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A Bibliometric and Contextual Analysis of Technology-Related Stressors in Flexible Working Arrangements: A Socio-Technical Perspective

Hasan Koç* and Jennifer Hynes

Berlin International University of Applied Sciences, Salzufer 6, 10587 Berlin, Germany

koc@berlin-international.de, hynes@berlin-international.de

Abstract. This study presents a bibliometric and contextual analysis of technology-related stressors in flexible working arrangements (FWA), examining 32 Web of Science-indexed articles for bibliometric analysis and 37 eligible studies for contextual analysis published between 2014 and 2024. Using bibliometric methods and socio-technical systems theory, the analysis reveals a rapid field growth, concentrated in Germany, China, and the United States, with limited international collaboration. The research identifies a fundamental thematic shift: well-being and work engagement displaced job satisfaction as primary research outcomes in the post-pandemic period, signaling a movement toward human-centric perspectives. The field, however, remains constrained by methodological homogeneity, theoretical concentration, and a geographic focus on digitally mature economies. The socio-technical analysis reveals that technology outcomes in FWAs depend on alignment across technical, personnel, organizational, and environmental subsystems rather than technology characteristics alone, challenging technology-centric intervention approaches. The study identifies critical research priorities, including fostering Global South partnerships, enhancing methodological diversity through longitudinal and mixed-method designs, adopting socio-technical perspectives in research design, and developing diagnostic tools for assessing cross-subsystem stressor interactions. These findings provide the foundation for evidence-based human-centric FWAs.
Keywords: Technostress, Flexible Working Arrangements, Digital Workplace, Bibliometric Analysis, Socio-Technical Systems.

1 Introduction

The rapid digital transformation of organizations has fundamentally redefined the nature of work. Flexible working arrangements (FWAs), including remote [1], [2], hybrid [3], [4], and telework [5]–[7] models as well as digital workplaces [8], [9], are becoming increasingly prevalent across

* Corresponding author

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Additional information. Author ORCID iD: H. Koç – https://orcid.org/0000-0002-1614-0230 and J. Hynes – https://orcid.org/0000-0001-8620-4271. PII S225599222600256X. Received: 12 December 2025. Accepted: 9 March 2026. Available online: 30 April 2026.

sectors [1], [10]. While FWAs offer notable advantages such as increased autonomy [11], [12] and work-life integration [11], [13], [14], they also introduce new challenges related to the pervasive use of digital technologies for work purposes [3], [15]. Among these challenges, technostress, the stress experienced due to the use of Information and Communication Technologies (ICTs) [16], emerges as a critical concern for both employees [17]–[19] and organizations [20], [21]. Technostress can negatively impact well-being [22], job satisfaction [23], [24], and productivity [25], raising important questions about how digital transformation can be managed in a human-centric and sustainable manner.

Recent scholarly literature demonstrates that while digital transformation and FWAs offer increased autonomy and flexibility, they also intensify work demands and blur the boundaries between work and personal life, leading to heightened technostress and work-related stress [26]. Empirical studies show that factors such as excessive digital actions outside regular hours and frequent virtual meetings significantly increase stress levels in highly digitalized environments [27]. As digital transformation accelerates, organizations are increasingly recognizing that the success of flexible working arrangements depends not only on technological advancements but also on the ability to address human needs and experiences [28], [29]. Recent scholarship emphasizes that a human-centric approach, prioritizing employee well-being, engagement, and autonomy, is not merely about technology adoption, but focuses on tailoring digital initiatives to meet the diverse needs of individuals within various contexts [30]. This shift towards a more human-centric approach recognizes that successful digital transformation depends largely on understanding and addressing the experiences and interactions that users have with technology [31]. While technology use offers significant productivity gains, it also introduces new job demands, such as blurred work-life boundaries and increased cognitive load, which can negatively impact well-being if not managed carefully [32]. FWAs refer to "a pattern of working conditions that enable employees to have an increased degree of control over when, where, and how they work" [32, p. 3]. Designing human-centric FWAs requires not only technological optimization but also a strategic focus on psychosocial support, flexible boundaries, and the empowerment of employees to ensure well-being and sustainable performance [29], [33].

As FWAs continue to evolve and digital tools become ever more embedded in organizational processes, the academic literature on technology-related stressors has expanded rapidly. The field is characterized by a diversity of disciplinary perspectives and theoretical approaches [16], [34]. This diversity, while enriching, also makes it challenging to obtain a clear, quantitative understanding of the intellectual structure, influential contributors, and emerging trends within the research domain. Bibliometric analysis offers a systematic and quantitative approach to mapping the development of a research field by examining publication patterns, citation networks, authorship, and thematic evolution [35], [36]. Unlike conceptual or narrative reviews, bibliometric methods focus on the dynamics of scholarly communication, the identification of core publications and authors, and the detection of research trends and knowledge gaps. Such analyses of FWA-related research are increasingly important for supporting evidence-based decision-making by researchers, practitioners, and policymakers in the context of responsible, human-centric digital transformation.

Despite the growing body of empirical research on technology-related stressors in FWAs, the intellectual structure, thematic evolution, and contextual patterns of this literature have not yet been systematically examined through bibliometric methods. Existing bibliometric studies have addressed technostress [37] or FWAs [38] in isolation, but have not mapped their intersection as a distinct research domain. Moreover, prior reviews have not employed a socio-technical lens to organize findings across the technical, personnel, organizational, and environmental subsystems. As we argue in Section 4, such a lens can reveal how research motivations, objectives, and reported outcomes cluster and interact across dimensions.

To do so, this study applies bibliometric analysis to the scholarly literature on technology-related stressors in FWAs, with the aim of interpreting the field's intellectual landscape and supporting the development of human-centric digital work environments. In addition to the bibliometric analysis, this study also applies a contextual analysis, extending our prior work [39]. This

complementary approach examines the motivations, key aims, reported benefits, and challenges highlighted across the reviewed studies, thereby offering a descriptive layer that enhances the quantitative insights and enables a richer interpretation of the research landscape. The following research questions guide the analysis:

1. How has the scholarly literature on technology-related stressors in flexible working arrangements developed? (Section 3.1)
2. Which journals, authors, and countries have played central roles in advancing this field and what are the collaboration patterns? (Section 3.2)
3. What are the foundational works of technostress research in FWAs? (Section 3.3)
4. How have research priorities and thematic foci in this field evolved over time? (Section 3.4)
5. What methodological approaches and theoretical frameworks have been used in studying technology-related stressors in FWAs (Section 3.5), and how are key concepts defined across the literature? (Section 3.6)
6. What are the primary research motivations (Section 4.1), objectives (Section 4.2), and reported benefits and challenges of FWAs in relation to technology-related stressors (Section 4.3)?

Against this background, the article is structured as follows: Section 2 outlines the review methodology. Sections 3 and 4 present the analysis results, addressing the research questions in dedicated subsections. Section 5 discusses the findings from a human-centric design perspective. Section 6 summarizes the study and addresses its limitations.

