



Nothing will be the same: a comparative review of the scientific literature on remote work before and after COVID-19

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Authors' notes

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Abstract

Objective: The aim of this study is to analyze the evolution of the scientific literature on remote work by comparing the periods before and after the COVID-19 pandemic, to understand how the pandemic has reconfigured work dynamics and propelled research in new directions.

Methodology: We employed a bibliometric approach, utilizing visual maps generated by VOSviewer based on data indexed in the Web of Science. This methodology allowed us to illustrate trends and paradigmatic changes in remote work research, providing a detailed comparative analysis of the two periods in question.

Originality/Relevance: A theoretical gap related to understanding the transformations in remote work in response to the COVID-19 pandemic is addressed. The academic relevance lies in the need to comprehend these changes to guide future research and work practices.

Results: The results indicate an exponential increase in the number of annual publications on remote work, as well as a shift in research focuses, evidencing an evolution in theoretical and practical approaches to the topic.

Theoretical/Methodological Contributions: The study contributes to the existing literature by offering a comparative view of the evolution of research on remote work and highlighting how the COVID-19 pandemic served as a turning point in academic and professional discussions on the subject.

Social/Management Contributions: The insights generated by this study have significant implications for researchers, practitioners, and policymakers, providing a solid foundation to navigate and shape the future of work in a digital and flexible context. It highlights the importance of adapting work practices to the new realities imposed by the pandemic.

Keywords: remote work, COVID-19, telecommuting, digital transformation, systematic literature review

Resumo

Nada será como dantes: uma revisão comparativa da literatura científica acerca do trabalho remoto antes e depois da COVID-19

Objetivo: Este trabalho visa analisar a evolução da literatura científica sobre o trabalho remoto, comparando os períodos antes e após a pandemia de COVID-19, para entender como a pandemia reconfigurou as dinâmicas de trabalho e impulsionou novas direções de pesquisa.



Metodologia: Empregamos uma abordagem bibliométrica, utilizando mapas visuais gerados pelo VOSViewer com base em dados indexados na Web of Science. Essa metodologia permitiu-nos ilustrar tendências e mudanças paradigmáticas na pesquisa sobre trabalho remoto, oferecendo uma análise comparativa detalhada dos dois períodos em questão.

Originalidade/Relevância: O estudo se insere em um gap teórico relacionado à compreensão das transformações no trabalho remoto em resposta à pandemia de COVID-19. A relevância acadêmica reside na necessidade de entender essas mudanças para orientar futuras pesquisas e práticas de trabalho.

Resultados: Os resultados indicam um aumento exponencial no número de publicações anuais sobre trabalho remoto, bem como uma mudança nos focos de pesquisa, evidenciando uma evolução nas abordagens teóricas e práticas sobre o tema.

Contribuições teóricas/metodológicas: O estudo contribui para a literatura existente ao oferecer uma visão comparativa da evolução da pesquisa sobre trabalho remoto, destacando como a pandemia de COVID-19 serviu como um ponto de inflexão nas discussões acadêmicas e profissionais sobre o tema.

Contribuições sociais/para a gestão: Os insights gerados por este estudo têm implicações significativas para pesquisadores, profissionais e formuladores de políticas, fornecendo uma base sólida para navegar e moldar o futuro do trabalho em um contexto digital e flexível, e destacando a importância de adaptar as práticas de trabalho às novas realidades impostas pela pandemia.

Palavras-chave: trabalho remoto, COVID-19, teletrabalho, transformação digital, revisão sistemática de literatura

Resumen

Nada será como antes: una revisión comparativa de la literatura científica sobre el trabajo remoto antes y después de la COVID-19

Objetivo: Este trabajo tiene como objetivo analizar la evolución de la literatura científica sobre el trabajo remoto, comparando los períodos antes y después de la pandemia de COVID-19, para entender cómo la pandemia reconfiguró las dinámicas laborales e impulsó nuevas direcciones de investigación.

Metodología: Empleamos un enfoque bibliométrico, utilizando mapas visuales generados por VOSViewer basados en datos indexados en la Web of Science. Esta metodología nos permitió

ilustrar tendencias y cambios paradigmáticos en la investigación sobre el trabajo remoto, ofreciendo un análisis comparativo detallado de los dos períodos en cuestión.

