MAG Scholar® Marketing in Asia Group

AJBR
Asian Journal of Business Research Volume 14 Issue 3, 2024
ISSN 2463-4522 e-ISSN 1178-8933 DOI: 10.14707/ajbr.240182

Research Paper

Technostress at workplace: Antecedents, decisions and outcomes (ADO) and future research pathways through a systematic literature review

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Abstract

The COVID-19 pandemic has accentuated the proliferation of Information and Communications Technologies (ICTs) at the workplace as organisations adopt teleworking, causing stress in employees, termed technostress. The authors aim to conduct an in-depth systematic literature review on technostress by adopting the four-stage "preferred reporting items for systematic reviews and meta-analyses" (PRISMA) protocol for article retrieval and selection. Only technostress-related studies were chosen from peer-reviewed journal articles from two prominent databases: Scopus and Web of Science. We focused on studies published in journals with high rankings to enhance the review quality. We conducted this by selecting only those studies published in journals classified as "A*" and "A" according to the Australian Business Deans Council (ABDC) journal ranking list. This yielded 73 high-quality studies for the systematic review. The antecedents, decisions, and outcomes (ADO) framework was leveraged to conduct a scientific review. This is one of the pioneering studies to conduct an ADO framework-based technostress review and formally report the Decisions related to the technostress process, namely a) challenge and hindrance technostressors, b) challenge and hindrance coping responses. Research is moving towards studying new technological and non-work life-related antecedents (e.g., cyberbullying) and outcomes (e.g., loneliness). Considering the changing workplace realities after the COVID-19 pandemic, sixteen future research objectives have been put forward based on three research pathways: advancing conceptual robustness, contextual novelty, and methodological rigour. Organisations can leverage insights on key sources, outcomes, and mitigation measures of technostress to develop human resource strategies, as well as training plans to maximise the benefits of their ICT initiatives.

Keywords: Technostress, Antecedent, COVID-19, ICT, Stress, Systematic literature review.

Publication Details: Received 14 February 2024; Revised 28 July 2024, 25 October 2024; Accepted 14 November 2024

Introduction

Modern workplace Information and Communications Technologies (ICTs) are becoming indispensable to workplace processes and tasks (Ma et al., 2021; Wang et al., 2021). Such ICTs include the Internet, communications networks (e.g., Webex), tools and devices (e.g., smartphones), and modern technologies (e.g., artificial intelligence and blockchain). This trend toward digitisation of business and adoption of ICTs has been further accentuated by the COVID-19 pandemic (Marsh et al., 2022). Firms are experimenting with new ways of working, such as telework and hybrid work. The increased adoption of ICTs can have positive effects (e.g., enhanced sense of autonomy, competency, and connection) or negative effects (e.g., addiction, distraction, burnout) (Marsh et al., 2022). It can create demands on an individual, which may exceed their resources and lead to an experience of technostress (Tarafdar et al., 2019). A survey in the year 2022 conducted by the American Psychological Association (APA) reported that due to an intensification of digitisation in the COVID-19 period, 79% of employees experienced technology-related stress and burnout (Wang et al., 2022). The necessity to examine the technostress construct has become significantly more relevant and urgent during the COVID-19 pandemic, particularly due to the rise in technostress among employees working remotely (Taser et al., 2022).

The technostress literature in the Information Systems (IS) domain remains young and nascent (Tarafdar et al., 2019). Though young, it has evolved significantly, picking up aspects from stress literature and related disciplines such as psychology, business management, and sociology, indicating its multi-disciplinary and complementary nature (Fischer and Riedl, 2017). Still, many existing aspects of the literature, especially the conceptual framing of technostress at the workplace, warrant further investigation (Tarafdar et al., 2015). The conceptual framing underpins the foundation of studying technostress theoretically. It encapsulates different elements associated with the construct and their relationships. Many aspects of the framing, such as technostressors and the elements of the technology environment, have been investigated in IS and management (Tarafdar et al., 2019). However, many IS-related facets of the conceptualisation, such as primary and secondary appraisal mechanisms and coping responses, remain insufficiently explored. This offers a significant opportunity to augment technostress research at the intersection of IS and psychological stress literature. Also, the literature is fragmented and calls for consolidation (Tarafdar et al., 2019).

The authors reviewed existing systematic reviews on technostress (N=9) and identified three major gaps for further attention. First, past reviews focused on non-framework-based approaches (D'Arcy et al., 2014; La Torre et al., 2019), bibliometric studies (Bondanini et al., 2020; Salazar-Concha et al., 2021), and a trifecta model approach (Tarafdar et al., 2019). This review distinguishes itself from other reviews by structuring the associations using the antecedents, decisions, and outcomes (ADO) framework (Paul and Benito, 2018). Secondly, COVID-19 brings us to an inflexion point both for the technostress literature and for technological well-being in organisations – driven by the surge in digital adoption (Marsh et al., 2022). This article captures the entire timeline of technostress publications and highlights the evolving direction of technostress research. Thirdly, past reviews have focused on specific facets of technostress, such as the "dark side of technology" in only the IS field (Agogo and Hess, 2018), the application of multi-method approaches in technostress IS literature

(Fischer and Riedl, 2017), the influence of socioeconomic position (Borle et al., 2021), and the study of neurophysiological tools (Fischer and Riedl, 2015). This review fulfils the need for a broad-based review of technostress at the workplace, covering both IS and business management research domains, Scopus and Web of Science databases, and a complete technostress publication timeline (1984-till date).

Hence, this review focuses on the following key research questions (RQs):

RQ1 What are the antecedents, decisions, and outcomes of technostress?

RQ2 What are the gaps in the existing research on technostress, and what are the key future research objectives for research scholars?

The review is the first study to conduct an ADO framework-based technostress review covering the Covid period and formally report the Decisions related to the technostress process. The review highlights the growing trend towards studying new technological and non-work life-related antecedents (e.g., cyberbullying) and outcomes (e.g., loneliness) and states sixteen future research objectives across three research pathways: advancing conceptual robustness, contextual novelty, and methodological rigour. It aims to guide academicians and practitioners alike by providing insights on key sources, outcomes, and mitigation measures of technostress across different domains such as health, family, and organisation. The study re-imagines insights and recommendations given the 'new normal' – changing ways of working, business dynamics, and rapidly changing technology landscape. Organisations can develop human resource policies and training plans at an individual level to mitigate technostress and maximise the benefits of their teleworking implementation.