2 Methodology

This study follows the analysis procedure proposed by [40], which includes the following steps: research design, data collection, data analysis, visualization, and interpretation. We conducted a systematic search across EBSCOhost, Scopus, ProQuest, and Web of Science to identify empirical studies on technology-related stressors in flexible working arrangements (FWAs). The search string combined two main concepts: ("new way? of working" OR "digital workplace?" OR telework OR "remote work?" OR "telecommut?" OR "virtual work?") AND ("digital stress" OR "technology-related stress" OR "technological stress" OR technostress* OR techno-stress* OR "techno-overload" OR "techno-complexity" OR "techno-uncertainty" OR "techno-insecurity" OR "techno-invasion").

The following inclusion criteria were used: empirical studies (quantitative or qualitative) published in English, in peer-reviewed journals or conference proceedings, focusing on adults in organizational contexts (including freelancers), with outcomes related to technology-related stressors (e.g., technostress, digital stress, digital well-being) in the context of flexible working arrangements supported by ICTs. Exclusion criteria used were as follows: non-empirical articles (e.g., reviews, editorials, conceptual papers), studies not addressing technology-related stressors, those not involving FWAs or lacking employee autonomy, and articles not published in English or not peer-reviewed. The procedure was supplemented by forward snowballing to identify additional relevant studies that may not have been captured by database searches alone [41]. A systematic search across four databases initially identified 214 records. After removing 140 duplicates, non-English, or non-peer-reviewed articles, 74 records underwent title/abstract screening, excluding 55 for irrelevance to technology-related stressors or flexible work contexts, leaving 19 eligible articles. Forward snowballing of these 19 articles yielded 294 additional records, of which 276 were excluded during screening, resulting in 18 further inclusions. This produced a total of 37 eligible articles for the contextual analysis. As only 5 of these articles were not indexed in Web of Science, the citation-based bibliometric analysis was limited to the articles indexed in Web of Science only for consistency and comparability of bibliometric data [42]. As a result, five articles were excluded, yielding a final sample of 32 articles (see Table 1). Two independent reviewers screened all titles, abstracts, and full texts for eligibility. Discrepancies were resolved through discussion. To assess the consistency of the selection process, we calculated

the inter-rater reliability using Cohen's kappa, achieving substantial agreement ($\kappa = 0.68$), which indicates a high level of consistency between reviewers [43].

Table 1. Overview of the article selection process

Stage	Database search (n)	Forward snowballing (n)	Reason for exclusion
Records identified	214	294	
Removed before screening	140	-	Duplicates, non-English, not peer reviewed
Screened	74	294	
Excluded after screening	55	276	Irrelevant to technostress/ FWAs, non-empirical
Total eligible articles	19	18	
Final pool for contextual analysis: 37			
Not indexed	5	-	Not available in Web of Science for bibliometric analysis
Final pool for bibliometric analysis: 32			

3 Bibliometric Analysis

For the bibliometric analysis, we used the bibliometrix package in R [44]. Of the 32 articles in the pool, the metadata completeness was excellent, except for the DOI, which was missing in one article.

The analysis reveals a rapidly evolving field of study spanning from 2014 to 2024, with a robust annual growth rate of 25.89%, indicating a significant increase in scholarly interest and output, especially after 2020. The corpus comprises contributions from 102 authors, with 28.12% of the articles demonstrating international collaboration. On average, each document is authored by 3.47 researchers, suggesting a trend towards collaborative research efforts. The pool's richness is evidenced by 164 keywords, while the substantial number of 2072 references underscores the depth and breadth of the theoretical foundations of this research area. Having received 14.53 citations on average, the relative recency of the field is highlighted by the average article age of 1.75 years, indicating a contemporary and rapidly developing body of knowledge.

3.1 Scientific Outlets

Of the 32 articles, Internet Research has published the most studies (n = 4), followed by Frontiers in Psychology (n = 3), Information Technology & People (n = 3), and Computers in Human Behaviour (n = 2). Collectively, these four journals account for 38% of the articles in the pool, indicating their significant role in shaping the discourse on this subject (see Table 2). According to Bradford's Law [45], these journals can be considered the core sources for research in this area; they consistently publish high-quality, relevant studies on the topic. Within the same pool, MIS Quarterly is the most frequently cited journal (n = 103), followed by the Journal of Applied Psychology (n = 94), and the Computers in Human Behavior Journal (n = 83).

Table 2. Most relevant and locally cited resources

Most relevant sources (Number of articles)	Most locally cited sources (Number of articles)
− Internet Research (4) − Frontiers in Psychology (3) − Information Technology and People (3) − Computers in Human Behavior (2) Others (20)	− MIS Quarterly (103) − Journal of Applied Psychology (94) − Computers in Human Behavior (83) − Information Systems Journal (56) − Information Systems Research (48)

3.2 Authors and Country Collaborations

Jaeung Lee emerges as the most influential author, receiving 129 total citations, closely followed by Ayoung Suh with 124 citations. Louise Leung and Renwen Zhang share the third position with 73 citations each, while Pengzhen Yin accumulates 66 citations. In terms of longitudinal contribution, Christian Maier demonstrates the most extended research timeline, spanning from 2014 to 2024 with two publications ([12], [18]). Jaeung Lee follows with three articles ([6], [23], [46]) across this period, and Pengzhen Yin contributes two ([19], [24]). The publication pattern indicates a high degree of diversity in authorship, with 92% of authors contributing a single article, 7% publishing two, and only 1% producing three articles. Table 3 illustrates the publication pattern of top 5 authors from the perspective of total citations (TC) in Web of Science an article received.

Table 3. Authors' impact metric (Top 5 Authors according to TC of Web of Science)

Authors	h_index	g_index	m_index	TC	NP	PY_start
Jaeung Lee	2	3	0.25	129	3	2017
Ayoung Suh	1	1	0.125	124	1	2017
Louise Leung	1	1	0.125	73	1	2017
Renwen Zhang	1	1	0.125	73	1	2017
Pengzhen Yin	2	2	0.286	66	2	2018

We investigated the distribution and international collaboration of scientific publications across various countries which have two or more records (see Figure 1). Judging by the corresponding authors' countries, German institutions lead by contributing to 18.8% of the articles, with a notable but low Multiple Country Publication (MCP) rate of 16.7%. This indicates limited international collaboration among German researchers. In contrast, Chinese institutions account for 15.6% of the articles, with a higher MCP rate of 40.0%, the second highest among the analyzed countries, reflecting a stronger inclination towards international partnerships. French and US institutions each contribute 9.4% of the articles; however, while French publications have an MCP rate of 33.3%, indicating moderate international collaboration, US publications exhibit no MCP activity, suggesting a focus on domestic research collaborations. Finnish, Indian, and Italian institutions each contributed 6.3% of the articles. Notably, Indian institutions demonstrate the highest MCP rate at 50%, highlighting their international research collaborations, whereas Finnish and Italian institutions show no MCP activity.

