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Original Research

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From Techno-Stressors to Techno-Exhaustion: The Mediating Role of Techno-Anxiety in the IT Workplace

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Abstract

The widespread use of information and communication technology in modern workplaces has intensified techno-stress. This study examines the impact of techno-stressors—techno-overload and techno-complexity—on techno-anxiety, its role in driving techno-exhaustion, and the mediating effect of techno-anxiety in this relationship. Data from Indian IT sector employees, collected via snowball sampling, was analyzed using structural equation modeling in AMOS (Version 23). Our findings revealed that techno-overload and techno-complexity significantly heighten techno-anxiety, which, in turn, exacerbates techno-exhaustion. Techno-anxiety serves as a crucial mediator in linking stressors to exhaustion. The study offers theoretical insights and practical implications, and emphasizes managerial strategies, employee support, and socio-technical interventions to mitigate techno-stress and to enhance workplace well-being.

Keywords: *techno-anxiety, techno-complexity, techno-exhaustion, techno-overload, techno-stress, techno-stressors*
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Introduction

Information and communication technology (ICT) plays a transformative role in the modern work life of industry 4.0 and 5.0 (Bregar, 2024; Cannavacciuolo et al., 2023). ICT offers benefits, such as enabling remote work and ensuring business continuity during disruptions like the COVID-19 pandemic (Matthes et al., 2024). However, the extensive use of ICT poses risks to employee health and performance (Bourlakis et al., 2023), and techno-stress is emerging as a significant form of stress (Tarafdar et al., 2019, 2024).

Techno-stress needs to be understood as an ongoing process rather than an outcome. The process begins with appraising technological environment conditions as threats, giving rise to *techno-stressors* (Cadieux et al., 2024). Techno-stressors, also known as techno-stress creators, refer to the technology-induced stimuli or demands that generate techno-stress among ICT users (Wang et al., 2024). These lead to short-term *techno-stress responses,* which can be psychological or physiological (Mishra & Rašticová, 2024; Shi et al., 2023).

Psychological responses to techno-stress include anxiety and lower job and user satisfaction (Berger et al., 2024; Tarafdar et al., 2011, 2024). Physiological responses to techno-stress comprise cardiovascular, biochemical, and gastrointestinal symptoms (Mattern et al., 2024; Mishra & Rašticová, 2024). Over time, sustained or repeated techno-stress responses—especially when intense—result in *techno-stress outcomes*, such as emotional exhaustion, burnout, sleeping problems, or depression (Berger et al., 2024; Califf & Brooks, 2020).

Eminent researchers, namely Ragu-Nathan et al. (2008) and Tarafdar et al. (2007), identified five techno-stressors: (1) techno-overload, (2) techno-complexity, (3) techno-invasion, (4) techno-uncertainty, and (5) techno-insecurity. These techno-stressors are well recognized and widely explored in various studies across different fields and contexts (Berger et al., 2024; Thurik et al., 2023). A systematic review by Borle et al. (2021), however, mentions that not all techno-stressors are relevant in each research context, and researchers should focus on specific techno-stressors rather than replicating the entire techno-stress model. Additionally, Nastjuk et al. (2023) and Singh et al. (2022) underlined the necessity to understand the relevance of specific techno-stressors. For example, previous techno-stress research did not concentrate on techno-uncertainty (Kim et al., 2022; Sriwidharmanely et al., 2022), techno-insecurity (Singh et al., 2022), and techno-invasion (Wang et al., 2023).

To understand the distinct roles of individual techno-stressors, Nastjuk et al. (2023) and Yuan et al. (2023) recommended that a disaggregated approach be adopted, suggesting that such an approach is particularly suitable when only one or two techno-stressors are studied (Nastjuk et al., 2023). Accordingly, we posited that techno-overload and techno-complexity are essential job-specific techno-stressors (Wirth et al., 2024) among information technology–sector employees, which contributes to anxiety and exhaustion. By targeting these stressors, our study aligned with recommendations for refining the techno-stress model to specific research contexts (Borle et al., 2021; Lin & Yu, 2024; Singh et al., 2022; Yuan et al., 2023).