Originalidad/Relevancia: El estudio se inserta en una laguna teórica relacionada con la comprensión de las transformaciones en el trabajo remoto en respuesta a la pandemia de COVID-19. La relevancia académica reside en la necesidad de entender estos cambios para guiar futuras investigaciones y prácticas laborales.

Resultados: Los resultados indican un aumento exponencial en el número de publicaciones anuales sobre trabajo remoto, así como un cambio en los enfoques de investigación, evidenciando una evolución en los abordajes teóricos y prácticos sobre el tema.

Contribuciones teóricas/metodológicas: El estudio contribuye a la literatura existente al ofrecer una visión comparativa de la evolución de la investigación sobre el trabajo remoto, destacando cómo la pandemia de COVID-19 sirvió como un punto de inflexión en las discusiones académicas y profesionales sobre el tema.

Contribuciones sociales/para la gestión: Los conocimientos generados por este estudio tienen implicaciones significativas para investigadores, profesionales y formuladores de políticas, proporcionando una base sólida para navegar y dar forma al futuro del trabajo en un contexto digital y flexible, y destacando la importancia de adaptar las prácticas laborales a las nuevas realidades impuestas por la pandemia.

Palabras clave: trabajo remoto, COVID-19, teletrabajo, transformación digital, revisión sistemática de la literatura

Nothing will be the same: a comparative review of the scientific literature on remote work before and after COVID-19

The emergence of remote work, a phenomenon dating back to the 1970s, gained notable centrality and relevance during the COVID-19 pandemic, a period in which restrictions and lockdowns made its adoption imperative for labor and educational activities (Ozimek, 2020). This large-scale abrupt transition fostered renewed academic interest, catalyzing an exponential increase in scientific production focused on remote work.

It is thus essential to analyze the emerging transformations and trends in this field of study,



as well as to map the predominant areas of growth. Such an understanding is crucial to deciphering both the legacies left by pre-existing literature and the responses and strategies proposed to face current and future challenges and questions within organizations (Henry et al., 2021).

Set against this backdrop, this article proposes to conduct a bibliometric analysis, employing the VOSviewer tool to extract and visualize the frequency and relationships between concepts associated with remote work. The aim is to ascertain the dynamics and transformations in the study of this phenomenon, both in the pre-pandemic period and the subsequent context, providing valuable insights into the trends, challenges, and opportunities shaping the future of remote work.

The goal is thus to significantly contribute to the existing body of knowledge while proposing future directions for research and practice in the realm of remote work, particularly in the context of urban studies, environmental management, and sustainability.

Remote Work

Remote work, an expanding labor practice, challenges traditional notions of work organization by allowing individuals to choose their place of residence regardless of their employer's location. This phenomenon has captured the attention of academics and professionals and has fostered relevant interdisciplinary dialogue (Nakrošienė et al., 2019; Choudhury et al., 2020).

Substantial progress in digital technologies has been a crucial catalyst for the adoption of remote work, making computers more accessible and powerful and expanding broadband internet availability. These innovations, along with the advancement of information and communication technologies (ICT) and cloud-based services, have facilitated remote collaboration in various fields, including research (Sako, 2021).

In 2017, 37.0% of workers in the U.S. carried out their professional activities from home, while in the European Union, this percentage was 17.0%. This disparity suggests that although the internet infrastructure in the EU was adequate, organizational factors, such as a lack of trust in virtual interactions, may have slowed the adoption of remote work (Eurofound and the International Labor Office, 2017).

The advantages and disadvantages of remote work for individuals, organizations, and society have already been widely discussed in the literature (Hill et al., 2010). For workers, the benefits include greater autonomy, reduced stress and time, savings on commuting costs, and a healthier work-life balance (Belzunegui-Eraso & Erro-Garcés, 2020; Korb & Souza, 2022).

Organizations, in turn, experience smoother communication, increased productivity, and access to a more diverse workforce (Ozimek, 2020). From a social and environmental perspective, the reduction in daily commutes contributes to lower CO₂ emissions and pollution levels (Tremblay & Genin, 2007; Wolor et al., 2020). Additionally, remote work allows the provision of essential services in remote areas or for vulnerable populations.

However, this mode of work is not without its challenges. Organizations face the dilemma of monitoring employee productivity remotely, sometimes leading to the adoption of intrusive surveillance practices (Laker et al., 2020; Drumea, 2020). From the worker's perspective, the lack of face-to-face interaction can result in social isolation and disconnection from organizational culture, negatively impacting innovation and the sense of belonging (Brusseovich et al., 2020; Yang et al., 2022).