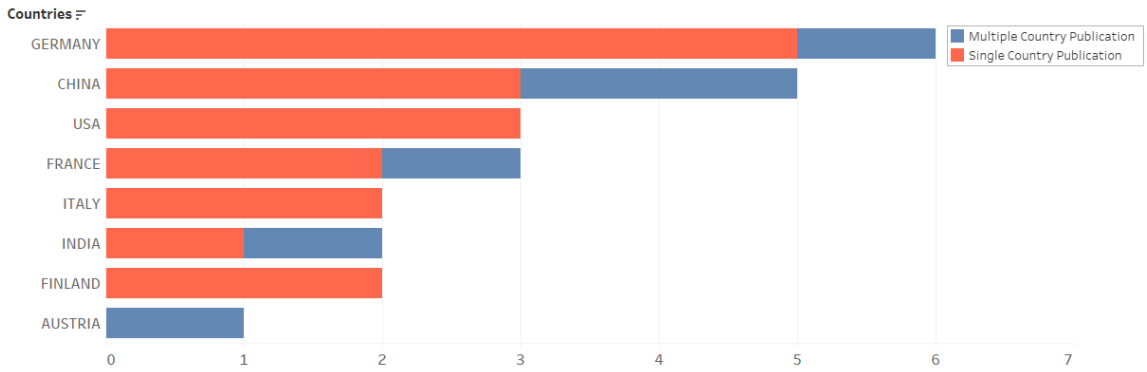

Figure 1. Publishing countries and collaborations

Considering the author affiliations, Germany emerges as the most productive country with 19 authors, notably exhibiting a significant increase in 2022. China and the United States of America are tied for the second position, each contributing with 10 authors to the literature. Interestingly, the data suggests a shift in productivity for American authors, who became more prolific after

2021. India and Italy have contributed with 6 and 5 authors respectively. Both countries only began contributing after 2022, suggesting a recent recognition of the importance of this field (see Figure 2).

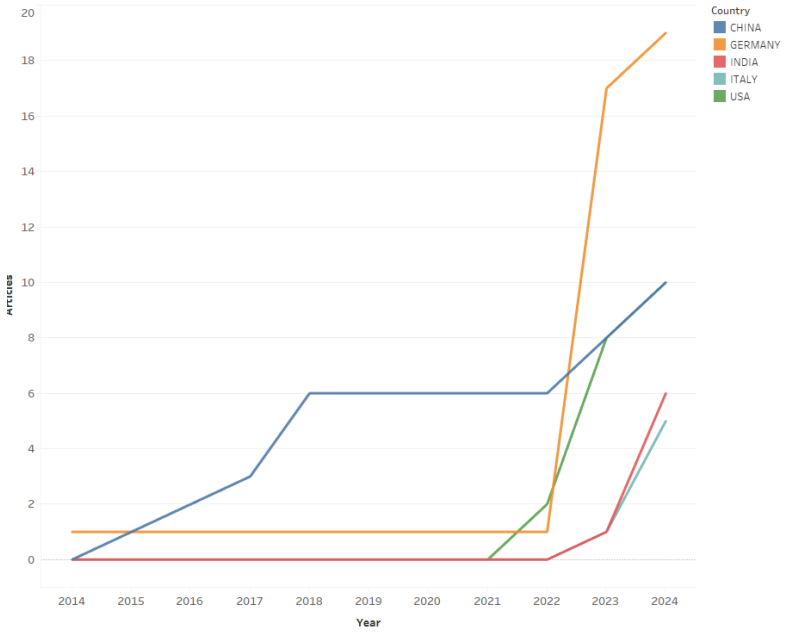

Figure 2. Publication timeline by country

3.3 Influential and Seminal Articles

In the analysis, several articles within the pool emerged as particularly influential based on their citation metrics. The normalized TC score is calculated by dividing the actual count of citing items by the expected citation rate for documents published in the same year. [11] demonstrates a strong impact with 53 total citations, translating to an average of 17.67 citations per year and a normalized total citation score of 3.53 (calculated by dividing the actual count of citing items by the expected citation rate for documents published in the same year). While [46] has received the highest absolute number of citations (124) over time, yielding an annual average of 15.50, its normalized total citation score of 1.26 suggests a more moderate impact when adjusted for field and temporal factors. [9] exhibits robust citation performance with 47 total citations, an annual average of 11.75, and a normalized total citation score of 1.77. Importantly, [7] presents the highest normalized total citation score of 4.07, despite a lower absolute citation count of 11. The most globally cited articles (with at least 10 total citations), ordered by annual average TC (TC per year), are shown in Table 4.

Table 4. Most globally cited documents

Article	TC	TC per year	Normalized TC	Pub. Year
[11]	53	17.67	3.53	2022
[46]	124	15.50	1.26	2017
[9]	47	11.75	1.77	2021
[7]	11	11.00	4.07	2024
[5]	73	9.13	0.74	2017
[24]	62	8.86	1.00	2018
[12]	26	2.36	1.00	2014

The Reference Publication Year Spectroscopy (RPYS) analysis of technology-related stressors in FWAs (see Figure 3) reveals a concentration of influential work in recent years, with notable

historical roots. The most prominent peak occurred in 2020, accumulating 211 citations, with seminal contributions from [47]–[49] reflecting the surge in research interest coinciding with the global shift to remote work (see Figure 3). This is closely followed by 2021 (206 citations), with [50]–[52]. The third highest peak was in 2017 with 144 citations. The most cited article is [46], and the two most influential authors have been discussed earlier. They are followed by [53] and [54]. Notably, 2007 stands out as a landmark year when examining the deviation from the 5-year median, marking the first instance of exceeding 100 citations and highlighting the foundational nature of publications from this period. Article [25] was cited 17 times within the analyzed pool and emerges as a particularly influential work. This is accompanied by significant contributions from [55] and [56]. References prior to 2007 refer to theoretical constructs (e.g., Job Demands-Resource (JD-R) Theory [57]), research methods (e.g., common method bias [58]), stress-related concepts (e.g., occupational stress [59] or work exhaustion [60]).

