

Profiling the disciplinary foundation of telework research: A journal co-citation analysis

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ABSTRACT

Objective. This study employed bibliometric analysis to identify the most relevant journals in telework research and utilized journal co-citation analysis to map the intellectual foundation of this field of study. **Design/Methodology/Approach.** To conduct this study, we used data from Scopus, employed the cluster modularity technique to identify journal communities, gathered centrality measures to pinpoint essential journals, and chose to rank the journals based on relevance. We combined two key measures to achieve this: the number of citations received and closeness centrality within the co-citation network. **Results/Discussion.** Seven communities of journals were identified, encompassing the following subject areas: organizational psychology and management, technology and information systems, occupational health and psychological well-being, sustainability and the environment, education and skills development, economics and public policy, and sociology and cultural studies. Some of the most relevant journals included the Journal of Applied Psychology; the International Journal of Environmental Research and Public Health; Sustainability, the Journal of Organizational Behavior; the Journal of Vocational Behavior; New Technology, Work and Employment; Frontiers in Psychology; Human Relations; the Academy of Management Journal; and the Academy of Management Review.

Conclusions. The co-citation analysis revealed that the disciplinary structure of teleworking is underpinned by a network of influential journals covering different areas of knowledge. The most relevant publications form seven major thematic clusters, reflecting the multidisciplinary nature of teleworking research

Keywords: telework; telecommuting; remote work; journal co-citation analysis; journal ranking; bibliometric analysis.

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1. INTRODUCTION

T ELEWORKING is a modality that began in the 1970s, with the 1990s being when it reached its most remarkable proliferation (De Vries Tummers & Bekkers, 2019). Daniels, Lamond, & Standen (2001) state that there are three types of teleworking: working from home, working from remote offices, and working from mobile devices. According to Illegems, Verbeke, and S'Jegers (2001), three scenarios occur around teleworking. The first of these is the technological scenario, related to the worker's skills required to carry out their work. The second is the institutional scenario, which has to do with the legal environment in which that work is carried out, and the last is the organizational scenario, related to how companies manage these remote workers.

Empirical findings indicate that attitudes toward teleworking are less favorable among individuals who perceive greater job insecurity or disadvantages associated with remote work. However, those with lower organizational commitment tend to exhibit a more positive attitude, possibly because they prefer to maintain physical distance from the company (Lim & Teo, 2000). Although teleworking was initially viewed as a tool to enhance employees' quality of life, organizations now primarily implement it to cut costs and boost productivity (Mann & Holdsworth, 2003). While increased teleworking can enhance job satisfaction, it may also contribute to social and professional isolation, as well as perceptions of risk regarding professional development (Zöllner & Sulíková, 2021).

The benefits of teleworking include improved work-life balance, greater flexibility, decreased commuting, reduced costs for employers, enhanced employee skills, and increased productivity. Meanwhile, its drawbacks include social isolation, presenteeism, insufficient support, limited professional advancement, and the blurring of boundaries between work and home (Mann & Holdsworth, 2003). During the COVID-19 pandemic, teleworking became a crucial method for maintaining work continuity, leading to a significant rise in its global adoption. However, its rapid implementation was executed hastily and lacked adequate planning. In the aftermath of the pandemic, many organizations have opted for hybrid models, while large technology companies have promoted teleworking as a permanent option. Despite the advantages of flexibility and employee well-being, teleworking presents challenges such as isolation, stress, a need for improved technological infrastructure, and organizational support (El Hajal, 2022).

The literature on this subject is continually expanding, particularly as technological advancements have transformed work practices and the concept of remote work has taken precedence over traditional office environments. In this study, we will conduct a bibliometric analysis to identify the most influential journals in teleworking research. To achieve this, we will perform a journal co-citation analysis to map the intellectual foundation of this field.

2. LITERATURE REVIEW

González-Mendoza and Calderon-Contreras (2022) conducted a bibliometric analysis of teleworking using the Web of Science (WoS) database to identify its evolution, main countries, journals, and collaboration networks. The results highlight the leadership of the United States, England, and Canada in scientific production, and demonstrate the impact of teleworking at home on costs, satisfaction, and mental health. This leadership from the United States and England is also evident in the study by Šímová and Zychová (2023), who emphasized two historical research areas: the multicultural dimension and aspects of trust, communication, and leadership. The authors also underline key concepts such as organizational capabilities, behavior, management, and gender, proposing a theoretical framework for adapting to remote work and guiding future research.