The COVID-19 pandemic accelerated the transition to remote work, often without adequate preparation or support for workers, exacerbating pre-existing challenges and introducing new ones, such as managing the boundary between work and personal life in the same physical space (Maritsa & Kalemis, 2020; Wang et al., 2021; Xiao et al., 2021).

Thus, it is imperative for organizations, academics, and policymakers to collaborate to develop effective strategies that maximize the benefits and mitigate the challenges associated with remote work, especially considering its growing role in contemporary professional life.

Methodology

This research was conducted by means of a data mining approach using VOSviewer (version 1.6.19), a software package that enables the creation and analysis of bibliometric networks, based on data from databases. Bibliometrics is a quantitative technique aimed at analyzing the existing scientific production on specific subjects, thus allowing for the understanding of the evolution of knowledge and scientific interests. Therefore, it is essential to consider the indicators presented in Table 1. In this study, only the number of publications and citations were evaluated.



Table 1

Bibliometric Indicators

Indicator	Definition
Lotka's law	Considers information about the frequency distribution of authorship on a given topic/scientific area.
Bradford's law	Considers information about the frequency distribution of the number of articles published in periodicals on a given topic/scientific area.
Zipf's law	Considers information about the frequency distribution of the vocabulary in texts on a given topic/scientific area.
Number of publications	Considers information about the number of publications on a given topic/scientific area.
Number of citations	Considers information about the impact of articles on a given topic/scientific area based on the number of citations.

Source: Soares et al. (2018)

Bibliometric research is based on information obtained from large databases (e.g., Web of Science, Scielo, Google Scholar), allowing the identification, synthesis, and extensive analysis of literature on a specific topic (Costa et al., 2020; Pereira et al., 2020). It is worth mentioning that the same search criteria were used to compare literature published before and after COVID-19 on motivation and e-learning/remote learning.

The search was conducted on the Web of Science platform using the Boolean equation "Remote Work" OR "Telework" OR "Work from Anywhere" OR "Telecommuting." Only scientific articles in English, published in journals from the fields of business, management, social sciences, and psychology were selected. For the pre-COVID-19 period, the literature published between January 1, 2010, and December 31, 2019, was searched, resulting in a total of 469 scientific articles. The post-COVID-19 search covered the period from January 1, 2020 to December 31, 2021, yielding 284 scientific articles.

Understanding the most frequently used terms and their co-occurrence in the literature provides a general idea of the types of questions and relationships being studied and presented in the literature as "hot topics," showing trends and how nomological networks are being interpreted.

VOSviewer (version 1.6.19), developed by Van Eck and Waltman (2014), was used to facilitate the systematic review of the scientific literature. This software simultaneously uses mapping and clustering techniques that together provide a structure based on the location of terms on the map, grouping them by color and creating visual landscapes of the literature



(Waltman et al., 2010). In the present study, the terms previously mentioned had to appear at least ten times to be included in the analysis. Thus, a full count was required, meaning each article was counted based on the number of times a term appeared, not just whether it appeared. Using a presence/absence approach in a given text would have been fractional counting, which would not meet the study's objectives.