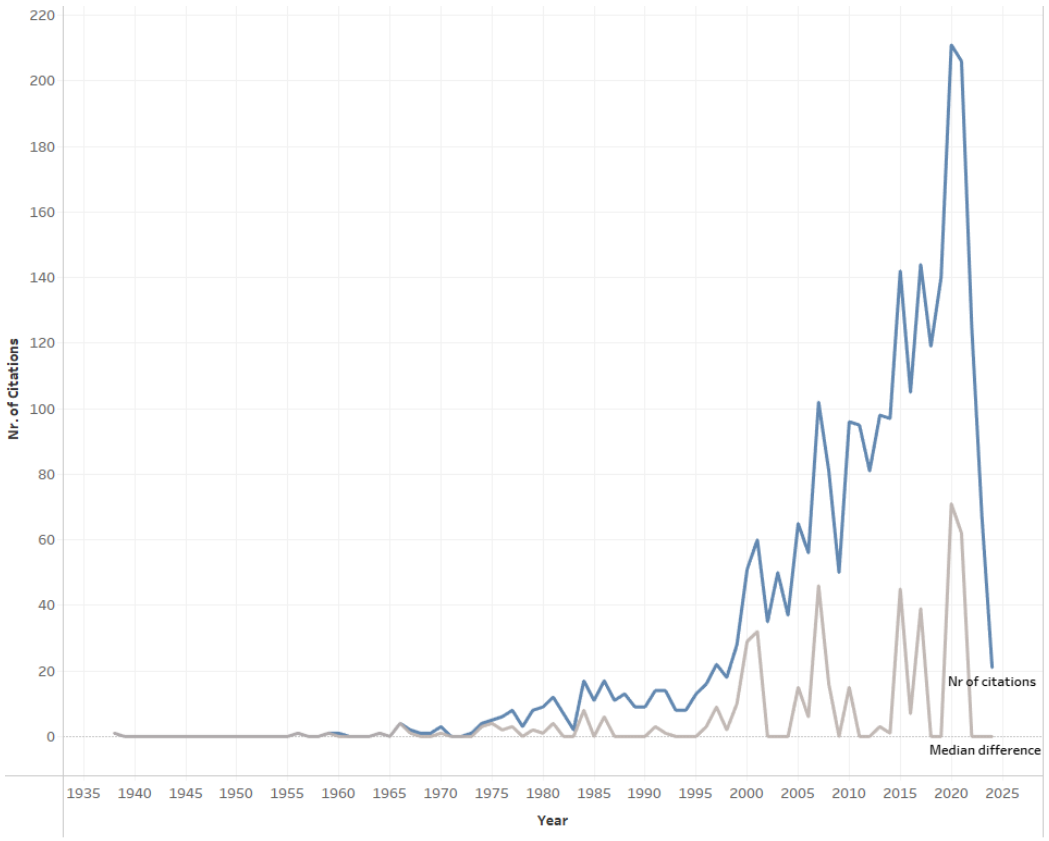

Figure 3. Reference publication year spectroscopy analysis

The RPYS analysis, combined with an examination of the most frequently cited articles within our sample, reveals three significant patterns in the literature on technology-related stressors in FWAs. Firstly, five seminal works on technology-related stress emerge as foundational to the field: [25], [61]–[63], [65]. These studies collectively establish the theoretical underpinnings and conceptual framework for understanding technostress in organizational contexts. Secondly, [64] stands out as a primary methodological reference for quantitative studies in this domain, indicating its importance in guiding the analytical approaches employed by scholars. Lastly, [46] represents a pivotal contribution in contextualizing technology-related stressors within FWAs, with a particular focus on teleworking. This study bridges the gap between the broader technostress literature and the evolving landscape of FWAs, thereby setting a foundation for subsequent research in this area (see Table 5).

Table 5. Most frequently cited articles within the pool

Article	First author	Local citations	Pub. Year
[61]	T.S. Ragu-Nathan	24	2008
[62]	Ramakrishna Ayyagari	21	2011
[25]	Monideepa Tarafdar	17	2007
[63]	Monideepa Tarafdar	16	2015
[64]	Joseph F. Hair	12	2010
[65]	Monideepa Tarafdar	12	2010
[46]	Ayoung Suh	11	2017
[16]	Didem Taşer	9	2019
[55]	Chudoba Ahuja	9	2007
[56]	Ravi S. Gajendran	9	2007

3.4 Thematic Shifts in Research

We ran a word frequency analysis over time, based on the author keywords. To account for the substantial increase in published research post-pandemic (only 12.5% of all articles in our pool were published in the pre-pandemic era), all term frequencies were normalized by the number of articles in each period. The decision to partition the analysis into pre-pandemic (2014–2019) and post-pandemic (2020–2024) phases is supported by the multi-correspondence analysis findings, which revealed that while the COVID-19 pandemic frequently contextualizes studies, it serves as a temporal marker rather than a primary research focus. The results are shown in Table 6. Terms with zero frequency imply complete absence of the keywords. Nevertheless, these were included to highlight the emergence of new themes post-pandemic.

Table 6. Most frequently cited articles within the pool

Pre-pandemic (2014-2020)		Post-pandemic (2021-2024)	
Top 10 Terms (Ordered by normalized frequency)	**Normalized Frequency**	**Top 10 Terms (Ordered by normalized frequency)**	**Normalized Frequency**
Technostress	0.50	Technostress	0.46
Job satisfaction	0.50	FWA	0.32
FWA	0.25	Well-being	0.21
Work-life balance	0.25	Work-life balance	0.18
Well-being	0.00	Work engagement	0.14
Work engagement	0.00	Performance	0.11
Performance	0.00	Stress	0.11
Stress	0.00	Coping	0.07
Coping	0.00	Covid-19	0.07
Covid-19	0.00	Job satisfaction	0.07

The keyword analysis reveals both continuity and transformation in the research focus on technology-related stressors in FWAs from the pre-pandemic to the post-pandemic period. Before the pandemic, technostress, job satisfaction, FWAs (synonyms: telework, remote working, remote work), and work-life balance (synonyms: work-life conflict, work-family balance, family-work conflict, work-family conflict) were the most prominent keywords, indicating a strong emphasis on individual experiences and outcomes within flexible work contexts. In contrast, the post-pandemic era is characterized by a reordering of priorities: technostress remains central, but FWAs rise in prominence, and new themes such as well-being (synonyms: mental health, psychological health), work engagement, performance, coping, and stress emerge as significant keywords, none

of which appeared in the pre-pandemic period. Notably, job satisfaction drops sharply in the rankings, while well-being and work engagement become much more visible, reflecting a shift towards a human-centric perspective on employee experience and organizational health. The increased attention to well-being and stress underscores the field's adaptation to new realities and challenges introduced by the pandemic.

3.5 Methodological and Theoretical Approaches

Using three categories (qualitative, quantitative, or mixed-method approaches), we analyzed the research methods employed across the studies (including also the 5 works not indexed in Web of Science, which were excluded from the analysis in previous subsections). Of the 37 articles in the pool, 31 utilized quantitative methods (83.78%), followed by 4 qualitative (10.81%), and 2 mixed methods (5.41%) studies. Our findings support the conclusions from similar studies that quantitative methods are utilized the most in technostress [32], [66], New Ways of Working [67], and remote e-working [68]. The average sample size of the articles adopting quantitative methods is 343. The qualitative studies report an average sample size of 33 respondents.

Upon exclusion of articles lacking a theoretical framework, we found that the JD-R model was the most frequently cited (20.41%), followed by the Transactional Model of Stress and Coping (TMSC) (18.37%), as shown in Figure 4. Other prominent theories include the Conservation of Resources Theory (8.16%), Person-Environment-Fit Theory (6.12%), Job Characteristics Theory (4.08%), and Boundary Theory (4.08%). The JD-R model dominated in quantitative studies, while qualitative and mixed-method studies primarily employed TMSC.