In the subsequent sections, the review explains the methodology adopted to conduct the review and the organising framework. Then, an analysis of the ADOs of technostress is summarised. In the final section, we lay out critical research gaps, followed by the potential research objectives around three research pathways. We conclude by highlighting the key contributions of this review for scholars and practitioners and its limitations.

Literature Review

Introduction and Publication Trends

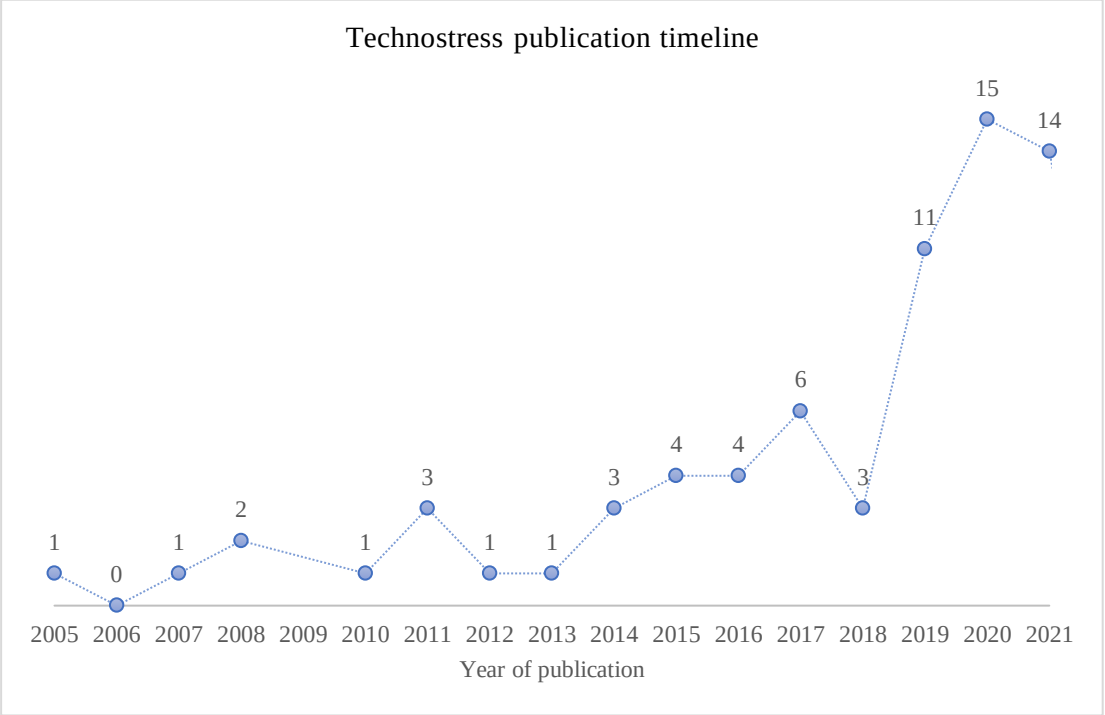
There has been a continuous evolution in the conceptualisation of technostress over the last 35+ years (Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Craig Brod (1984) posited the first definition of technostress as "a modern disease of adaptation caused by an inability to cope with the new computer technologies".

Though the concept dates to 1984, technostress research did not pick up significant momentum in the following two decades. In business management and IS, till 2005, only 13 technostress articles were published. They constitute only 5.28% of total articles (n=246) published to date. From our review scope of 73 articles, the first technostress article in journals ranked "A*" or "A" in the ABDC journal ranking list was published (Figure 1) as recently as 2005 (Tu et al., 2005). Since then, the

proliferation of technostress articles in the premier IS and business management journals has steadily increased in recent years to 14 articles in 2021.

The 73 high-quality technostress articles in the scope of this review garnered 3,530 citations as of November 2021 (as shown in Table 1). This study's top ten most cited technostress journal articles received 2,219 citations (an average of 284.6 citations per year). They contributed to 62.8% of the total number of citations across the sample.

Figure 1: Technostress publication timeline



Note: Figure 1 depicts the publication timeline for the 73 articles included under the scope of this systematic review

Table 1: The ten most cited articles in the review scope

Rank	Authors	Total citations (n= 3,530)	Citations per year (n= 284.6)*
1	Ayyagari et al. (2011)	465	46.5
2	Ragu-Nathan et al. (2008)	387	29.8
3	Tarafdar et al. (2007)	312	22.3
4	Tarafdar et al. (2010)	222	20.2
5	Tarafdar et al. (2015)	169	28.2
6	Zhang et al. (2016)	162	32.4
7	Srivastava et al. (2015)	143	23.8
8	Tarafdar et al. (2011)	130	13
9	Tarafdar et al. (2019)	120	60
10	Wang et al. (2008)	109	8.4

Note: In Table 1, Citations per year = Total citations ÷ current year (2021) minus year of publishing

Methodology

Procedure

The "preferred reporting items for systematic reviews and meta-analyses" (PRISMA) protocol provides established guidance for conducting the literature review (ter Huurne et al., 2017; Moher et al., 2009). This protocol defines four stages: identification, screening, eligibility, and inclusion. Figure 2 outlines the details of each stage of the PRISMA protocol.

Identification

Though most of the technostress research has appeared in the IS journals, the popular journals from business and management domains are increasingly publishing technostress research (e.g., Journal of Business Research and International Journal of Electronic Commerce). Hence, this review included both IS and computer science journal articles as well as business and management journal articles. For searching the indexed articles, this study leveraged the two largest and most prominent databases: Web of Science by Clarivate Analytics and Scopus, as they provide multi-disciplinary results and advanced search functionalities (Wang and Waltman, 2016). The search was conducted in November 2021. It was not limited to a specific publication period to enable the retrieval of all relevant articles till November 2021.