Elsamani and Kajikawa (2023) explored the evolution of teleworking and its effects on employee well-being and innovation. Through citation network analysis and data mining, the authors identify emerging trends, influential works, and research opportunities, offering guidelines for organizations managing teleworking as well as for future academic studies. Additionally, using mapping techniques, de Melo Carneiro *et al.* (2022) examine Brazilian scientific production on teleworking from articles in the CAPES portal between 2012 and

2022. The findings indicate a rise in research, especially in the post-pandemic period, highlighting applicable legislation and low output in the public service sector. This post-pandemic growth is evident in the study by Yang and Huang (2024), which highlights that the primary areas of study are applied psychology, management, and business, focusing on well-being, mental health, and work-family conflict. Gupta, Misra, and Dash (2023) conducted a retrospective bibliometric analysis of teleworking during the COVID-19 pandemic. The authors identify nine key research topics in the global economy and propose a framework for future research, offering guidelines for academics and organizational policymakers. Meanwhile, Cruz-Cárdenas et al. (2024), using the Scopus database to structure knowledge about teleworking, illustrate its academic growth following the pandemic. The results emphasize its multidisciplinary nature and the leadership of institutions in developed countries, identifying four major areas of research: technology, advantages and disadvantages, human factors, and the relationship with the pandemic.

The study by Yorulmaz et al. (2023) conducts a bibliometric analysis of the governance of telework in business and management literature using the WoS database from 2013 to 2023. The results indicate that, although there are studies addressing digitization and innovation in teleworking, its governance remains an under-explored area, underscoring the need for future research on its integration into business management strategies and continuity. Meanwhile, the study by Barbosa and Ferreira-Lopes (2023) performs a bibliometric analysis of telecollaboration and virtual exchange using 254 articles from WoS and Scopus to characterize the field and its trends. The results reveal diversification in formats and knowledge areas but limited international collaboration. Additionally, emerging and declining topics and the benefits and challenges of the technological tools utilized in this field are identified.

3. METHODOLOGY

To conduct this study, we used data from Scopus, a multidisciplinary scientific literature database that is widely employed for bibliometric research and science mapping. We utilized various terms to retrieve the literature, including telecommuting, teleworking, telework, remote work, working from home, remote working, telecommuter, remote worker, workfrom-home, and home-based work. The search strategy was refined in several aspects and is outlined as follows:

(TITLE-ABS-KEY ("Telecommuting*") OR TITLE-ABS-KEY ("Teleworking*") OR TITLE-ABS-KEY ("remote work*") OR TITLE-ABS-KEY ("Working from home*") OR TITLE-ABS-KEY ("Telecommuter*") OR TITLE-ABS-KEY ("Remote worker*") OR TITLE-ABS-KEY ("Work-from-home*") OR TITLE-ABS-KEY ("home-based-work*") OR TITLE-ABS-KEY ("Telework*") OR TITLE-ABS-KEY ("Remote working*")) AND PUBYEAR > 1989 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE, "cr")).

Using the previous search strategy, we obtained 12,486 documents. Since the variable under analysis was the name of the cited journal, we normalized all the journal entries. The research team conducted this manual process, which underwent several rounds of revision. Once the cited journals were standardized, we generated the co-citation map, which included 1,436 journals and 308,385 edges. This count reflects the total after establishing a threshold for journals that have been co-cited at least 20 times. After creating the map in Gephi, we applied the cluster modularity technique to identify the journal communities. Each cluster represented a disciplinary area contributing to the theoretical foundation of teleworking as a research domain. We obtained centrality measures to identify significant journals and qualitatively analyzed each cluster to define its disciplinary area. We also decided to rank the journals by relevance by combining two key measures: the number of citations received and the closeness centrality in the co-citation network. The citations reflected the direct academic impact of a journal, while the closeness centrality indicated how close a journal was to others in the network, allowing for an evaluation of its strategic position within the co-citation structure. Both indicators were previously normalized to the range [0, 1], making them comparable and reducing biases resulting from differences in measurement scales. The normalization was applied using the formula:

$$X_norm = (X_i - X_min) / (X_max - X_min),$$

where X_i represents the metric value for a specific journal, while X_m and X_m and denote the minimum and maximum values of the indicator, respectively.