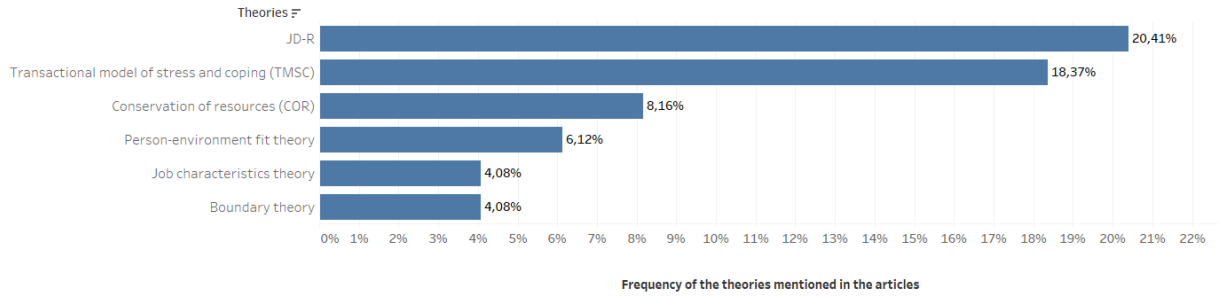

Figure 4. Theories employed in the articles (37 sources analyzed)

3.6 Definitions and Conceptualizations of FWAs

We identified various terms and concepts used to refer to FWAs, analyzed how and in which year they are defined and investigated the commonalities the terms share.

Telework(ing) was the most widely applied term (n = 9), suggesting its prominence in FWA research. The usage pattern visualized in Figure 5 suggests a resurgence of interest after 2022, possibly due to the global shift to remote work during the COVID-19 pandemic. The term has been used synonymously with telecommuting [5], [7], [12], [23], [69], remote work [6], [12], [69], [70], virtual work [12], and work from home [7], [71]. The second most common term was remote (e-)work(ing) (n = 8). The trend analysis in Figure 5 shows that this term has found consistent usage over time. This trend suggests that remote work has become a stable concept in FWA research, maintaining its relevance across different periods. The term was used synonymously with telecommuting [5], [72], telework(ing) (see above), and work from home [19], [71], [72]. The term "digital workplace/ digital working environment/ digital work" was also applied frequently (n = 7). Figure 5 shows that this term gained popularity over the years, finding its peak in 2023. This trend indicates a growing focus on the digital aspects of FWAs, reflecting the increasing importance of technology in shaping modern work environments.

The definitions adopted to describe FWAs share several common attributes. *Use of ICTs* is a central theme, emphasizing the reliance on digital tools and technologies to facilitate FWAs and enhance productivity. *Location independence* is another key aspect, allowing employees to work from various locations rather than being limited to traditional office spaces. *Flexibility* enables individuals to adapt their work schedules and environments to better balance their responsibilities.

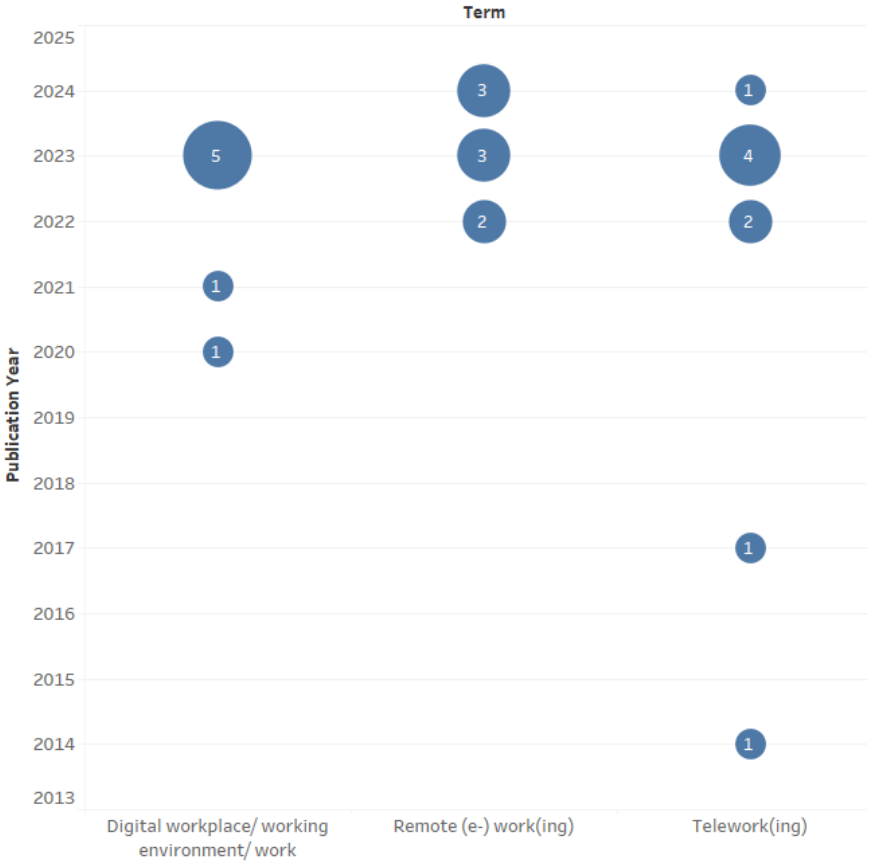

Figure 5. Top three terms and trends

4 Contextual Analysis of FWA Research

With the contextual analysis, we investigate the motivations, primary objectives, benefits, and challenges mentioned in the studies, providing a descriptive foundation. To do so, we employ socio-technical systems (STS) theory, which emphasizes that organizational outcomes emerge from the complex interplay between social and technical elements [73]. Rooted in the foundational work of Trist and Bamforth [74], STS theory recognizes that the social and the technical dimensions are inherently interdependent and must be jointly optimized to achieve favorable workplace outcomes. This theoretical lens is particularly relevant given the evolving nature of contemporary workplaces and the changing dynamics between employees and technologies [75]. The STS framework comprises four interconnected subsystems: the technical subsystem (technological infrastructure and tools), the personnel subsystem (employee experiences and well-being), the organizational subsystem (internal structures, policies, and culture), and the environmental subsystem (broader contextual factors shaping work arrangements).

We chose the STS theory as our organizing framework because it captures the multi-layered interdependence that characterizes technology-related stress in FWAs: stress rarely arises from technology alone but from misalignments across technical, personnel, organizational, and environmental factors [25], [62], [76]. Accordingly, we use the four subsystems as an analytical lens to categorize and interpret the motivations, objectives, benefits, and challenges reported across the reviewed studies, tracing how stressors emerge from the interaction between these

subsystems rather than from any single dimension. These interpretations are discussed and finally amalgamated in Table 7 in the remainder of this section.

4.1 Rationale of Investigating FWAs in the Reviewed Studies

The relevance of studying FWAs is underscored by the influence of ICT-related work stressors. Within the *technical subsystem*, the increased reliance on technology in FWAs has led to concerns about its implications, in particular technostress creators and digital overload. Scholars have been exploring how the (excessive) use of technological devices and adaptation to new software impacts employees and how they can deal with the dark side of technology use. The use of ICTs in the virtual and hybrid work settings can lead to technostress [4], [77] and interruption overload [24]. Understanding these unintended negative consequences [78] is essential, as is exploring the interplay between technostress and coping responses [18], [79]. Underlining the importance of the humanistic effects of technology use is thus a key motivator [6], the findings may help solve the paradoxes associated with it [80].