Keywords for the database search query were identified based on an initial screening of seminal articles related to technostress and the database search query was constructed as follows: "technostress" OR "techno stress" OR "techno-stress". Search query included direct mention of technostress in some form to ensure the inclusion of only those papers which explicitly mention technostress as a study construct. Articles that contained keywords such as stress due to ICT and technology stress or technological stressors were excluded from the review scope as the specificity and preciseness of the review need to be maintained while avoiding subjective biases. Only journal articles were considered, excluding all other source types. Books and book chapters have limited potential for contributing toward scholarly advancement; hence, they were excluded. Conference papers, working papers, and industry reports receive limited scrutiny compared to journal articles; therefore, they were also omitted. Only English-language articles were included in the review. The above criterion yielded n=195 and n=107 results in Scopus and Web of Science databases, respectively. Subsequently, duplicates (n=56) were removed, resulting in a consolidated set of n=246 unique articles.

Screening

The following selection stage tried to ensure the inclusion of high-quality and relevant articles by adopting a triadic criterion. The Australian Business Deans Council (ABDC) journal ranking list was selected because it is a commonly used standard for business journals that adhere to international standards (Hao *et al*., 2019). The ABDC journal rankings list considers the citations and the joint opinion about the journal's relative reputation and rigour by prominent academicians and domain experts. On the contrary, many other journal rankings, such as Web of Science and Scopus, consider only citations as a quality parameter. Moreover, the ABDC lists categorise a journal with a

single field of research only, which avoids confusion while considering the quality measures.

Only those articles were considered which were (1) indexed and (2) ranked in the ABDC journal ranking list as (3) "A*" or "A". The source-quality threshold was set at selecting articles from only "A*" and "A" ranked journals. "A*" and "A" category journals have a unique focus on ensuring originality in research rather than duplication, which helped the authors define a pool of high-quality and novel research articles on technostress.

Also, setting the bar to select only higher-ranked journals and not the entire ABDC ranking list helps focus on a manageable review scope for an interdisciplinary construct like technostress. This exercise provided a subset of 117 articles for review.

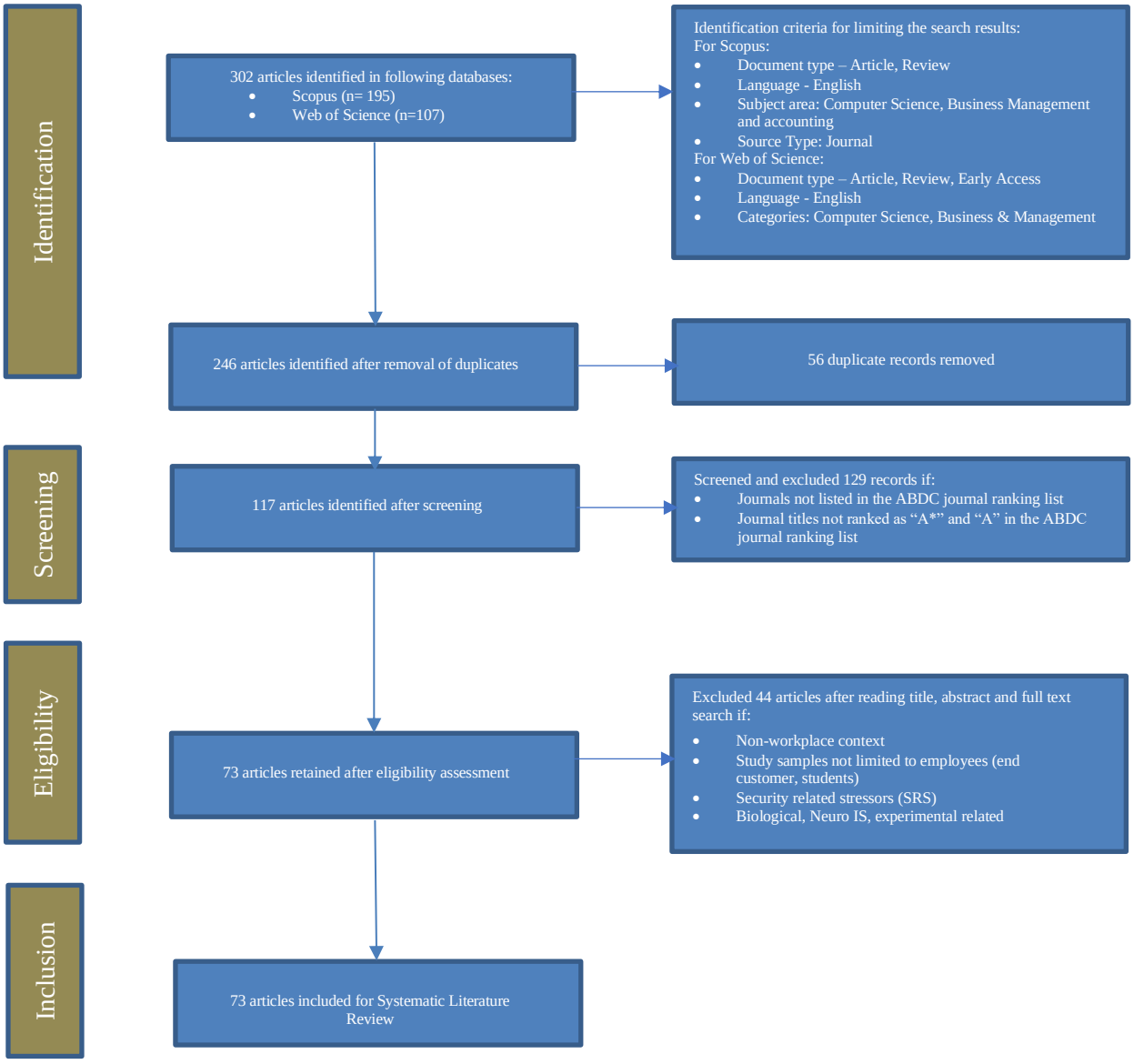
Eligibility

As a part of the eligibility stage, a detailed exclusion criterion was laid out to screen the articles further. Since this review aims to consolidate technostress research done in the workplace context, hence all articles related to non-workplace contexts were excluded. Besides, it was ensured that the technostress-related research samples do not include samples related to end-customers, students, or other non-employee-related contexts. The review allowed mixed-sample articles (for example - Christ-Brendemühl and Schaarschmidt (2020)) only when they satisfied the following conditions: a) Since this review pertains to technostress at workplace studies, hence the mixed-sample should have an employee-only sample for ensuring workplace context; b) Some or all of the technostress-related insights mentioned in the article are an output of studying technostress on the employee-only sample. Only empirical and review articles were included, while experimental, biological or Neuro-IS-related articles were excluded. Articles related to Security Related Stressors (SRS) were ruled out as they did not relate directly to the technostress construct. The authors of this review went through the title, abstract, and full text of selected articles and, after mutual discussion, selected 73 high-quality articles for the final review. The scope aimed to address challenges with the current body of review studies (Agogo and Hess, 2018; Bondanini et al., 2020; Borle et al., 2021; D'Arcy et al., 2014; Fischer and Riedl, 2015; Fischer and Riedl, 2017; La Torre et al., 2019; Salazar-Concha et al., 2021; Tarafdar et al.,2019). Forward and backward searches were also conducted to ensure that any other high-quality article on technostress was not left out.