Techno-overload refers to the excessive amount of information and demands stemming from technology (LeRoy et al., 2023). In contrast, *techno-complexity* refers to the perceived challenges and intricacies involved in utilizing and adapting to new technological tools and systems (Tarafdar et al., 2024). The literature reveals the impact of these specific stressors on negative psychological outcomes, such as anxiety (Thurik et al., 2023), emotional exhaustion (Scholze & Hecker, 2024), techno-exhaustion (Hessari & Nategh, 2022; Singh et al., 2022; Wang, et al., 2023), burnout (Consiglio et al., 2023), and well-being (Hang et al., 2022; Marsh et al., 2024). However, among various psychological outcomes, techno-anxiety remains unexplored (Marsh et al., 2022; Nisafani et al., 2020), and techno-exhaustion has received little scholarly attention as outcomes of techno-stressors (Weinert et al., 2020). *Techno-anxiety* represents psychological discomfort or apprehension

when interacting with technology and influences the digital workplace negatively (Marsh et al., 2022, 2024; Sawiji, 2024). *Techno-exhaustion* refers to feeling tired, drained, frustrated, or fatigued due to prolonged exposure to technological demands and stressors (Singh et al., 2022; Wang et al., 2023).

Despite extensive research on techno-stressors and strain responses, the links among specific techno-stressors, techno-anxiety, and other psychological outcomes such as techno-exhaustion remain unexplored (Agogo & Hess, 2018, p. 8; Hessari & Nategh, 2022; Sriwidharmanely et al., 2022). Recently, Lin and Yu (2024, p. 14) commented that research in technology-driven fields would benefit significantly if the role of techno-stress and psychological constructs, such as anxiety, were considered. Similarly, the systematic review by Nisafani et al. (2020) suggested the investigation of specific causes of techno-stress (e.g., techno-complexity) and their relationship with strains such as negative emotions (e.g., anxiety) and emotional exhaustion. Further, Marsh et al. (2022) recommended exploring the association between the dark side effects (like techno-stress, techno-overload, and techno-anxiety) and affective outcomes (like techno-exhaustion) of techno-stress.

The literature on techno-stressors lacks clarity in identifying the mechanisms that mediate the relationship between technology-related stress and resulting psychological outcomes (Marsh et al., 2022; Nastjuk et al., 2023). Moreover, the information system literature provides evidence that techno-stressors increase techno-exhaustion (Singh et al., 2022; Weinert et al., 2020), but this does not explain the whole process, as the mediator's role remains underexplored. To address these research gaps, this study considered techno-overload and techno-complexity as independent variables that affect techno-exhaustion (outcome) through techno-anxiety (mediator). Hence, the primary research questions addressed by this study were:

RQ1. Does techno-overload and techno-complexity affect techno-anxiety?
RQ2. Does techno-anxiety affect techno-exhaustion?
RQ3. What is the role played by techno-anxiety in the techno-stressors and techno-exhaustion relationship?

This study sought to contribute to the techno-stress literature by providing important insights into translation processes: how techno-stressors, such as overload and complexity, are perceived, interpreted, and transformed into psychological outcomes like techno-anxiety and techno-exhaustion. Furthermore, the study paves the way for future research on interventions to prevent or mitigate the negative job outcomes associated with techno-overload and techno-complexity.

The following section outlines the theoretical background, followed by a review of the literature and hypothesis development. Subsequently, the methodology and results are presented. This is followed by a discussion of the theoretical and practical (managerial, employee-related, and socio–technical) implications. Finally, the study's limitations are addressed, and directions for future research are proposed.

Theoretical Background

Transactional Theory of Stress and Coping

Our study utilized the transactional theory of stress and coping, propounded by Lazarus and Folkman (1984), as the theoretical foundation for understanding how techno-stressors translate into negative outcomes. According to this theory, employees experience stress when they perceive their work environment as threatening or challenging (Cadieux et al., 2024; Zhao et al., 2020). The factors contributing to these perceptions are referred to as stressors, and the initial response to stressors triggers an interdependent cycle of physiological and psychological reactions (e.g., anxiety or frustration). If stress responses persist for a

longer period, it further leads to negative outcomes, such as exhaustion (Becker et al., 2021; Berger et al., 2024). In line with this theory, the study conceptualized that employees experiencing techno-stressors, such as techno-overload and techno-complexity, can develop strain or techno-stress responses (techno-anxiety). Over time, the techno-stress response can result in negative techno-stress outcomes (techno-exhaustion). Therefore, Lazarus and Folkman's (1984) theory provided a robust lens to understand the nuanced relationship among individual perceptions (techno-overload and techno-complexity), techno-stress response (techno-anxiety), and techno-stress outcomes (techno-exhaustion) in the techno-stress process.