Due to the rapid shift towards remote/ hybrid working models in the post pandemic age, and the prevalence of technology-mediated business models, adapting to the new normal is the most mentioned *environmental subsystem* topic in justifying the need to study FWAs. Contemporary workplaces develop more to digital workplaces [8], [80]; with telework [23], hybrid workforce models [81], work from home [82] becoming the new normal [23], potential norm for work [11] or default working option [71]. FWAs have gained acceptance in various sectors [83] even with the mitigation of the pandemic [72]. As Banerjee and Gupta state, the "very foundation of the traditional work setting is being challenged by the need for working in remote mode" [2, p. 1]. Although extensive technology use (e.g., Enterprise Bots, [70]) and communication via ICTs [83], [84] characterize this transformation, the changes not only impact the tools used for work, but also the nature of work as such [9]. In this sense, employer's premises, employees' personal workstations and collaboration platforms form important components of the FWAs [3]. Consequently, scholars advocate the need for more empirical research assuming the significance of FWAs in future work scenarios [7], as the use of digital technologies may lead to the specific paradoxes [80], and impact organizational outcomes in adapting to the new normal. One such paradox concerns balancing work and family roles. A key challenge lies in finding the right balance between these two roles [5], [85], leading researchers to investigate the impact of segmentation preferences in FWAs [78]. Advances in technology have also led to the adoption of novel business models. Against this background, the growth of Online Labor Markets (OLMs) and the gig economy[†] in general has prompted research into the broader economic implications of FWAs. Articles mention well-being related aspects as the primary motivation for their research, emphasizing the role of OLMs in driving growth within the gig economy [86] and pointing out the increase in platform workers [87].

Scholars also justify the need for studying the *organizational* aspects within the FWAs to understand performance/ productivity related outcomes. Despite the benefits for organizations to minimize costs [13], the implementation of FWAs can also have negative results [12]. Productivity relying on ICTs may have increased, but at the cost of decreasing well-being [19], motivating the investigation of remote work's impact on job satisfaction [46]. Understanding the performance factors related to remote work is important for highlighting how FWAs impact organizational success or failure [88]. Focusing on technology, some success factors are argued to be ICT use training [69] and adopting new capabilities for increasing efficiency [89] and productivity [20].

With the rise of FWAs, there is a growing need to understand the *personnel* subsystem, in particular mental health, burnout, and coping strategies. Digital work may result in health issues [90], making it essential to understand employees' needs when working from home to reduce burnout [5] and strain [17]. Studies provide descriptive statistics on burnout rates [83],

[†] https://www.investopedia.com/terms/g/gig-economy.asp

emphasizing the relevance of this literature gap [21]. This also connects to the productivity/ performance discussed earlier, as scholars argue that improving well-being in FWAs leads to a more productive workforce [24]. Henceforth, some scholars research into coping mechanisms to alleviate the negative impacts of FWAs [6], [18], and the dark side of technology use [79], [80].

4.2 Objectives Identified in the Reviewed Studies

This section summarizes the primary objectives of the 37 studies, which were synthesized after analyzing the research questions and objectives mentioned in the articles. From a *technical subsystem* perspective, a common objective among the studies is the examination of technostress creators, with studies exploring how job and technology characteristics contribute to stress [46], and how demographic information may be used to predict technostress [5]. The context of remote work receives particular attention, with investigations into technology-related stressors specific to teleworkers [81] and the role of remote working technology in technostress generation [2], [11]. Some studies narrow their focus to specific factors, such as techno-invasion in digital platform work [87], technology overload factors [24], and ICT-based mobile managers' technostress [79].

The design and attributes of technologies emerge as an essential area of study within the technical subsystem of FWAs. The studies have examined the technology characteristics in inducing technostress among remote or teleworkers [4], [8], [46], collectively underscoring the importance of technology design in mitigating stress. In response, Zeuge et al. [85] have explored the potential for integrating autonomy into technology design, seeking ways to reduce technology-related stress.

Within the *personnel subsystem*, key terms emerge around stress, well-being, and coping strategies in technology-mediated work environments. Researchers have aimed to explore the stress and well-being perspective by analyzing the exhaustion due to teleworking stressors among IT personnel [12] and the connections between remote working self-efficacy, organizational support, and mental well-being [21]. Departing from the idea that not all stress is bad, the goal of van Slyke et al. [23] was to explore the distinction between eustress and distress in telework settings, with their antecedents and effects on work outcomes. Scholars have sought to investigate the interaction with technology-related stressors, focusing on the long-term impact of workplace cyberbullying on employee well-being and strain [17], the influence of technostress on satisfaction with remote working [82], and its connection to feelings of loneliness [11]. One objective was to analyze the impact of technology characteristics on worker outcomes. Here, investigations intended to understand how mobile ICTs shape employees' adaptive use behavior and well-being [19], and how technology attributes affect OLM workers' strain [86].

A further goal mentioned in a few studies was unfolding the effect of coping strategies. Scholars examine their impact on humanistic telework outcomes [6], such as decreasing the overload effects of mobile technology use [24], preventing technostress via a set of predefined measures [77] or raising awareness on the technological paradoxes [80]. Additionally, the role of coping strategies is analyzed in relation to virtual competencies [2], and a digital mindset [18] contributing to the intersection of technology-personnel subsystems.

In the *organizational subsystem*, studies set out to understand the change in productivity in FWAs with the use of professional social media [20], enterprise bots [70] or enterprise social media [13]. Scholars have intended to investigate support and communication as key research topics. They have sought to understand the impact of technostressors on perceived organizational support and work engagement [4], job satisfaction [19], [46], and the role of supportive team communication in mitigating stress due to technology [69]. Additionally, they have aimed to explore the influence of digital leadership on technostress [83] and examine the role of job demands [88] and resources [7] in enhancing employee performance [21] and commitment [3] in technology-mediated work environments.

The studies address the need to understand the factors contributing to a successful transformation [9] and digitalization of working environments [89] in the *environmental*

subsystem. Classifying job-demands and resources, the objective of Ruiner et al. [90] is designing a digital workplace typology from a human-computer interaction (HCI) perspective. Another key topic mentioned in the environmental subsystem is the work-life balance [84]. Researchers have explored how individual preferences and group segmentation norms influence work-home boundaries [72]. The technical aspects of this integration are demonstrated in studies examining the impact of technology invasion on work-life balance [87], the role of videoconferencing fatigue in work-family conflict [71], and how technology-driven demands affect employees differently based on their preference to separate or integrate life domains [78].

4.3 Benefits and Challenges within the FWAs Context

We identified the advantages and drawbacks of FWAs cited by the authors and categorized them using the STS perspective.