Inclusion

As previously stated, this review considers Scopus and Web of Science databases. During the identification stage, the authors discovered a time delay in indexing "in-press" studies by the two databases. This inherent limitation of these databases prompted the reviewers to perform a countercheck for "in-press" technostress articles. The articles were searched at the publishers' websites for the business, management and IS journals which were marked as "A*" and "A" in the ABDC journal ranking list. This step enabled this review to become more comprehensive in its approach. This step established that no new articles besides the already shortlisted 73 articles need to be included, which laid the foundation for this detailed literature review on technostress.

Figure 2: PRISMA protocol for article retrieval and selection



Note: n=number of articles

Organizing Framework

A framework-based review approach uses a framework that the scholarly community can either adopt from others, develop, or customise based on existing knowledge gaps and literature. This systematic literature review is a domain-based literature review leveraging the ADO framework-based approach (Paul and Benito, 2018), which outlines "A" as antecedents, "D" as decisions, and "O" as outcomes. Antecedents highlight the key factors for associating or not associating with a specific behaviour, decisions denote the different types of "behavioural performance" or "non-performance", and outcomes signify the assessments emerging after behavioural performance or non-performance.

Results

Antecedents of Technostress at the Workplace

This study classified antecedents as individual, organisational and technology-related antecedents. Before the COVID-19 pandemic, the major focus was on studying organisational and individual antecedents, with little emphasis on studying technology-related antecedents. Key technology-related antecedents explored during this period include technology characteristics related to usability and dynamic features (Ayyagari et al., 2011; Suh and Lee, 2017), computer literacy (Tu et al., 2005) and computer confidence (Ragu-Nathan et al., 2008). The literature suggests that traditional individual-level factors such as age, gender education (Ragu-Nathan et al., 2008), and newly discovered factors such as masculinity and power distance (Krishnan, 2017) significantly influence the degree of technostress experienced. Past studies have established the significant impact of hierarchical levels of personality traits such as neuroticism, personal innovativeness in IT (PIIT), and IT mindfulness (Maier et al., 2019) and combinations of Big Five personality traits (Khedhaouria and Cucchi, 2019; Krishnan, 2017) on the overall perception of technostress and subsequent coping. This research stream is still limited in its scope, but it is vital in designing personalised intervention mechanisms and mitigating technostress for employees. The study of organisational antecedents attracted significant attention from researchers. Suh and Lee (2017) established that job autonomy has a negative relation with invasion of privacy, and task interdependence has a positive relation with work overload and invasion of privacy.

In this evolution period of literature, a few scholars did realise the importance of studying the differential relationships of antecedents with the five individual technostressors rather than just focusing on technostress as one lumped construct. Tu et al. (2005) discovered a negative association of computer literacy with techno-complexity and a favourable association with techno-overload. This review posits that research on the interaction effects of various technostressors and their relationship with antecedents is a potential focus area for future research.

During the pandemic, technology adoption increased and accelerated use of ICTs caused a major challenge as employees faced workflow and social media interruptions, rising workloads, and perceived constant availability while teleworking (Pflügner et al., 2021). The research focused more on exploring new technology-related antecedents such as social media communication (indirect), cyberbullying at work (Oksanen et al., 2020), Neuroticism (Oksanen et al., 2021), and Technological Pedagogical Content Knowledge (TPACK) (Özgür, 2020) rather than researching the established antecedents. This points to an increasing novelty in technostress research as scholars explore different dimensions and technologies causing technostress. A study by Taser et al. (2022) established the role of remote e-working driving technostress and loneliness at the workplace, leading to decreased flow levels at work. Scholars also studied the new resources needed to alleviate the influence of technostress on employees, such as techno-training (Rayburn et al., 2021) and school support (Özgür, 2020).

Research is also happening at the intersection of technostress literature and AI literature as the use of AI expanded across industries more rapidly during the COVID-19 period.

Malik et al. (2022) established AI deployment as a key antecedent of technostress. Another qualitative study explored the influence of different Big Five personality trait combinations on technostress (Pflügner et al., 2021). Most of these studies have focused on studying individual-related antecedents, pointing to the need for more organizational-level research in the future. Table 2 provides a summary of antecedents of technostress.

Table 2: Antecedents of technostress

Typology	Antecedents	Associations with technostress	Exemplary studies
Individual	Hierarchical levels of personality traits	Neuroticism - Positive; Personal innovativeness in IT (PIIT) - Negative; IT mindfulness - Negative	Maier et al. (2019)
	Personality Traits Configurations	Positive (Low/High depends on personality configuration)	Khedhaouria and Cucchi (2019); Krishnan (2017)
	Age, Education, Computer Confidence	Negative	Ragu-Nathan et al. (2008);
	Computer Literacy	Negative with Techno-complexity; Positive with Techno-overload	Tu et al. (2005)
	Espoused cultural values (Masculanity, Power distance)	Positive	Krishnan (2017)
	Personality profile of Big Five personality traits	Positive (Low/High depends on personality profile)	Pflügner et al. (2021)
	Age	Positive	Özgür (2020); Tu et al. (2005)
	Technological Pedagogical Content Knowledge (TPACK)	Negative	Özgür (2020)
	Personal resources (optimism towards technology)	Negative	Christ-Brendemühl and Schaarschmidt (2020)
	Remote e-working	Positive	Taser et al. (2022)
	Social Media Communication (SMC); Cyberbullying at work	Positive	Oksanen et al. (2020); Oksanen et al. (2021)
	Neuroticism	Positive	Oksanen et al. (2021)
Organizational	Job Characteristics	Job Autonomy (Negative with invasion of privacy), Task Interdependence (Positive with work overload, and invasion of privacy)	Suh and Lee (2017)