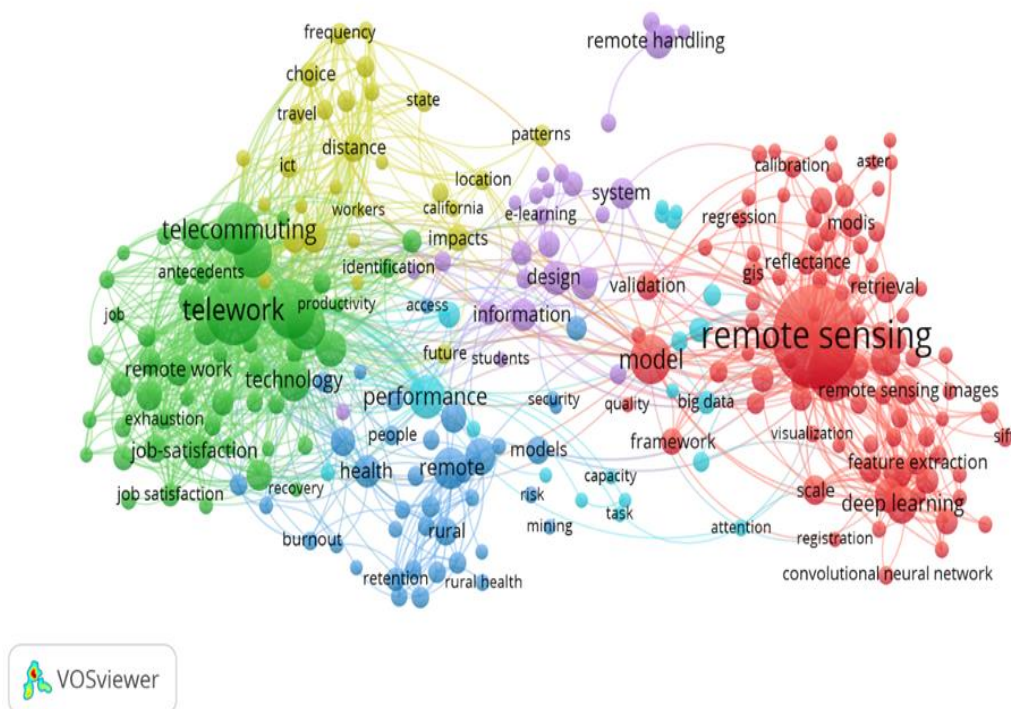
Results

Research on remote work in the pre-COVID-19 era

The map generated by the research related to the pre-COVID-19 reality can be observed in Figure 1.

Figure 1

VOSviewer map of term co-occurrences in the literature from January 1, 2010 to December 31, 2019



During this time frame, research in this area can be divided into six clusters that are directly related and mostly overlapping:

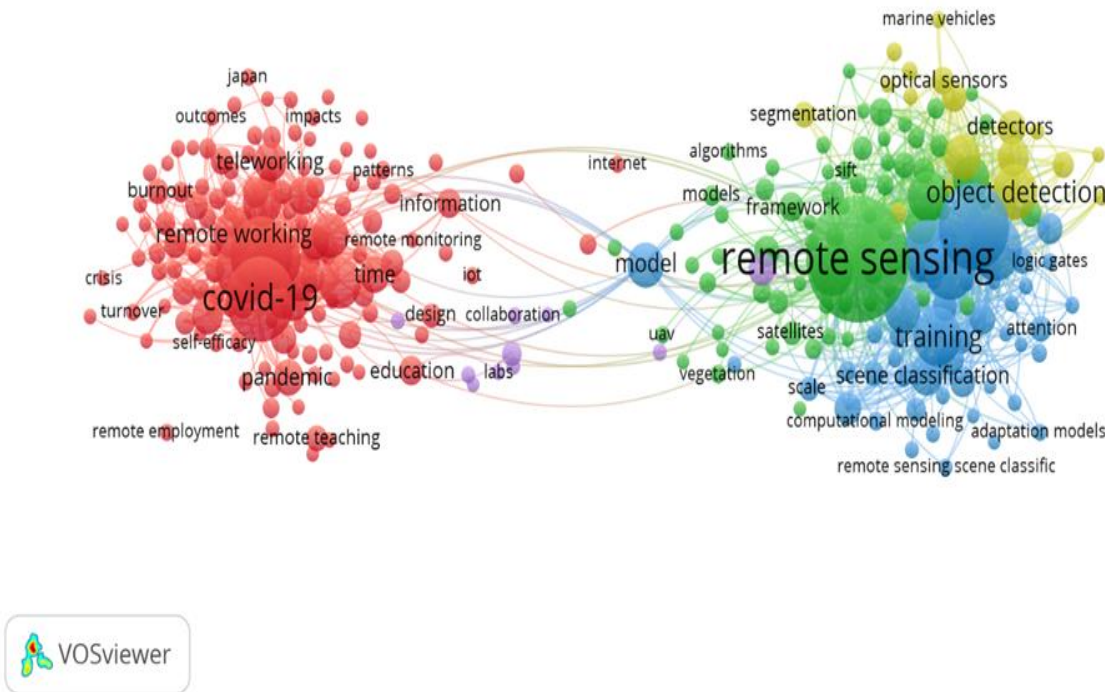
1. **The red cluster** concerns the technology used to evaluate work performance/safety and comprises 189 items that include the following keywords: remote detection, deep learning, dynamics, fusion, calibration, and quality assessment. This cluster indicates that one of the main sources of interest in research in the pre-COVID-19 era was how technology could help ensure that workers were actually performing the tasks for which they had been hired, even when they were not in the same location as their manager.
2. **The green cluster** consists of 53 items addressing the psychosocial aspects of remote work. Keywords in this cluster include: exhaustion, job satisfaction, work-family balance, trust, productivity, personality, background, and workplace. These results reveal that the impact of remote work on workers' quality of life and well-being was considered a significant topic in the pre-COVID-19 literature.
3. **The blue cluster** includes 39 items related to healthcare in remote areas. This cluster seems to focus on the potential of remote work as a way to access healthcare and mental health services in remote areas. Keywords include nurses, community, burnout, remote healthcare, mental health, and rural health.
4. **The yellow cluster** refers to the choice of remote work and includes 28 items with keywords such as accessibility, adoption, barriers, commuting, distance, mobility, and time. This cluster seems to highlight the need to consider what can be done to encourage workers to opt for remote work.
5. **The purple cluster** encompasses 27 items related to distance learning and includes keywords associated with distance education, e-learning, engineering education, remote collaboration, remote labs, space, science, and virtual reality. This cluster focuses on the realities of learning and the construction of joint knowledge.
6. Finally, **the turquoise cluster**, comprising 20 items related to innovation, groups keywords such as attention, communication, creativity, performance, network, cloud computing, future, and teleportation. This cluster appears to focus on the future and innovation generated by and for remote work.