Literature Review and Hypothesis Development

Techno-Overload and Techno-Anxiety

In today's digital world, employees are constantly bombarded with rampant technological innovation, resulting in techno-overload (Marsh et al., 2024). Techno-overload is the excessive use of technology that surpasses individuals' capacity to manage work efficiently (Nastjuk et al., 2023). Techno-overload leads to various negative outcomes, such as tension, job strain, work exhaustion (Marsh et al., 2022; Wang et al., 2024), and anxiety (Thurik et al., 2023). Among these negative outcomes, anxiety is a universal initial response that arises from the excessive use of technology, such as email (Becker et al., 2019; da Silva et al., 2024; Marsh et al., 2024), mobile phones (Fu et al., 2020), and video conferencing (Rahmani et al., 2023). For example, employees in large consulting firms are required to manage multiple communication channels (email, video conferencing, and instant messaging) to maintain prompt client responsiveness.

Researchers discuss that increased technology use results in employee addiction, anxiety, and depression (da Silva et al., 2024). Relatedly, scholars reveal techno-overload as a cause of cognitive and emotional disturbances (Marsh et al., 2022; Rasool et al., 2022), which happens when encountering new technologies or recalling negative past experiences with technology. For example, the intrusion and diffusion of artificial intelligence (AI) in work often results in anxiety (Chang et al., 2024). Further, studies have demonstrated the negative effects of techno-overload on psychological well-being (Bahamondes-Rosado et al., 2023; Marsh et al., 2024). More importantly, Thurik et al. (2023) focused solely on techno-overload by considering it a significant driver of negative well-being. Furthermore, Al-Youzbaky and Hanna (2022) and Yang and Lin (2018) highlighted that techno-overload leads to symptoms of anxiety and tension. Thus, our study hypothesized that excessive work-related ICT use increases techno-anxiety, as expressed in Hypothesis 1:

> H1: Techno-overload positively and significantly impacts techno-anxiety.

Techno-Complexity and Techno-Anxiety

Techno-complexity refers to instances in which the sophistication of technology leaves users feeling insufficiently skilled, demanding extra time and effort to grasp its use (Tarafdar et al., 2024). In Industry 4.0, employees face pressure to adapt to rapidly evolving technology, which leads to increased complexity and anxiety (Firk et al., 2020; Malik et al., 2022; Scholze & Hecker, 2024). Further, time spent on mastering complex ICTs reduces focus on core tasks and fosters inadequacy and digital anxiety (Consiglio et al., 2023; Ioannou et al., 2022).

While digital transformation enhances organizational potential, it also drives techno-complexity, a workplace stressor that is linked to negative psychological outcomes (Elemam et al., 2024; Sriwidharmanely et al., 2022). Techno-complexity heightens the challenges associated with task completion, which leads to increased anxiety among employees (Konuk et al., 2023). For example, a manufacturing supervisor who uses complex

software to track production metrics may face challenges in understanding the system, which may lead to anxiety over potential errors and their impact on operational efficiency.

Malik et al. (2022) found that employees face negative outcomes due to techno-complexity and the adoption of AI. Employees who are less proficient and lack confidence in using technology often experience heightened anxiety (Marsh et al., 2024; Powell, 2013). Scholars Baj-Rogowska (2023), Lin and Yu (2024), and Pang (2021) also mentioned that the diverse skills and expertise required to keep up with emerging technology leads to psychological strain (e.g., anxiety). Additionally, Maier et al. (2019) and Nastjuk et al. (2023) contended that employees' psychological responses to techno-stressors, including techno-complexity, often manifest as feelings of exhaustion, anxiety, and tension. Relatedly, Fernández-Fernández et al. (2023) further affirmed that the higher the techno-stress, the greater the anxiety employees experience. Drawing from the discussion above, we proposed Hypothesis 2 (H2), which states:

H2: Techno-complexity positively and significantly impacts techno-anxiety.

Techno-Anxiety and Techno-Exhaustion

The extensive use of digital devices poses a risk to employees' mental health, which increases levels of stress, anxiety, and digital exhaustion (da Silva et al., 2024; Ma et al., 2021). Employees often experience techno-anxiety when they perceive technology-related tasks as challenging, complex, or threatening (Marsh et al., 2024; Pfaffinger et al., 2020). This anxiety further intensifies stress levels and contributes to emotional exhaustion (Cheng & McCarthy, 2018; Perepelkin & Wilson, 2023). Anxiety also increases cognitive load, requiring more mental effort to manage the task and leading to negative emotions such as fear, frustration, and self-doubt (Rahmani et al., 2023).