	Technology Characteristics	Usefulness (Negative with work overload), Reliability (Negative with work overload), Presenteeism (Positive with work-home conflict, invasion of privacy, work overload, role ambiguity), Anonymity (Negative with invasion of privacy), Pace of Change (Positive with work overload, role ambiguity and job insecurity)	Ayyagari et al. (2011); Suh and Lee (2017)
	Task Complexity	Positive with overall Technostress, Techno-overload, Techno-invasion, Techno-complexity and Negative with Techno-uncertainty	Tu et al. (2005)
	Reward	Positive with overall Technostress, Techno-overload, Techno-complexity and Techno-uncertainty	Tu et al. (2005)
	Technostress Inhibitors	Negative	Jena (2015); Tarafdar et al. (2015); Tarafdar et al. (2010)
	Power centralization; Organizational culture of innovation	Positive	Wang et al. (2008)
	Job demands (technology-induced role overload, technology-induced role ambiguity)	Positive	Christ-Brendemühl and Schaarschmidt (2020)
	Continuous techno training	Negative	Rayburn et al. (2021)
	AI deployment in industry 4.0	Positive	Malik et al. (2022)
	School Support	Negative	Özgür (2020)

Decisions of Technostress at the Workplace

Decisions serve as a direct response to antecedents and a precursor of outcomes, and they relate to behavioural performance or non-performance (Paul and Benito, 2018). Since no other review paper in the field of technostress has leveraged the ADO framework yet, uncovering decisions becomes a unique finding of this review.

Decisions can be inferred by reviewing the process view of technostress, as elucidated by the Transaction Theory of Stress (TTS). Tarafdar et al. (2019) proposed a technostress process framework based on TTS theory with two sub-processes – techno-eustress and techno-distress. The techno-eustress subprocess is posited as "the phenomenon that embodies the positive stress that individuals face in their use of IS" and happens when "individuals appraise IS as challenging or thrilling". Conversely, the techno-distress subprocess encapsulates "how and why individuals appraise IS as a threat, experience consequent 'bad' stress, and are faced largely with detrimental outcomes".

When encountering probable causes of stressful situations, such as task demands, technological demands, and role demands, the "Primary appraisal" process is set in motion. An individual assesses the environmental conditions as a challenge or a hindrance techno-stressor. A challenge stressor facilitates task accomplishment or creates prospects for enhancing an individual's skills or work-life activities. In comparison, a hindrance technostressor is perceived as an obstacle or barrier to accomplishing the task or strengthening the skills (Califf et al., 2020; Tarafdar et al., 2019). Hence, the initial decisions made by the employee relates to challenge and hindrance technostressors.

Following the primary appraisal, an individual undertakes a secondary appraisal to decide the suitable coping response to the technostressor. In response to a challenge technostressor, a challenge coping response is activated, a positive coping response meant to achieve a command over using technology at the workplace. In response to a hindrance technostressor, a threat-coping response is activated, a negative coping response to counter the perceived threat from using technology at the workplace (Califf et al., 2020; Tarafdar et al., 2019). Furthermore, these coping responses, in turn, can lead to positive or detrimental consequences. Hence, the second set of decisions taken by the employee relates to a challenge coping response or a hindrance coping response.

Hence, we conclude that two types of decisions are involved through the technostress process: 1) Challenge and/or Hindrance technostressors; 2) Challenge coping response and/or Hindrance coping response. Table 3 provides a summary of the decisions of technostress.

Table 3: Decisions of technostress

Decisions	Exemplary studies
Challenge and/or Hindrance technostressors Challenge coping response and/or Hindrance coping response	Califf et al. (2020); Tarafdar et al. (2019)

Outcomes of Technostress at the Workplace

Before the global spread of COVID-19, most technostress studies explored user perceptions of evaluations (Agogo and Hess, 2018). There is limited research on studying the direct behaviours resulting from technostress. This review leveraged a modified version of the outcome classification by Tarafdar et al. (2019), broadly

categorising the outcomes from literature into individual well-being-related and organisational or job-related.

Technostress can have a severe detrimental influence on an individual's well-being as it can reduce job engagement (Srivastava et al., 2015), which can further lead to exhaustion at the workplace (Gaudioso et al., 2017; Kim et al., 2015) and subsequent job burnout (Khedhaouria and Cucchi, 2019; Maier et al., 2019; Srivastava et al., 2015). Different technostressors may drive different outcomes depending on their influence on various facets of an individual's life. Since techno-overload targets the work domain and techno-invasion targets the out-of-office life, they result in strain related to distress and work-family conflict, respectively (Gaudioso et al., 2017). The adverse outcomes, such as negative affectivity, relate to an individual's mental and emotional well-being (Jena, 2015).

Organizationally, the scenario looks far grimmer in the pre-COVID-19 era as technostress results in adverse consequences such as a decrease in productivity at the workplace, increased role stress (Tarafdar et al., 2007), reduced job satisfaction (Jena, 2015; Ragu-Nathan et al., 2008; Suh and Lee, 2017; Tarafdar et al., 2010) and reduced sales performance and technology-enabled innovation (Tarafdar et al., 2015). It can additionally cause other undesirable consequences, such as reduced end-user satisfaction and end-user performance (Maier et al., 2019; Tarafdar et al., 2010) and decreased organisational commitment and continuance commitment (Jena, 2015; Ragu-Nathan et al., 2008).

Before the pandemic, there was a limited focus on studying technology-related outcomes. Key IS-related outcomes include reduced employee satisfaction with ICT use, lower ICT-enabled employee innovation, reduced Technology-Enabled Performance, and reduced IT-enabled productivity (Chandra et al., 2019; Fuglseth and Sørebø, 2014; Jena, 2015; Pirkkalainen et al., 2019).

There is a potential to study objective strain, episodic demand stressors, their key outcomes, and the necessary coping behaviours to moderate the influence of these stressors (Galluch et al., 2015). Prospective investigation can target studying the positive consequences of technostress, including employee engagement or innovation-related outcomes (Tarafdar et al., 2019).