Research on remote work in the post-COVID-19 world

In Figure 2, we can observe the map generated by the research concerning the post-COVID-19 reality.

Figure 2

OSviewer map of term co-occurrences in the literature from January 1, 2020 to December 31, 2021



The post-COVID-19 research reveals the existence of five clusters, as presented below:

1. **COVID-19 impact cluster:** the red cluster includes 136 items. This cluster gathers all kinds of consequences and impacts caused by COVID-19 on remote work. The keywords in this cluster include COVID-19, anxiety, benefits, challenges, crisis, emergency remote teaching, impact, Internet, Internet of Things (IoT), life, management, motivation, mental health, self-efficacy, stress, work-life balance, and workaholism.
2. **Technology for worker performance evaluation/safety:** the green cluster includes 69 items referring to remote detection, deep learning, dynamics, fusion, calibration, and quality assessment. This cluster highlights how technology in the post-COVID-19 era helps ensure that workers are truly performing the work for which they were hired, even when not in the same location as their manager.
3. **Task analysis in learning:** the blue cluster includes 49 items on task analysis, attention, adaptation models, semi-supervised learning, and learning transfer. These results suggest that the interest in learning can drive civilizational development.

4. **Specific segments:** the yellow cluster consists of 19 items related to geospatial analysis, ship detection, optical remote detection, and optical imagery. This cluster seems to point to specific work areas where distance is an important element and should still be addressed.
5. **Infrastructure:** The purple cluster includes 10 items, encompassing augmented reality, collaboration, labs, networks, and virtual reality. This cluster highlights the need for a reliable infrastructure that allows for the execution of all projects and perspectives related to remote work.

Discussion

The discussion of the results begins by addressing the scientific literature published in the pre-COVID-19 period, followed by a reflection on the results obtained from the post-pandemic research. Finally, the main differences between the periods under study are analyzed.

Before the COVID-19 pandemic, the literature mainly focused on the social and technological implementation of remote work, showing a tendency to focus on technological advancements that facilitate remote management of workers. The dynamics of organizations, as well as interactions between workers and teams, underwent substantial transformations driven by the advent of remote work. This change goes beyond the mere use of ICT and involves complex relationships between work environments, motivations, management, and work practices (Belzunegui-Eraso & Erro-Garcés, 2020).

It is crucial to recognize that organizations function as sociotechnical entities, integrating subsystems that encompass technological, political elements, production practices, labor actions, and standardization strategies. In the context of remote work, the technical subsystem covers ICT, working conditions, labor practices, and compensation packages (Ozimek, 2020).

Perez et al. (2003) point out that, in the pre-pandemic period, inefficient access to technology and documentation constituted significant obstacles to telework. These findings are aligned with those of Cooper and Kurland (2002), who suggest that telework tends to be more successful in organizations where workers have adequate access to ICT and necessary tools, thus contributing to increased productivity and job satisfaction.

