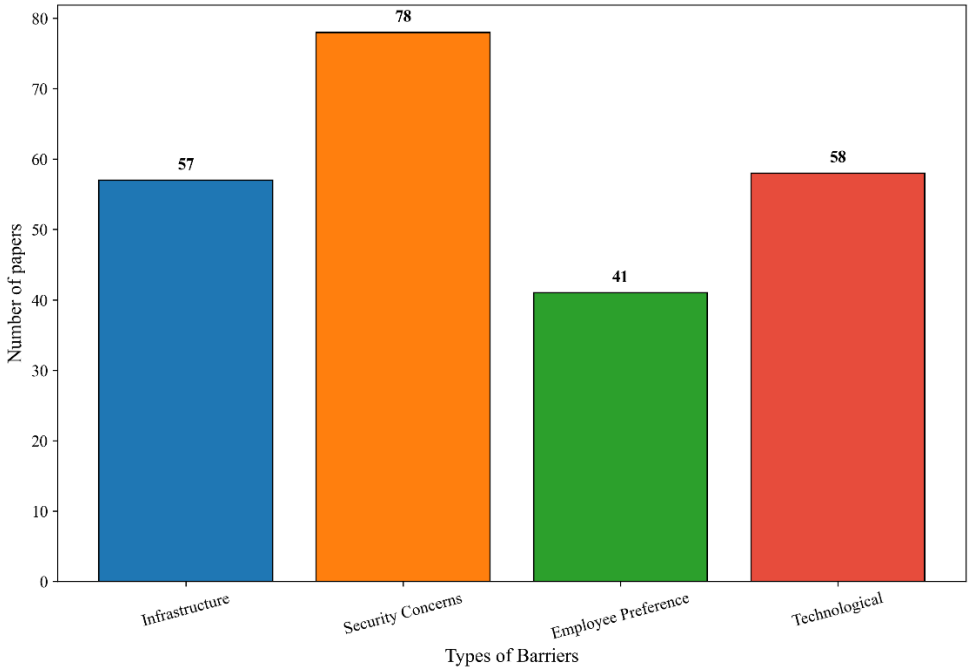

Figure 6. Types of barriers

At the same time, the rise of Industry 5.0 allows for an array of prospects to alleviate these challenges and increase the feasibility of telework among industrial applications. Industry 5.0 is focused on human-machine collaboration, sustainability, and resilience, making it more flexible for telework integration than Industry 4.0, which caused harsh pauses at full automation. Therefore, the successful integration of advanced robotics, AI, digital twins, and IoT-based monitoring systems will facilitate remote supervision and management of production processes that respect the workflow via a solution to some technological limitations and infrastructural challenges that exist at present in the industrial setting.

Moreover, industry 5.0 offers an avenue for building smart factories in which automation and human expertise work in synergy. In this regard, it can relieve several of the physical constraints of telework through remote monitoring, predictive maintenance, and decentralized decision-making. Despite this, for its successful enactment, critical issues such as increased cybersecurity, reskilling of the workforce, and thorough investment into digital infrastructure must be solved to enable remote collaborative work. The bounteous interaction of telework strategies within the principles of Industry 5.0 suggests some solutions to the still-existing barriers faced by industrial settings to develop organizational cultures that are adaptable, resilient, and sustainable. Future research should establish exactly how much this technology can be expanded across various industry blocks, alongside designing hybrid work models that allow on-site operational demands with flexibility for off-site work.

5. Conclusion

This bibliometric analysis of telework barriers in industrial companies presents interesting findings that reflect the increased interest and progress of telework research in the industrial sector. Findings of Scopus and Web of Science databases reveal some common prevailing themes like security problems, technological problems, infrastructural problems, and attitudes of workers as main barriers to telework adoption in industrial firms. The use of Python-based analysis determined the leading subjects and themes among telework studies, where focus is directed on technological and functionality aspects, together with organizational behavior. Results are indicative of the visible growth of publications year-by-year, most notably in the years 2022 and 2024, which can indicate a rising university interest in probing the consequences of telework across industrial corporations.

Therefore, keywords analysis and author collaboration networks confirm the interdisciplinarity of the research in that underlying themes such as cybersecurity, automation, and remote work technology provide the bases for further detailed exploration. Research geographical distribution also confirms the centering role played by distribution

countries, while also testifying to the need for globalized solutions to telework problems. On a barrier basis, the study confirms that industrial companies view security matters, technological limitations, and infrastructure as their most relevant concerns. Security concerns, in particular cyberattacks, were seen to be the top hindrance, followed closely by technological and infrastructural concerns. Employee requirements, while important, ranked lower compared to the infrastructural and security-related concerns.

The application of industry 5.0 principles provides a feasible solution to overcome these challenges, particularly through human-machine collaboration, sustainability, and the application of advanced technologies like AI, IoT, and digital twins. Industry 5.0 has the potential to enable the same flexibility and responsiveness in a telework modality that surmounts technological as well as infrastructure-related barriers. To do so, however, enormous investments have to be undertaken in cybersecurity, skilling and reskilling people, and digital infrastructure.

5.1 Future Research Directions

Exploring Industry 5.0's role in crossing barriers: Future studies must investigate how industry 5.0 technologies can lower existing barriers to telework in manufacturing. Studies must examine how these technologies can support remote supervision, ease digital collaboration, and enable effective production management in remote offices.

Geographic and Sectoral Variations: Geographic scope needs to be widened to understand the methods through which different geographies and sectors are adopting telework. Cross-industry comparison studies with different operating needs can be utilized to understand sector-specific problems and solutions.

Workplace Design and Employee Well-being: Future studies should be carried out to examine the psychological and well-being aspects of teleworking, especially in an industrial setting. Studies may consider how the teleworking locations can be designed to promote employees' health, work-life balance, and work productivity, especially when the employees are subjected to higher isolation and stress.

Hybrid Work Models in industrial Settings: Experimentation and development of hybrid work models that harmonize on-site and off-site work could be a different line of inquiry. The models need to consider the requirements of operations, the degree of complexity that industrial operations entail, and how off-site work is evolving.

Long-term impact of telework on productivity and Security: Long-term studies can give valuable information about the impact of telework on productivity, business performance, and business effectiveness in industrial companies. The study can also identify long-term security threats related to off-site work and how they can be effectively countered.

Through these loopholes, future studies can provide even more insight into the optimal way telework can be leveraged within industrial settings and lead to more sustainable, more resilient, and more efficient workplaces.

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Biography

Sirine Bouaziz is currently a Ph.D. candidate in industrial engineering at the Higher Institute of Industrial Management of Sfax (ISGIS), Tunisia. Recently, she obtained her master's degree in industrial systems and logistics from the same institution. Her research focuses on telework efficiency barriers in Industry 5.0, with a particular interest in industrial digital transformation, data science, telework adoption challenges, and Industry 5.0 applications. Dr. Bouaziz is an active member of IEEE and has participated in various academic and professional training programs, including ERP systems, crisis management, LaTeX, and machine learning. She is skilled in quantitative data analysis using Python and applies econometric modeling techniques in her research. She has contributed to academic conferences and publications in the fields of industrial engineering, operations management, and workplace digitalization.