In the past few years, a distinct shift has been seen in the direction of research on technostress outcomes. Since the COVID-19 pandemic, organisations have become accustomed to using ICTs more frequently and extensively to facilitate the transition of business processes from a face-to-face to a remote e-working model. Researchers realised the need to understand the implications of this trend, i.e. its outcomes on employees – both positive and negative. Though substantial research has been conducted on understanding the negative association of technostressors with employee attitudes and performance (Ayyagari et al., 2011; Tarafdar et al., 2019), limited investigation has been done to assess the influence of technostressors on employees' personal lives. Techno-stressors adversely influence work-life balance, but increasing personal resources, such as job self-efficacy, can help buffer this adverse effect by reducing emotional exhaustion (Ma et al., 2021). Employees tend to take part in divergent behaviours (such as minor cyberslacking) at the workplace (Güğerçin, 2020) to counter technostress. The new reality of the modern digital workplace even prompted

the researchers to explore new technostressors, such as insecurity induced by modern technologies like AI and websites that may tend to misinform clients.

Researchers picked up on the call to research both positive and negative outcomes influenced by challenge and hindrance technostressors, respectively (Tarafdar et al., 2019). Research demonstrated that challenge and hindrance appraisals can affect organisational outcomes like ICT-enabled productivity (Zhao et al., 2020) or job satisfaction, attrition, and turnover intention (Califf et al., 2020). Researchers can investigate the possible interaction effect of various outcomes or the sequential progression from one outcome to another (Agogo and Hess, 2018; Marsh et al., 2022). Additionally, technostress can be considered as a second-order construct to enable exploration of the differential influence of different configurations of technostressors on the outcomes (Cadieux et al., 2021). Table 4 provides a summary of the outcomes of technostress.

Table 4: Outcomes of technostress

Typology	Outcomes	Associations with technostress	Exemplary studies
Individual well-being related	Work exhaustion (direct/indirect)	Positive	Kim et al. (2015); Gaudioso et al. (2017)
	Job burnout	Positive	Maier et al. (2019); Khedhaouria and Cucchi (2019); Srivastava et al. (2015)
	Strain	Positive	Suh and Lee (2017); Ayyagari et al. (2011)
	Work family conflict Job distress	Positive effect of Techno-invasion Positive effect of Techno-overload	Gaudioso et al. (2017)
	Job engagement	Negative, influence depends on personality traits	Srivastava et al. (2015)
	Negative affectivity	Positive	Jena (2015)
	Psychological distress	Positive	Cadieux et al. (2021)
	Partnership satisfaction (indirect effect)	Negative effect of Technology-Driven Challenge Stressors and Positive effect of Technology-Driven Hindrance Stressors	Benlian (2020)
	Loneliness	Positive	Taser et al. (2021)
	Employees' work-life balance	Negative	Ma et al. (2021)
	Emotional exhaustion	Positive	Ma et al. (2021)
Organizational or Job-related	User performance	Negative quadratic effect	Maier et al. (2019)

	Technology-enabled performance; Organizational commitment (direct)	Negative	Jena (2015)
	Technology enabled innovation; Sales Performance	Negative	Tarafdar et al. (2015)
	End-user performance; End-user satisfaction	Negative	Tarafdar et al. (2010)
	IT enabled productivity	Negative	Pirkkalainen et al. (2019)
	Job satisfaction	Negative	Suh and Lee (2017); Ragu-Nathan et al. (2008); Jena (2015)
	Employee Satisfaction with ICT use (strain); Employee intention to extend the use of ICT (indirect)	Negative	Fuglseth and Sørebø (2014)
	Organizational commitment (indirect); Continuance commitment (indirect)	Negative	Ragu-Nathan et al. (2008)
	Role Stress	Positive	Tarafdar et al. (2007)
	Productivity	-Negative -Positive effect of Techno-overload and Negative effect of Techno-invasion and Techno-insecurity	Tu et al. (2005)
	ICT-enabled employee innovation	U-shaped relationship with Techno-overload, linear / U-shaped relationship with Techo-invasion, linear / U-shaped relationship with Techo-complexity	Chandra et al. (2019)
	Sales-efficacy (indirect outcome); Techno-efficacy	Negative	Rayburn et al. (2021)
	ICT enabled productivity	Positive effect of Challenge appraisal outcome, Negative effect of hindrance appraisal outcome	Zhao et al. (2020)
	Customers' satisfaction with the frontline service employee;	Negative	Christ-Brendemühl and Schaarschmidt (2020)

	Customers' delight with the frontline service employee		
	Job satisfaction	Positive effect of Challenge Technostressors and Negative effect of hindrance Technostressors	Califf et al. (2020)
	Attrition	Positive effect of hindrance Technostressors	Califf et al. (2020)
	Turnover Intention (indirect effect)	Negative effect of Challenge Technostressors and Positive effect of hindrance Technostressors	Califf et al. (2020)
	Minor Cyberslacking	Positive effect of Techno-invasion	Güğerçin (2020)

Summary of Results

This systematic review aligned itself with two key research objectives at the outset:

RQ1 What are the antecedents, decisions, and outcomes of technostress?

RQ2 What are the gaps in the existing research on technostress, and what are the key future research objectives for research scholars?

The study adopted ADO as an established framework for conducting the review. We contended that adopting this framework is imperative to uncovering insights and gaps from the literature in a structured and scientific way. The stated results seamlessly aligned with the initial research questions. The review articulated the key antecedents, decisions and outcomes discovered by the scholars across the publication timeline of technostress. The framework-based method enabled the discovery of crucial literature gaps aligned with the existing research on antecedents and outcomes. The application of PRISMA methodology and ADO framework facilitated the presentation of subsequent results towards ensuring novelty and rigour associated with "well-done" scientific reviews (Hulland and Houston, 2020). This, in turn, formed the foundation for suggesting the three pathways for further investigation and their practical ramifications for academia, corporations, and policymakers in Asian countries.

Discussion

Future Research Pathways for Technostress

Thus far, the review has endeavoured to highlight the critical gaps within the contemporary literature. The future research pathways for technostress research need

to be re-imagined in-backdrop of the 'new normal', i.e., changing ways of working and the rapidly evolving technology landscape, post COVID-19. We propose three research pathways to summarise our guidance to the researchers on future research agendas: advancing contextual novelty, methodological rigour, and conceptual robustness.