ICTs play a central role in enabling FWAs by providing essential infrastructure that support remote work and flexible schedules [5], [70], [77]. However, the reliance on digital tools also introduces significant obstacles. Technostress has been highlighted in many studies as a primary concern [8], [11], [13], [77], [79], [81], [84], [85], [90], often attributed to increased use of technology [8], [77] and the constant connectivity it enables. Studies highlight an overreliance on digital communication tools [17], [24], [88] and constant contact with ICTs [79]. Specifically, [2] and [80] cite "Zoom fatigue", indicating issues with prolonged use of video conferencing platforms. In addition, the increased employee monitoring [80], [90] and greater control on over work processes [4] bear the risk of workplace cyberbullying [17].

Turning to the *personnel subsystem*, the reduction in commuting [3], [7], [71] and greater flexibility and autonomy in work schedules [3], [11], [12] enabled by the ICTs contribute to a more positive work experience in FWAs. Among further advantages are increased job satisfaction and engagement [3], [12], [23], [81]. Interestingly, the decrease in the feelings of belonging to the organization is cited as a drawback in FWAs [7], [46], [69], [71]. Similarly, mental health aspects are mentioned both as challenges and benefits, underscoring the importance of understanding the technical-personnel subsystem interactions. While ICT use can lead to cognitive overload [19] and pressure to remain constantly available [69], [79], resulting in heightened stress [9], [12], [85], burnout [9], [71], guilt [19], enhanced well-being is also noted as one of the benefits of FWAs [7], [19], [23].

FWAs present numerous benefits for the *organizational subsystem*, such as enhanced talent attraction and retention [12], [23], improved organizational adaptability [21], access to a global talent pool [86], and fostered innovation [9], [82]. Furthermore, cost savings through reduced office space and overhead expenses [2], [12], [82] are cited as advantages. Many studies mention improved organizational performance and productivity [8], [9], [79], [83], often attributed to the flexibility and efficiency afforded by digital technologies. In contrast, decreased job effectiveness [88], and job performance [81] are noted as drawbacks. A similar dilemma arises regarding cross-functional collaboration, which is perceived as enhanced [9], [46], but also challenging due to the reduced face-to-face interaction of the technology-mediated communication. This reduction complicates team coordination [6], information exchange [72], and informal communication [3].

The contribution of FWAs to the *environmental subsystem* has also been cited in several articles. The most notable advantage is the reduced environmental impact due to decreased commuting [3], [7], [71], leading to less traffic congestion and pollution [2], [5], [71]. This shift also results in energy savings and contributes to more sustainable work practices [5], [71]. However, a dilemma arises regarding work-life balance; struggles to separate work from personal life [5], [20], [70] and feelings of isolation [12], [86] are listed. The physical work environment is also mentioned as a drawback due to home-office constraints [7], including lack of space for work activities [11] or poorly arranged workstations [87].

Table 7. FWA Research Context: A Summary

Subsystem	Rationale for investigating FWAs	Study goals	Benefits	Challenges
Technical	- Need to understand the impact of increased reliance on technology - Exploration of coping responses - Understanding the unintended negative consequences of ICT use - Investigating the humanistic effects and paradoxes associated with technology use	- Examine technology-related stressors - Explore the role of remote working technology in technostress generation - Study the role of demographic information on technostressors - Analyze technology characteristics - Technology design optimization	- Technology enables remote work and flexible schedules, providing essential infrastructure for FWAs	- Technostress due to increased use and constant connectivity - Overreliance on digital communication tools - Zoom fatigue - Increased employee monitoring - Workplace cyberbullying
Environmental	- Adapting to the "new normal" - Understanding the transformation of traditional work settings to digital workplaces - Investigating work-life integration challenges and segmentation preferences - Exploring the growth of the gig economy	- Understand factors contributing to the digitalization of working environments - Design a digital workplace typology - Explore work-life balance and the role of preferences in boundary management	- Reduced environmental impact due to decreased commuting - Less traffic congestion and pollution - Energy savings - More sustainable work practices	- Struggles to separate work from personal life - Feelings of isolation - Home-office constraints (lack of space, permeability issues, poorly arranged workstations)
Personnel	- Examining the impact of digital work on mental health and burnout rates - Understanding employees' needs when working from home to reduce strain - Investigating coping mechanisms to alleviate the negative impacts of FWAs - Exploring the relationship between well-being and productivity - Researching strategies to address the dark side of technology use	- Analyze exhaustion and strain - Explore connections between job and organizational resources, and well-being - Examine the effects of coping strategies - Investigate the distinction between eustress and distress - Examine the impact of technostress on loneliness in remote e-working	- Reduced commuting stress - Greater flexibility and autonomy - Increased job satisfaction and engagement - Enhanced well-being	- Cognitive overload - Pressure to remain constantly available - Heightened stress and burnout - Feelings of guilt - Decreased feelings of belonging to the organization - Decline in employee well-being
Organisational	- Understanding performance and productivity outcomes in FWAs - Investigating the cost-benefit balance of implementing FWAs - Exploring the impact of FWAs on job satisfaction and organizational success - Identifying success factors such as ICT training and new capabilities for efficiency	- Understand changes in productivity in FWAs with the use of various technologies - Investigate the impact of technostressors on perceived organizational support and work engagement - Examine the role of supportive team communication and digital leadership in mitigating technology-related stress - Investigate the role of job demands and resources in enhancing employee performance and commitment	- Enhanced talent attraction - Improved organizational adaptability - Access to a global talent pool - Fostered innovation - Cost savings through reduced office space - Improved organizational performance and productivity - Enhanced collaboration	- Decreased job effectiveness - Reduced job performance - Challenges in team coordination - Reduced informal communication - Difficulties in information exchange

5 Discussion

5.1 The Shift Toward Human-Centric Research

Comparing pre- and post-pandemic periods, well-being displaced job satisfaction as the primary research outcome, suggesting researchers increasingly prioritize holistic employee outcomes over instrumental objectives. This evolution aligns with recent bibliometric findings: Yadav and Bagri [91] analyzed 400 articles on flexible work cultures, and identified well-being as a central emergent theme, Kumar et al. [92] found work-life balance and effectiveness dominated remote work research across 745 articles. Our temporal analysis extends these findings by revealing that well-being emerged from complete absence from pre-pandemic keywords to become a central priority, while job satisfaction declined sharply. However, alternative explanations warrant consideration. The prominence of well-being may reflect pandemic-specific mental health concerns rather than lasting conceptual evolution, or researchers adapting language to align with COVID-era funding priorities. Lin and Yu [93] observed similar patterns in higher education technostress research, attributing the surge to the stressful and anxious nature of remote learning during the pandemic.

5.2 Field Fragmentation: Methodological, Theoretical and Geographic Patterns

Research on technology-related stress is primarily based on quantitative methods, as echoed in comparable scholarly investigations [32], [37], [66]. Quantitative methods provide analytical consistency, but they also constrain understanding of context-dependent experiences. Cross-sectional surveys cannot capture temporal dynamics, such as adaptation effects or evolving coping strategies. More critically, they struggle to explain the paradoxes our analysis revealed: why identical technologies enhance well-being in some contexts while diminishing it in others. Regardless of the adopted method, a detailed analysis of the studies revealed several shortcomings. Notably, the criteria for inclusion in study samples were often not clearly defined, with a lack of emphasis on important factors such as remote work requirements or definitions thereof. In longitudinal studies, strategies to address incomplete follow-up were not mentioned. To enhance the rigor and reliability of future research in this field, scholars should carefully consider the methodological issues, such as well-defined sample inclusion criteria, and robust approaches to handling longitudinal data challenges.