Regarding the psychosocial aspects of remote work, there is an increase in the feeling of social isolation and reduced communication with colleagues, negatively impacting job satisfaction and career prospects (Baert et al., 2020; Leite & Chambel, 2018). However, remote work also offers advantages, such as reduced distracting interactions and promoting a better work-life balance (De Clercq, 2020; Rocha & Amador, 2018).

In addition, remote work emerges as a viable alternative in cases of health problems, contributing to a reduction in presenteeism in the workplace and consequently minimizing the risk of contagion (Brussevich et al., 2020). The time and financial savings associated with eliminating daily commutes are also noticeable benefits of remote work. It is also observed that women tend to value this work mode more, as it facilitates managing domestic and family responsibilities (Tavares et al., 2020; Brussevich et al., 2020).

Remote healthcare and distance education, previously discussed, gained special relevance during the pandemic, intensifying research in these areas (third and fifth clusters). Autonomy in time management and self-regulation stand out as crucial factors for those opting for remote work, especially in families with young children (Morikawa, 2020; Alipour et al., 2020).

The post-pandemic period brought a shift in research focus to the impact of remote work on worker well-being and productivity, as well as identifying specific conditions that facilitate professional task execution during health crises (Galanti et al., 2021; Zappalá & Torriano, 2021).

Technological advancements played a crucial role in smoothing the transition to remote work, with a significant increase in investments in cloud-based software (Sako, 2021). Task analysis related to remote work reveals a trend towards flexibility and individualization of work, contrasting with the traditional office work model (Koch & Gerber, 2021).

Although the study results show that permanent remote work may increase the risk of burnout and disengagement, they also point to improved efficiency and productivity in certain circumstances (Gigauri, 2020; Gajendran & Harrison, 2007).

Current discussions revolve around establishing a hybrid work model, integrating the flexibility of remote work with the benefits associated with physical presence in the office (Koroma et al., 2020). A balanced and well-regulated approach to this hybrid model has the potential to maximize productivity and worker well-being while preserving social interactions and team cohesion (Blok et al., 2020).

Regarding the main differences between the pre- and post-pandemic periods, there was an acceleration in the adoption of remote work, driven by the need to maintain business continuity during lockdown periods. Social and organizational perceptions of remote work underwent a positive transformation, moving from an alternative option to an essential and integral component of contemporary work practices (Kniffin et al., 2021).

However, it is essential to address the challenges associated with remote work, such as effectively managing the boundaries between work and personal life, maintaining mental and physical health, and establishing inclusive and equitable management practices. The adaptability and resilience of workers and organizations thus become crucial aspects in shaping the future of



remote work (Shockley et al., 2020; Vaziri et al., 2020).

This systematic review highlights the importance of approaching remote work holistically, integrating technical, social, psychological, and organizational dimensions. Developing inclusive and equitable work practices, coupled with continuous investment in technologies that facilitate remote communication and collaboration, will be key to the future success of remote work.

To facilitate the comparison of the most studied topics in the pre- and post-COVID-19 periods, Table 2 presents a summary of the main findings.

Table 2

Comparison between clusters and most discussed topics, before and after the pandemic

Clusters			
Before the Pandemic		After the Pandemic	
1. Technology for worker performance evaluation/safety (red cluster, 189 items)	Remote detection, deep learning, dynamics, fusion, calibration, quality assessment, and access to technology to ensure the effectiveness of the work performed.	1. COVID-19 impact (red cluster, 136 items)	COVID-19, anxiety, benefits, challenges, crisis, emergency remote teaching, impact, internet, IoT, life, management, motivation, mental health, self-efficacy, stress, work-family balance, and workaholism.
2. Psychosocial aspects of remote work (green cluster, 53 items)	Exhaustion, job satisfaction, work-life balance, trust, productivity, personality, background, and workplace.	2. Technology for worker performance evaluation/safety (green cluster, 69 items)	Remote detection, deep learning, dynamics, fusion, calibration, and quality assessment.
3. Healthcare in remote areas (blue cluster, 39 items)	Remote work, mental health in isolated areas, nurses, community, remote healthcare, and rural health.	3. Task analysis in learning (blue cluster, 49 items)	Training in task analysis, attention, adaptation models, supervised learning, and learning transfer.
4. Choice of remote work (yellow cluster, 28 items)	Accessibility, adoption, barriers, commuting, distance, mobility, and time.	4. Specific segments (yellow cluster, 19 items)	Geospatial analysis, ship detection, optical remote sensing, and optical imagery.
Remote education (purple cluster, 27 items)	Distance education, e-learning, engineering education, remote collaboration, remote labs, space, science, and virtual reality.	5. Infrastructure (purple cluster, 10 items)	Augmented reality, collaboration, labs, networks, virtual reality, and collaboration.
6. Innovation (turquoise cluster, 20 items)	Attention, communication, creativity, performance, network, cloud computing, future, and teleportation.		