Pathways to Enhance Contextual Novelty

Most of the technostress articles included in the scope of this review were anchored in a single-country context, mostly in America and Europe. This calls for the need to study technostress in the context of different cultures, societal values, different digital maturity levels, and socio-economic development levels (Chandra et al., 2019; Christ-Brendemühl and Schaarschmidt, 2020; Ozgür, 2020). Similarly, researchers emphasised the need to study technostress across different types of organisations (Rayburn et al., 2021) and other sectors and industry settings such as business-to-consumer sales, business-to-business, and government organisations (Srivastava et al., 2015; Tarafdar et al., 2010).

Organisations are increasingly adopting flexible working practices and many new models of working such as remote work (e.g., teleworking) (Soga et al., 2022). Though recent studies did consider remote e-working and work-from-home related settings (Benlian, 2020; Taser et al., 2022), the research is still very limited in scope.

Practitioners and academicians should study different digital tools and technologies that shape the experiences of the working day, work processes, and contexts embedding them (Marsh et al., 2022). They can focus on re-inventing theoretical models to incorporate cross-domain perspectives on tasks, technology, roles and interactions (D'Arcy et al., 2014).

Hence, we summarise the following research objectives for enhancing the contextual novelty of technostress research in business management and IS:

- Conduct research in different contextual settings related to the country, cultural dimensions, societal values, digital maturity levels, socio-economic development levels, industries, sectors, and roles, and assess how these settings influence the associations between ADOs of technostress.
- Given an externality like COVID-19, study the differences in alternate work settings such as teleworking, remote e-working, on-demand work, and hybrid office settings from the perspective of differences in their sources of technostress, the extent of influence, and eventual outcomes. Explore the interplay of the different contextual factors, such as technological, socio-economic, and historical factors, with the various work processes of flexible working arrangements.
- Explore the interplay between tools and technologies (e.g., automation, social media, smartphones) embedded in various tasks and processes (routine and non-routine tasks, automated tasks) to include various technostress facets. Focus on re-invention of theoretical models to include cross-domain perspectives on examining fit between task and technology, role overload, role ambiguity, and enhanced human-computer interaction.
- Conduct research on measures that an employee can take to moderate the effect of different work settings like teleworking and possible organisational design mechanisms to reduce technostress in employees.

- Validate possible organisational and human resource measures to cater to the differences in contextual settings and reduce technostress among employees.

Pathways to Enhance Methodological Rigour

There are two dimensions of enhancing methodological rigour in the field of technostress. The first dimension relates to improving the current methods for technostress research. Scholars can leverage longitudinal multi-time period data instead of cross-sectional data to uncover the time-dependent and long-term changes (Rayburn et al., 2021).

To enhance the elucidative capacity of the technostress research designs, data collection should involve multiple stakeholders experiencing different levels of technostress (Califf et al., 2020).

A review article by Fischer and Riedl (2017) highlighted that technostress studies primarily rely on self-reported measures leading to common method bias (Podsakoff et al., 2003). Analysis of qualitative data, such as observational data and biological measures of stress, can help corroborate findings from quantitative approaches (Fischer and Riedl, 2017).

The seminal works from Ayyagari et al. (2011) and Tarafdar et al. (2007) provided two notions on technostressors and the corresponding measurement scales. Grounding on the systematic review's findings, explicit scale items corresponding to different ICT-enabled devices need to be added to contemporise technostress measurement (Güğerçin, 2020). The adverse effects of the interaction of new technostressors related to work, family, employees, and technology with the existing ones should be studied in detail (Cadieux et al., 2021).

The second dimension for further exploration is to augment the research with new methods, considering new opportunities and constraints created by the pandemic. This calls for adopting more interpretative methodologies to study behavioural and physical reactions and outcomes. Researchers can also tap into the advanced techniques of AI, social media analytics and data analytics (Fu et al., 2019).

Hence, we state the following research objectives for enhancing the methodological rigour of technostress research in business management and IS:

- Leverage longitudinal multi-time period research design for studying the evolution of relationships between the technostress ADOs and the long-term or chronic effects of technostressors. Deploy interventionist approaches that allow pre- and post-inhibitor or stressor implementation tests.
- Conduct qualitative studies focusing on reports, observations, or empirical dyadic studies across external stakeholders such as customers and suppliers and internal stakeholders such as co-workers, supervisors, and middle and top management.
- Deploy multi-method research designs, including qualitative data such as bio-physiological measures of stress for understanding ICT adoption, technostress and resulting employee outcomes while using techniques such as interpretive methods and multi-sensory data points.

- Introduce and validate explicit scale items corresponding to different ICT-enabled devices, such as laptops, tablets, or smartphones, and/or new technostressors corresponding to various technologies in the existing technostress scales. Introduce new technostressors related to work, family, employee, and technology and study how their combinations with existing ones create a breeding ground for high technostress levels and subsequent adverse outcomes.
- Generate deeper insights into the behaviours and responses of employees subjected to technostress, using techniques like videography and projective techniques such as role-play.
- Uncover potential technostress mitigation mechanisms by leveraging new methods and techniques enabled by AI, machine learning, and social media analytics to churn big data sets and uncover more profound insights.
- Use wearable devices for data collection and apply psychophysiological methods to study consumers' and employees' emotions and responses to technostressors.

Pathways to Enhance Conceptual Robustness

There is a lack of suitable typology or taxonomy organising different technologies in a coherent, mutually exclusive, and collectively exhaustive manner. Also, the prior experiences of these technologies, attitudes towards technology adoption and different coping strategies need to be investigated (Malik et al., 2022). A noticeable gap exists in understanding the positive and harmful consequences of new technologies such as AI in industry 4.0-led organisations (Malik et al., 2022). Future qualitative research using case studies or focus groups can be conducted to examine the employees' experiences with AI usage.

Little research has been done to study the factors influencing the spillages of stress from work life to personal life (Benlian, 2020). This research can enable organisations to design suitable work-life balance programs and policies to address stress management holistically.

During a crisis like COVID-19, organisations try to develop a supportive organisational environment (Marsh et al., 2022). This can enable individuals to adopt challenging coping behaviours and activate technostress inhibitors, such as getting social support from co-workers and peers (Zhao et al., 2020). Strategic workforce development measures can enable rapid and more effective up-skilling and re-skilling of the workforce (Malik et al., 2022).