Sustained cognitive strain and anxiety deplete mental resources (Hou et al., 2022), which cause fatigue and techno-exhaustion (Karim et al., 2024; Marsh et al., 2022). For instance, a financial analyst using complex software may experience fatigue from ongoing anxiety over errors impacting client portfolios. This fatigue from ongoing errors leads to mental fatigue and exhaustion. Thus, prolonged exposure to techno-anxiety not only hampers performance but may also lead to exhaustion. In light of the above discussion, Hypothesis 3 (H3) was formulated:

H3: Techno-anxiety positively and significantly leads to techno-exhaustion.

The Mediating Role of Techno-Anxiety

The extant techno-stress literature reveals that techno-anxiety (a negative affective response) is an essential psychological outcome of techno-stress (Agogo & Hess, 2018; Marsh et al., 2022; Salanova et al., 2013), which, in turn, leads to adverse outcomes (Lepp et al., 2014). Research papers have proved empirically the link between stress and anxiety (Vahedi & Saiphoo, 2018), anxiety and emotional exhaustion (Cheng & McCarthy, 2018), and anxiety and burnout (Koutsimani et al., 2019).

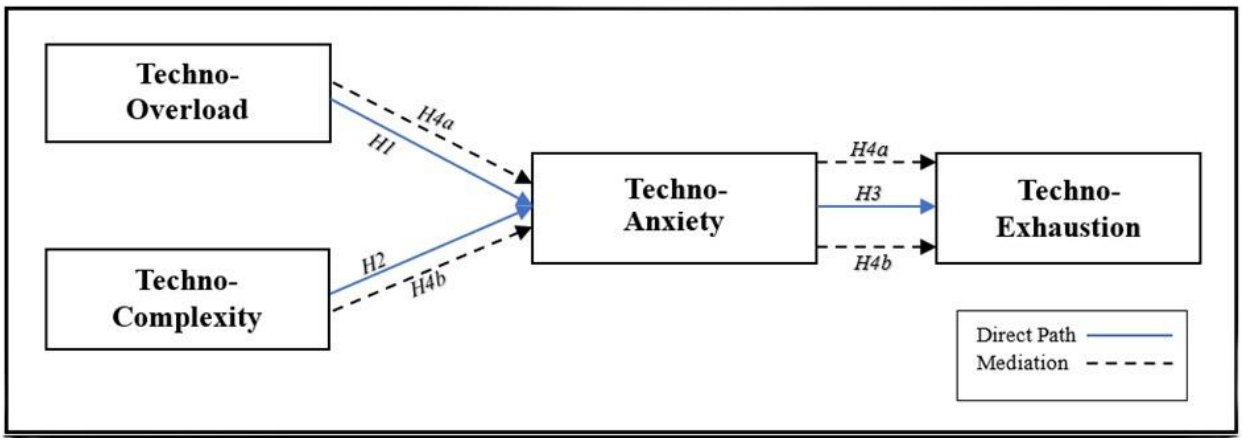
The mediating role of anxiety in this study was based on the stressor–strain–outcome model (Koeske & Koeske, 1993) and meta-analysis by Nastjuk et al. (2023), which considered psychological factors as mediators between stressors and outcomes. For instance, Gaudioso et al. (2017) found that techno-stressors' effect on work exhaustion is mediated by employee techno-strain. Further, Becker et al. (2019) found that ICT-related anxiety mediates the relationship between psychological stressors and employee well-being. Similarly, Chang et al. (2024) established AI-induced anxiety (a psychological factor) as a mediator between technology stressors and adoption intention. Based on the above discussion, our study anticipated that

techno-stressors (techno-overload and techno-complexity) will negatively affect techno-exhaustion through techno-anxiety. Thus, Hypothesis 4a (H4a) and Hypothesis 4b (H4b) were framed as:

> H4a: Techno-anxiety positively and significantly mediates the relationship between techno-overload and techno-exhaustion.
>
> H4b: Techno-anxiety positively and significantly mediates the relationship between techno-complexity and techno-exhaustion.