The proliferation of academic publications on remote work attests to its exponential growth in relevance. We observed a transition from 469 articles over a decade to 284 articles in just two years following the pandemic, indicating a significant increase in academic attention devoted to

this topic (pre-pandemic average: 46.9 articles/year; post-pandemic average: 142 articles/year). The existing literature reflects a shift in focus, moving from an analysis of the determinants of adopting remote work to a deeper scrutiny of the psychosocial impacts of this work modality, particularly in the tumultuous context of the pandemic.

The intersection of remote work with health and innovation represents critical areas of interest that have been reconfigured in the post-pandemic period. Remote healthcare, previously an independent research cluster, has had its identity diluted, now subsumed under the broad umbrella of COVID-19 impacts. This phenomenon reflects a necessary reorientation of primary healthcare to address the demands imposed by the pandemic, an effect widely recognized and documented in the literature (Teixeira et al., 2020).

Similarly, innovation, once an autonomous domain of study in the context of remote work, has lost its independent status. The compulsory adoption of telework during the pandemic leveled the playing field, eliminating the distinction between remote and in-person teams. This reality imposes an urgent need to rethink how innovation can be fostered in predominantly digital environments, where face-to-face interaction is minimized.

As we move into a post-pandemic future, the flexibility to choose between remote and in-person work is being restored. However, the lessons learned during this critical period provide an essential foundation for the successful implementation of sustainable remote work practices. Renewed research on the motivation for remote work, along with strategies to foster innovation in virtual environments, emerges as imperative.

This work highlights the need for a holistic and multidisciplinary approach to understanding and optimizing remote work, integrating technical, social, psychological, and environmental considerations. Developing inclusive and sustainable work practices aligned with the principles of environmental management is crucial to shaping the future of remote work in our cities and beyond.

Conclusion

The exponential growth of remote work, substantially influenced by advancements in information and communication technologies (ICT), represents a key organizational strategy to increase internal efficiency, enhance competitive advantage, and meet the growing demands for flexible working hours (Belzunegui-Eraso & Erro-Garcés, 2020). The COVID-19 pandemic acted as a catalyst for this trend, spreading remote work globally due to mobility restrictions (Sako, 2021).

In academia, pre- and post-pandemic literature reflects a significant evolution in the topics



and research focuses related to remote work. Before the pandemic, research was dispersed, primarily focusing on managerial concerns related to performance evaluation and the psychosocial aspects of workers, as remote work was more of an option than a necessity. However, the pandemic drastically changed this scenario, making remote work an imposition and shifting the research focus to the impact of the COVID-19 bioevent on the work environment.

Contemporary research is now delving into the operational complexities of remote work, addressing topics such as task analysis, learning, and the implementation of practices tailored to different sectors, as well as improving the infrastructure that supports remote work.

It is essential to highlight that traditionally, remote work was perceived as a beneficial situation for both employers and employees, offering flexibility in working hours and contributing to reducing organizational costs, such as expenses with physical facilities and commuting (Ramos et al., 2022). However, the pandemic highlighted other dimensions of work, emphasizing the importance of in-person socialization and building a strong organizational culture.

The transition to remote work also raises reflections on sustainability and urban environmental management. By enabling work from any location, remote work contributes to reducing urban traffic and pollution, in alignment with the principles of sustainable development and responsible environmental management.

Regarding future studies, it is imperative to pay attention to the evidence presented by recent research, such as a study conducted in the U.S., which revealed that 61.9% of the managers interviewed consider the implementation of remote work a discretionary decision (OECD, 2020). This trend underscores the need for deep reflection on the implications of remote work for labor dynamics, social interactions, and, crucially, for environmental management and urban sustainability.

Although in-person interactions remain a vital component for building professional and social networks, remote work emerges as a transformation vector, offering unique opportunities for personal and professional development. Moreover, it is crucial to recognize that amidst the adversities imposed by the pandemic, remote work played a key role in job preservation and organizational resilience, signaling a promising future for this work modality (Ramos et al., 2022).

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