With the normalized values, a relevance index (R) was calculated that integrates the two metrics using a weighted formula:

$$R = \alpha \cdot C_{norm} + \beta \cdot Ce_{norm}$$
.

In this study, weights $\alpha = 0.6$ and $\beta = 0.4$ were assigned, prioritizing the impact of citations over structural centrality. This approach allowed journals with a high level of citations to be considered more relevant, while still acknowledging their structural importance in the network. Finally, the values obtained for R were organized in descending order, creating a ranking where the most relevant journals exhibit a high number of citations alongside a strategic position in the network. This process enabled the identification of both the most influential journals and those with the least impact in the area of study, providing a comprehensive overview based on quantitative and structural data.

4. RESULTS

4.1. Journals clustering

The journal co-citation map includes 1,436 nodes and 308385 edges. Seven clusters were created after applying the modularity technique in Gephi (see Figure 1). The largest of these clusters focuses on "Organizational Psychology and Management." The most notable journals in this cluster are the *Journal of Applied Psychology* (6,500 citations) and the *Academy of Management Journal* (6,200 citations). The Academy of Management Review

(5,400 citations) is frequently co-cited with the Journal of Applied Psychology. In contrast, the Human Resource Management Review (3,800 citations), also often co-cited with Personnel Psychology (4,200 citations), forms a core around the connection between occupational psychology and human resources. The co-citation of journals such as the Journal of Organizational Behavior (4,100 citations) and Leadership Quarterly (3,600 citations) further illustrates the strong relationship between the psychological and social dimensions of management and leadership. These connections are essential for understanding how leadership strategies affect employee performance in virtual environments.

From a disciplinary perspective, this cluster encompasses organizational psychology, human resource management, and business administration. For example, Industrial and Organizational Psychology (2,800 citations) and Work & Stress (2,400 citations) publish research on managing work-related stress, perceived workload, and organizational interventions aimed at enhancing well-being in remote work. Other important journals include the *Journal of Business and Psychology* (2,500 citations) and Group & Organization Management (2,100 citations). These relationships illustrate a multidisciplinary approach in the research that underpins studies on teleworking.

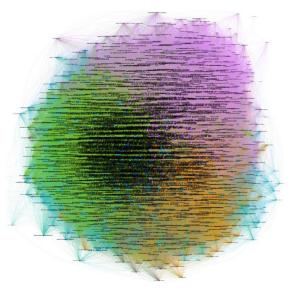


Figure 1. Mapping of co-cited journals in the telework research.

The second cluster reflects a disciplinary environment oriented toward information technologies and systems, a key dimension that enables and optimizes teleworking. For this reason, we have named this cluster "Technology and Information Systems." The most representative journals in this cluster, for their high citation rate and centrality on the network, include MIS Quarterly (6,200 citations) and the Journal of Information Technology (5,800 citations). These publications lead research in digital tools, collaborative platforms, and strategies to overcome technological barriers to teleworking.

When it comes to relationships, Information Systems Research (5,200 citations) and the Journal of Strategic Information Systems (4,900 citations) form a strong core. These journals regularly publish research on how technology can transform business management, with an emphasis on adopting integrated information systems and cybersecurity in remote environments. Another notable connection in this cluster is between Computers in Human Behavior (4,600 citations) and the International Journal of Human-Computer Studies (4,100 citations). These journals examine the impact of digital interfaces on user productivity and well-being, covering topics such as usability, human-computer interaction, and user experiences on collaborative platforms. Additionally, a key relationship exists between the European Journal of Information Systems (3,800 citations) and Decision Support Systems (3,500 citations). These journals focus on data-driven decision-making and the use of analytical tools for managing distributed teams. They are also distinguished by their emphasis on designing systems that support remote project management.

This cluster combines information technology, systems engineering, and computer science. For instance, the *Journal of Computer-Mediated Communication* (3,200 citations) examines digital communication and online collaboration. In comparison, *Technology in Society* (3,000 citations) publishes research on the social implications of technology adoption. Also notable are journals such as *Information & Management* (3,100 citations) and the *Journal of Digital Innovation* (2,800 citations), which focus on technological innovation. These

journals investigate the implementation of emerging tools, including artificial intelligence and machine learning, that boost productivity and facilitate remote collaboration.