Based on the aforementioned discussion, the following conceptual model was developed (see Figure 1).

Figure 1. Conceptual Model



Source. The authors

Methodology

Measures

This study used previously validated scales to increase the reliability and validity of its constructs and findings. The scale items of techno-overload and techno-complexity were adapted from Tarafdar et al. (2007), techno-anxiety from Venkatesh (2000), and techno-exhaustion from Moore (2000). The items were assessed using a 5-point Likert scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree." Further, the questionnaire was pretested by experts in the subject area of human resource management. The scale items in the final questionnaire were revised based on the valuable recommendations provided by the experts, such as the removal of technical words and language clarity. Table 1 represents the scale items and standardized factor loadings of all constructs. In addition, Table 2 provides the operational definitions of all the constructs.

Table 1. *Scale Items and Standardized Factor Loadings (SFL)*

Constructs	Items	SFL
Techno-Overload (TO)	I am forced by technology to work much faster.	.681
	I am forced by technology to do more work than I can handle.	.827
	I am forced by technology to work with very tight time schedules.	.779

	I am forced to change my work habits to adapt to new technologies.	.782
	I have a higher workload because of increased technology complexity.	.721
Techno-Complexity (TC)	I do not know enough about technology to handle my job satisfactorily.	.600
	I need a long time to understand and use new technologies.	.749
	I do not find enough time to study and upgrade my technology skills.	.808
	I find new recruits to this organization know more about technology than I do.	.524
	I often find it too complex for me to understand and use new technologies.	.862
Techno-Anxiety (TA)	Technology does not scare me at all (reverse coded).	.678
	Working with technology makes me nervous.	.625
	I feel threatened when others talk about technology.	.699
	Technology makes me feel uncomfortable.	.832
	I get a sinking feeling when I think of trying to use technology.	.680
	Technology makes me feel uneasy.	.720
Techno-Exhaustion (TE)	I feel drained from activities that require me to use technology.	.886
	I feel exhausted at the end of the work day from using technology.	.679
	I feel tired from my technological activities.	.778
	Working all day with technology is a strain for me.	.954
	I feel burned out from my technology activities.	.776

Source. The authors

Sample

The sample comprised IT employees from Delhi and Chandigarh, two major technology hubs in India. The employees from various roles (e.g., developers, project managers, and analysts) and organizational levels were contacted to ensure diversity in perspectives on techno-stressors and their outcomes. The IT sector in India is particularly relevant for studying techno-stress, as it exemplifies high exposure to technological demands, such as techno-overload and techno-complexity. This work environment requires continuous adaptation to new digital tools, which makes it a representative group for understanding technology-induced stressors.

Participants, for this study, were selected using snowball sampling to ensure the sample adequately represented the IT workforce in terms of gender, experience, and organizational size. This diversity ensured the generalizability of the findings to similar technology-intensive sectors globally. Of 1,219 questionnaires distributed, 533 responses were returned, giving a response rate of 43.72%. After screening out incomplete and invalid responses, a total of 418 valid questionnaires were retained.

Most study participants were male (60.4%), aged 26 to 33 years. Just under 60% of participants were married, and approximately 80% held a bachelor's degree. The majority of participants—just under 53%—had less than 3 years' work experience (see Table 3).

Table 2. *Operational Definitions*

Construct	**Operational Definition**	**Adapted From**
Techno-Overload	Perception that technology increases employees' workload, forcing them to work faster and longer due to the demands of various tech tools	Tarafdar et al. (2007)
Techno-Complexity	Feeling that new technologies are complex and require significant effort to understand and use, making employees feel inadequate or inefficient	Tarafdar et al. (2007)
Techno-Anxiety	Discomfort or fear experienced when using technology, often due to a lack of confidence in one's technical skills	Venkatesh et al. (2000)
Techno-Exhaustion	Feeling of fatigue and mental drain resulting from the constant use of technology, leading to reduced cognitive and emotional resources	Moore (2000)

Source. The authors

Table 3. *Sample Description (n = 418)*

Description	Count (*n*)	Percentage (%)
Gender		
Male	252	64.4%
Female	166	69.6%
Age (in years)		
18–25	101	24.17%
26–33	227	54.30%
34–41	76	18.18%
>41	14	3.35%
Qualification		
Bachelor's degree	333	79.66%
Master's degree	85	20.34%
Marital Status		
Married	249	59.57%
Unmarried	169	40.43%
Work Experience		
>3 years	221	52.87%
3–8 years	114	27.27%
8–13 years	66	15.79%
<13 years	17	4.07%