Theoretically, the JD-R model and TMSC prevail. Despite work-life boundary management emerging as central across all four STS subsystems, Boundary Theory appears in only 4.08% of the studies. This theoretical gap has important implications. The STS framework posits that technology outcomes depend on alignment across subsystems, not technology characteristics alone. Collaboration tools, to name an example, are argued to enhance productivity in some studies, but increase stress in others. These differences can be explained by organizational policies governing response expectations [11], training in digital communication [69], and cultural norms around availability [81]. When platforms are implemented without clear response time policies (organization subsystem), without communication skill development (personnel subsystem), and where norms demand constant availability (environmental subsystem), the same tools enabling coordination may generate overload.

The bibliometric analysis reveals limited international collaboration (28.12% of articles) and concentration in European and North American contexts, with German institutions contributing 18.8% of the analyzed studies indexed in Web of Science. This geographic distribution reflects infrastructure dependencies: technology-related stressors in FWAs presuppose reliable connectivity, organizational capacity for remote work implementation, and workforce segments engaged in knowledge work. Consequently, the current frameworks describe a context-specific

phenomenon with a focus on digitally mature economies, and their applicability will evolve as digital infrastructure matures globally.

5.3 Implications for Research and Practice

For researchers, four main priorities emerge. First, to foster inclusive FWA practices, future research should prioritize partnerships with Global South institutions to investigate localized stressors, such as infrastructure disparities and informal labor dynamics. Second, methodological diversity is critical: longitudinal designs can track adaptation trajectories, and mixed-method approaches can investigate conditions under which technologies enhance/diminish well-being. Third, adopting socio-technical perspectives in research design is critical, as our analysis revealed that technology outcomes depend on alignment across organizational, personnel, technical, and environmental subsystems. Researchers should develop measures that capture coordination across subsystems rather than only evaluating technology features. Fourth and last, developing diagnostic and analytical tools enabling structured assessment of stressors interacting across technical, personnel, organizational, and environmental subsystems would support both research and practice, moving beyond evaluations of isolated factors. Table 8 reformulates these four priorities as key questions and illustrates possible research directions.

Table 8. Key research priorities for FWAs: Questions and illustrative directions

Priority	Key question	Example research directions
Foster inclusive FWA practices	How do FWAs interact with local infrastructure and informal labor arrangements in different Global South contexts?	Comparative case studies of FWAs in regions with varying connectivity; ethnographic work on informal labor and flexible work; collaborations with local unions/non-governmental organizations.
Ensure methodological diversity	How do well-being and adaptation trajectories to FWAs unfold over time and across worker groups?	Longitudinal panel studies on FWA; mixed-method designs combining surveys with interviews; quasi experiments around phased FWA rollouts.
Adopt socio-technical perspectives	Under what conditions does alignment/ misalignment across socio-technical subsystems shape technology's impact on well-being?	Studies modeling interactions across organizational policies, technologies, and boundary norms; multi-level designs linking individual outcomes to organizational configurations.
Develop diagnostic/ analytical tools	How can we systematically assess interacting stressors across subsystems rather than isolated factors?	Development and validation of diagnostic instruments or checklists; simulation/modelling of stressor interactions; toolkits for researchers to code socio-technical configurations.

For practitioners, the shift from job satisfaction to well-being as research priorities signals the need to update FWA evaluation metrics. Organizations should assess well-being, work engagement, and boundary management quality, and related humanistic outcomes [94] alongside productivity indicators. The socio-technical interdependencies identified indicate that isolated interventions, such as implementing "better" technologies, offering well-being apps, or providing training alone, will likely prove ineffective and challenge technology-centric interventions. Instead, effective approaches require coordinated attention to technology design, organizational policies, skill development, and boundary management simultaneously. Addressing the need for diagnostic tools identified among the research priorities above, the authors have developed and empirically validated the Flexible Working Arrangements Socio-Technical Stress (FWA-STS) Maturity Model. FWA-STS Maturity Model is a diagnostic instrument that operationalizes the socio-technical framework by assessing organizational maturity across the four STS dimensions adopted in this review[‡].

[‡] The study describing the instrument's development and PLS-SEM validation is currently under review. Further details on the assessment framework are available at https://www.berlin-international.de/en/magazine/blog/fwa-sts-maturity-model/

6 Conclusion

This bibliometric and contextual analysis examined technology-related stressors in flexible working arrangements. Research (indexed in Web of Science) grew 25.89% annually after 2020, yet remains geographically concentrated (Germany-China-US) with limited international collaboration. The research demonstrates a fundamental reorientation in scholarly priorities: well-being and work engagement emerged as central concerns post-2020, displacing the pre-pandemic emphasis on job satisfaction. This thematic shift signals a movement toward more human-centric perspectives on technology-mediated work, yet the field's capacity to translate these insights into practice remains constrained by methodological homogeneity (83.78% quantitative).

The study extends prior bibliometric work on technostress, most notably Grummeck-Braamt et al.'s [37] analysis of 252 publications until 2019. While their review mapped the broader technostress field across all organizational contexts, our study specifically examines technology-related stressors, a broader term, within FWAs. Given that FWAs introduce unique boundary management challenges and work-life integration issues absent in traditional settings, our study adopts STS as a theoretical lens for an analysis of the relevant studies. The application of STS theory revealed that technology outcomes in FWAs depend on alignment across technical, personnel, organizational, and environmental subsystems rather than technology characteristics alone. This finding challenges prevailing technology-centric intervention approaches and explains why identical collaboration tools enhance productivity in some contexts while generating stress in others.

Nevertheless, several limitations need to be considered in this analysis. Restricting the bibliometric sample to Web of Science-indexed articles (32 of 37 eligible studies) excluded potentially relevant conference proceedings and emerging journals from citation-based analysis. This introduces a bias toward established venues. The field's rapid evolution means that recent influential work may lack sufficient citation accumulation, likely underrepresenting more recent contributions. The keyword analysis relied on author-provided terms, which may not comprehensively capture conceptual content. Additionally, the small pre-pandemic sample (4 articles, 12.5% of 32 sources) means that pre-pandemic patterns should be interpreted cautiously. The STS categorization, while providing an analytical structure, imposed boundaries on inherently overlapping phenomena. For instance, autonomy could be coded across multiple subsystems depending on the emphasis.

Despite these limitations, the study contributes a systematic mapping of an important research domain. As flexible working arrangements transition from pandemic necessity to a permanent organizational feature, the field faces a pivotal challenge: developing the international collaboration, methodological diversity, and sustained research programs necessary to transform findings into evidence-based design principles for human-centric FWAs.

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