Cluster 3 focuses on "Occupational Health and Psychological Well-Being," emphasizing employees' physical and mental health, along with strategies to enhance occupational well-being in remote settings. The leading journals in this cluster include the Journal of Occupational Health Psychology (4,900 citations, degree centrality: 0.88) and Occupational Medicine (4,400 citations). These publications are at the forefront of interdisciplinary research on work-related stress, worklife balance, and the effects of ergonomics in teleworking. A notable relationship within this cluster exists between Work & Stress (3,800 citations) and the Journal of Occupational and Environmental Medicine (3,600 citations). These journals often publish studies on the consequences of social isolation and the absence of face-to-face interaction, examining how these conditions can elevate the risk of emotional exhaustion and reduce productivity. Another significant connection is between Ergonomics (3,300 citations) and Safety Science (3,100 citations). These publications highlight the importance of ergonomic design in remote workspaces, investigating how the physical layout of these environments impacts posture, eye strain, and overall physical health.

This cluster features a combination of journals focused on occupational health, clinical psychology, and behavioral sciences. For instance, the International Journal of Workplace Health Management (3,000 citations) specializes in promoting the well-being of individuals in work environments. Similarly, Applied Ergonomics (2,900 citations) offers studies on adapting home workspace designs to enhance physical health. Other key journals within this cluster include the Journal of Stress Management (2,700 citations), which publishes research on stress reduction in remote work settings, and Human Factors (2,600 citations), which addresses the impact of technological and environmental characteristics on human performance.

We have named cluster 4 "Sustainability and the Environment" because it groups journals focused on these areas. Teleworking

impacts sustainability and the environment, as this work model contributes to reducing carbon emissions, saving energy, and promoting sustainable urban planning. The most prominent journals are Sustainability (with 6,200 citations) and Environmental Research Letters (with 5,800 citations), which lead research on how teleworking influences the transition to more sustainable economies. A noteworthy relationship within the cluster exists between the Journal of Cleaner Production (with 5,100 citations) and Resources, Conservation & Recycling (with 4,900 citations). These journals publish collaborative studies that analyze how reducing commutes and efficiently using energy resources can be catalysts for achieving sustainability goals. For instance, articles have been published on implementing business policies that promote telecommuting to reduce traffic congestion and enhance air quality (Atkyns, Blazek & Roitz, 2002). Another significant connection is between Global Environmental Change (with 4,500 citations) and Ecological Economics (with 4,200 citations), journals where papers discuss the economic impact of teleworking strategies on environmental sustainability (Pettifor, Agnew & Wilson, 2023; van den Berg et al., 2024).

From a disciplinary perspective, this cluster encompasses environmental economics, sustainability studies, and environmental sciences. For example, Energy Policy (4,000 citations) focuses on energy savings and their impact on global energy demand. Additionally, Urban Climate (3,900 citations) publishes research on how teleworking can affect the urban microclimate by reducing industrial and vehicular activity (Tenailleau et al., 2021). Other significant journals include Transportation Research Part D (3,800 citations), which examines the connection between teleworking and the reduction of motorized transportation, and Environmental Impact Assessment Review (3,600 citations), which investigates the cumulative effects of teleworking on the environment (Motte-Baumvol, Schwanen, & Bonin, 2024; Elldér, 2024; Hidalgo-Triana et al., 2023). This cluster also includes journals dedicated to the public policies needed to maximize environmental benefits. Policy and Society (3,500 citations) and Journal of Environmental Management (3,400 citations) analyze regulatory frameworks, government strategies, and issues related to teleworking as a sustainability tool (Vyas, 2022).

Cluster 5 brings together journals that focus on education and skills development, particularly those related to the use of digital technologies for continuing education and professional training. This cluster, named "Education and Skills Development," is notable for its focus on how remote work affects learning dynamics in academic and workplace settings. The most representative journals include the *Journal of Educational Technology* (5,800 citations) and *Computers & Education* (5,500 citations), which lead research on online learning platforms and virtual training strategies.

One significant relationship within the cluster is between the International Journal of Educational Technology (4,800 citations) and the Educational Research Review (4,600 citations). These journals publish studies on the effectiveness of digital educational resources and the design of adaptive content to enhance distance learning. Another meaningful connection exists between the British Journal of Educational Technology (4,300 citations) and The Internet and Higher Education (4,100 citations), journals that explore how universities and organizations are adopting emerging technologies, such as artificial intelligence and virtual reality, to develop specific skills that pertain to remote practices (Abdous & Yen, 2010; Exter, Harlin & Bichelmeyer, 2008). Other notable journals include the Journal of Workplace Learning (3,600 citations), which emphasizes workplace training, and Learning and Instruction (3,400 citations), which discusses methods and theories related to learning and instruction.