Hence, we state the following research objectives for enhancing the conceptual robustness of technostress studies in business management and IS:

- Develop a technology/ICT-based research agenda with a focus on the following aspects:
    a) developing a typology or taxonomy of different ICTs
    b) study the features of technologies influencing an employee
    c) study the extent of technology use by the study participants over a period
    d) prior experiences with technologies and attitudes toward technology adoption, e.g., new digital technologies like AI and social media communication.

- Study differences in coping strategies corresponding to different technologies and personality types to design suitable organisational technostress inhibitor mechanisms catering to differences in individuals and technologies.
- In-view-of increased teleworking:
    a) develop a deeper understanding of possible negative job outcomes of teleworking, such as burnout, fatigue, and exhaustion.
    b) study work-life balance construct in technostress research models.
    c) include constructs around individual health concerns, uncertainty about job continuance, and family/partner and children satisfaction as antecedents or moderators.
- Study the impact of novel technostress inhibitor mechanisms such as support for innovation, employee innovative behaviour, leadership, support from co-workers, support manuals and well-crafted training and enablement programs facilitated by modern technological methods and tools (e.g., augmented reality and virtual reality). These can be incorporated as mediators or moderators in the empirical research models.

Limitations and Conclusion

This structured, systematic review attempts to provide a perspective on the technostress construct in the workplace context. The review tried to cover the relevant scope exhaustively from the quality journals on the grounds of 'novelty' and 'manageability'. This review posits this as a pragmatic decision pertinent to a framework-based review. However, this restriction may be relaxed for other reviews where the objectives are narrowly defined with a scope containing fewer articles, making them easily manageable. One limitation of this review was that only English-language publications were reviewed. This review is anchored on the two most discussed and relevant disciplines in technostress – IS and business management. Future reviews can extend this scope by considering other related disciplines, such as medicine, mathematics, and sociology, to foster multi-disciplinary knowledge to enrich the literature further. Future research can also consider experimental, biological, or Neuro-IS-related studies. Scholars can explore using meta-analysis techniques to evaluate the effect size of antecedents on technostressors specifically. This review aimed to cover the maximum number of high-quality studies across the two search databases, i.e. Scopus and Web of Science. Still, searching other databases may fetch additional results on the subject. Additionally, including non-workplace technostress aspects and students' or customers' perspectives, such as social media usage, can be potentially rewarding for social scientists.

Practical Implications for Asian Business

Employees globally have been struck by several stressors, including the restrictions imposed by the pandemic, health anxieties, increased workloads due to teleworking and increasing job uncertainty. As per the Mckinsey (2022) report on workplace mental health, employees in Asian countries experience higher levels of poor mental health and burnout than their global peers. One in three employees in Asia are experiencing burnout, while one in four face symptoms of anxiety and depression. More than 40 per cent of Indian employees report vague boundaries between work and personal life,

which can lead to significant stress. In this backdrop, a detailed review of technostress literature becomes more pertinent.

Past scholarly research (Erumban and De Jong, 2006) leveraged Hofstede's cultural dimensions to explain the influence of cultural nuances on the differences in ICT adoption across countries:

1. Power distance: High power distance, often signified by increased hierarchy and centralised decision authority, can lead to stifled decision-making. It can reduce employee empowerment towards the adoption and implementation of ICTs. Hence, Asian countries with high power distances, like India, may experience slower adoption of new ICTs and higher stress levels.
2. Individualistic vs Collectivistic culture: ICT adoption in collectivistic cultures can be slow. The focus is group consensus and enhancing group productivity in countries like Indonesia. On the contrary, countries like Singapore prioritise individual efficiency and innovation over the group, and hence, ICT adoption can be faster.
3. Uncertainty avoidance: Cultures with high uncertainty avoidance have a more conservative approach to adopting new technologies, which may disrupt established routines. Hence, Asian countries with high uncertainty avoidance may experience slower ICT adoption at the workplace.

Moreover, cultural acceptability in discussing and treating mental health can be a crucial parameter influencing employee stress levels. In countries like India, the stigma around discussing mental health can lead to high stress levels in employees as they are not able to get due help.

The review highlighted the novel antecedents (such as remote e-working, Social Media Communication (SMC), cyberbullying at work, and AI deployment in Industry 4.0) and consequences (for example, loneliness, employees' work-life balance, and minor cyberslacking) being researched during the pandemic. Uncovering the decisions involved in the technostress process becomes a novel theoretical contribution of this study. By applying a unique and novel framework of three future research pathways to organise the potential research objectives, this review is expected to shorten the time-to-literature review for scholars' empirical studies.

Both industry practitioners and policymakers in Asia can capitalise on the actionable and structured insights gained from this review. Corporate bodies can even sponsor academic research on the relevant research objectives provided in this review. This can help them augment their understanding of technostress measurement and mitigation mechanisms' efficacy.

The pathways for future research can translate into actionable strategies for organisational leaders and managers. The research outcomes from the pathway to enhance contextual novelty can provide actionable insights for government policymakers in Asian countries to understand contextual differences in employee technostress levels. Contextual comparison with developed countries and within Asian countries can help them define suitable labour laws and policies for ensuring a conducive work environment. Additionally, industry and corporate bodies can leverage the insights around the effects of different tools and technologies in the work

environment and prioritise their deployment accordingly.

The insights from the pathway to enhance methodological rigour can help practitioners understand the differences in technostress levels across different organisational stakeholders. They can also understand the long-term chronic impact of technostress on employees. This can help them devise timely custom intervention mechanisms for various stakeholders. The study on the effect of these intervention approaches would be instrumental in deploying the right strategy promptly and achieving organisational outcomes.

The insights from the pathway to enhance conceptual robustness can inform managers and organisational decision-makers in Asia about the novel ways of working being implemented. Comprehending the impact of increased teleworking on personal and occupational aspects can help them choose between pure teleworking, hybrid working or working from the office to minimise technostress levels. Moreover, insights around the effect of personality traits on technostress can help them infuse custom interventions in the workflows for different personality types. This can help human resource functions devise suitable training plans and institute incentive plans, and policies to mitigate technostress' adverse outcomes.

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