Cluster 6, "Economics and Public Policy," comprises journals primarily focused on economic implications and public policy. This cluster features key journals such as *Economic Policy* (5,200 citations) and the *Journal of Public Economics* (4,900 citations), which lead research on the effects of teleworking on the labor economy and resource redistribution policies (Dingel & Neiman, 2020; Alipour, Fadinger & Schymik, 2021). A significant relationship exists within the cluster between *Regional Studies* (4,700 citations) and *Urban Studies* (4,500

citations). These journals publish research on the reorganization of urban space, examining how this model influences employment distribution, labor mobility, territorial planning, city decentralization, and suburban revitalization (Grabner & Tsvetkova, 2022; Luca, Özgüzel & Wei, 2024). Another critical link is found between Labour Economics (4,200 citations) and Applied Economics (3,900 citations). Additionally, relevant journals include Economic Geography (3,600 citations), Public Administration Review (3,400 citations), Social Policy & Administration (3,300 citations), and Regional Science and Urban Economics (3,100 citations).

Cluster 7, categorized as "Sociology and Cultural Studies," comprises journals focusing on human and social aspects, emphasizing impacts beyond productivity and technology. The most prominent journals include Sociology (4,800 citations) and Cultural Studies (4,400 citations), which lead to research related to sociological aspects of work and the economy (Wood & Lehdonvirta, 2023). A significant connection within the cluster is between Gender, Work & Organization (4,200 citations) and Sociological Review (4,000 citations). These journals often publish studies on gender inequalities in the workplace, exploring teleworking from a gender perspective (Sullivan & Lewis, 2001; Coban, 2022). This cluster 7 integrates journals primarily on sociology, gender studies, anthropology, and political science. Notable titles include Feminist Theory (3,500 citations), Social Problems (3,400 citations), Journal of Family Issues (3,300 citations), and Ethnography (3,100 citations). It serves as a disciplinary foundation from a social and cultural standpoint. The interdisciplinary relationships among the journals appear to reflect a shared interest in understanding how teleworking reconfigures social norms, cultural identities, and power dynamics.

4.2. Journals ranking

Table 1 presents a ranking of the 50 most relevant journals for telework research. In the top position is the *Journal of Applied Psychology,* with a relevance score of 0.986, highlighting it as the most influential source in examining the psychological impact of telework on

organizational behavior and work productivity. It is followed by the International Journal of Environmental Research and Public *Health*, which has a score of 0.736, indicating strong interest in the effects of remote work on employees' mental health, ergonomics, and quality of life. In third place is Sustainability (0.690), emphasizing the link between teleworking and environmental sustainability, particularly regarding carbon emissions reduction and changes in urban mobility patterns. The Journal of Organizational Behavior (0.677) and the Journal of Vocational Behavior (0.667) occupy the fourth and fifth positions, respectively. Both journals focus on the impacts of teleworking on organizational structure, team cohesion, and the professional development of employees in an evolving work environment. Following them, New Technology, Work and Employment (0.645) is a significant reference for exploring the digitization of work and the shift to hybrid work models.

Other relevant journals include Frontiers in Psychology (0.577), which explores the psychology of teleworking from both neuroscientific and behavioral perspectives, and Human Relations (0.561), which investigates how remote work affects interpersonal relationships and communication in the workplace. The Academy of Management Journal (0.559) and the Academy of Management Review (0.559) are essential publications in business management and organizational leadership, examining how teleworking reshapes organizational structures. In occupational health, the Journal of Occupational Health Psychology (0.507) focuses on the effects of teleworking on employees' well-being and mental health. Conversely, the journal Transportation (0.491) and Transportation Research Part A: Policy and Practice (0.481) discuss how teleworking impacts transportation infrastructure and urban policy planning. In organizational management and business economics, journals like Organization Science (0.491), the International Journal of Human Resource Management (0.488), Computers in Human Behavior (0.479), and the Harvard Business Review (0.470) are noteworthy for analyzing how digital transformation and automation are influencing the evolution of teleworking.

Rank	Journal	Relevance	Rank	Journal	Relevance
1	Journal of Applied Psychology	0.9863636	26	Work	0.4482551848512173
2	International Journal of Environmental Research and Public Health	0.7360690993688008	27	Applied Psychology: An International Review	0.4429382694319206
3	Sustainability	0.6901372605951308	28	Work and Employment	0.43797483823264205
4	Journal of Organizational Behavior	0.6775475754733995	29	Work, Employment and Society	0.43722272317403066
5	Journal of Vocational Behavior	0.6672733853922452	30	Bmc Public Health	0.4349398384129847
6	New Technology, Work and Employment	0.6451521082055907	31	Gender, Work and Organization	0.43441662037871953
7	Frontiers in Psychology	0.5771812458070333	32	Journal of Personality and Social Psychology	0.43044230730387734
8	Human Relations	0.5618640389540126	33	Journal of Managerial Psychology	0.4264807718665464
9	Academy of Management Journal	0.5597170290351667	34	Administrative Science Quarterly	0.4261166694319207
10	Academy of Management Review	0.5596503606853022	35	Psychological Bulletin	0.4250452786293959
11	Plos One	0.5541419779981965	36	Information and Management	0.4235751159603246
12	Journal of Management	0.5534211289449955	37	Work And Stress	0.42145280468890894
13	Journal of Occupational Health Psychology	0.5076983610459874	38	International Journal of Information Management	0.4212524321009919
14	Transportation	0.4914886665464383	39	Journal of Occupational And Environmental Medicine	0.4211580613165014
15	Organization Science	0.49148449702434627	40	European Journal of Information Systems	0.4198336854824166
16	International Journal of Human Resource Management	0.48890167646528404	41	Human Resource Management Review	0.4137707357980162
17	Transportation Research Part A: Policy and Practice	0.48103560072137064	42	Technological Forecasting and Social Change	0.41160857926059513
18	Computers in Human Behavior	0.4797816652840397	43	Personnel Review	0.4085971624887286
19	Harvard Business Review	0.47020513291253385	44	Organizational Dynamics	0.40833085374211003
20	Journal of Business Research	0.4691557428313796	45	Transportation Research Record: Journal of the Transportation Research Board	0.4082638788097385
21	MIS Quarterly	0.4650931491433724	46	Quarterly Journal of Economics	0.40466804256086564
22	American Psychologist	0.45778807754733997	47	World Economic Forum	0.4036789900811542
23	Lancet	0.4573308670874662	48	Workforce	0.401190261496844
24	European Journal of Work and Organizational Psychology	0.4536294340847611	49	Temas Laborales	0.4003246167718666
25	Personnel Psychology	0.4515430744815149	50	Journal of Occupational and Organizational Psychology	0.40009250099188454

5. CONCLUSION

The co-citation analysis reveals that the disciplinary structure of teleworking is supported by a network of influential journals across various fields of knowledge. The most significant publications form seven major thematic clusters, highlighting the multidisciplinary nature of telework research. Journals in organizational psychology and management, led by the Journal of Applied Psychology, the Academy of Management Journal, and the Journal of Organizational Behavior, are essential for understanding the impact of telework on productivity, leadership, and work commitment. In the area of technology and information systems, journals such as MIS Quarterly and the Journal of Information Technology are noteworthy for their focus on workplace digitization and collaborative tools. Occupational health and psychological well-being draw upon publications like the Journal of Occupational Health Psychology and Occupational Medicine. Regarding sustainability and the environment, journals such as Sustainability and the Journal of Cleaner Production support research investigating the reduction of carbon emissions and sustainable urban planning associated with teleworking. Additionally, education and skills development journals like Computers & Education and the British Journal of Educational Technology provide the intellectual basis for the digital training necessary for remote work. In economics and public policy, publications such as the Journal of Public Economics and Regional Studies are prominent; meanwhile, in sociology and cultural studies, journals like Sociology and Gender, Work & Organization offer the framework for examining gender inequalities and shifts in social relations.

Conflict of interests

The authors declare that there are no conflicts of interest.

Contribution statement

Conceptualization, formal analysis, investigation, and validation: Aníbal Pinchi Vásquez, Carlos Trigoso-García.

Methodology, validation, and visualization: Katty Álamo Larrañaga, Teresa del Pilar López Sánchez, Roger Ricardo Rengifo-Amasifen

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Statement of data consent

The data generated during the development of this study has been included in the manuscript. •

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