Source. The authors

Results

Common Method Bias

To check for common method bias, three methods were used. First, Harman's test was conducted to determine if a single factor would arise from the factor analysis. The result revealed that only 32% of the total variance was explained by one factor, which is less than the recommended threshold value (<50%) (Harman, 1976). Moreover, relying on a single method to assess common variance bias is inadequate (Taser et al., 2022). We performed two additional tests to resolve this issue and check common method bias. The common latent factor (CLF) method revealed that the differences among regression weights of all the items of the two models (i.e., with and without CLF) were below the recommended limit of 0.2 (Podsakoff et al., 2003). Additionally, the correlation matrix was examined to check for any highly correlated constructs (see Table 4). A correlation greater than 0.9 indicates evidence of common method bias (Rahmani et al., 2023). Therefore, common method bias did not pose a serious concern in our study.

Measurement Model: Reliability and Validity

A confirmatory factor analysis (CFA) was performed using AMOS (Version 23) to assess the reliability and validity of the measurement model. The results showed that Cronbach's alpha, composite reliability (CR), and maximal reliability (MaxR) exceeded 0.70, indicating high internal consistency (Fornell & Larcker, 1981; Hair et al., 2019). Average variance extracted (AVE) values for techno-overload (0.578), techno-complexity (0.503), techno-anxiety (0.502), and techno-exhaustion (0.661) surpassed the 0.50 threshold, confirming convergent validity (Hair et al., 2019).

Discriminant validity was established as the square root of AVE for each construct exceeded inter-construct correlations (Malhotra et al., 2017), and the maximum shared variance (MSV) of each construct was lower than its AVE (Hair et al., 2019). Furthermore, the discriminant validity also was determined by the HeteroTrait–MonoTrait (HTMT) criterion, which indicated that the construct correlation (see Table 5) was below the 0.85 threshold (Henseler et al., 2014).

Table 4. *Descriptive Statistics, Correlations, and Square Root of Average Variance Explained*

Constructs	**Mean**	**SD**	**(1)**	**(2)**	**(3)**	**(4)**
(1) Techno-Overload	3.16	1.02	**0.760**			
(2) Techno-Complexity	2.71	0.90	0.416***	**0.720**		
(3) Techno-Anxiety	2.41	0.82	0.317**	0.341***	**0.709**	
(4) Techno-Exhaustion	2.95	1.05	0.431***	0.514***	0.475***	**0.820**

Source. The authors

Note.[a] Values in bold on the diagonal axis are the square root of the average variance explained (AVE). Values below the diagonal axis are correlations among latent variables; [b] * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5: *Reliability, Validity, and HTMT analysis*

Constructs	CR	AVE	MSV	α	MaxR	(1)	(2)	(3)	(4)
(1) Techno-Overload	0.872	0.577	0.185	0.872	0.879				
(2) Techno-Complexity	0.839	0.518	0.265	0.839	0.875	0.481			
(3) Techno-Anxiety	0.857	0.502	0.225	0.857	0.869	0.344	0.388		
(4) Techno-Exhaustion	0.910	0.673	0.265	0.910	0.946	0.486	0.578	0.515	

Source. The authors

Note. CR = Construct Reliability; AVE = Average Variance Explained; MSV = Maximum Shared Variance; α = Cronbach's alpha; MaxR = Maximal Reliability

The model fit indices (CMIN/*df* = 1.527; GFI = .933; CFI = .952; NFI = .936; TLI = .942; SRMR = .068; RMSEA = .058) met the established threshold criteria (Hair et al., 2019). This confirmed the validity of the measurement model and provided a solid foundation for evaluating the validity of the structural model (Hair et al., 2019, p. 703). Tables 4 and 5 provide an overview of the reliability and validity of the measurement model.

Structural Model Assessment and Hypothesis Testing

After specifying the measurement model and achieving its validity, hypotheses were tested (see Table 6) using the structural equation modeling (SEM) technique on AMOS (Version 23). The structural model achieved validity with acceptable fit indices: CMIN/*df* = 1.686; GFI = .920; CFI = .936; NFI = .926; TLI = .935; SRMR = .069; and RMSEA = .066 (Hair et al., 2019).

Table 6. *SEM Analysis*

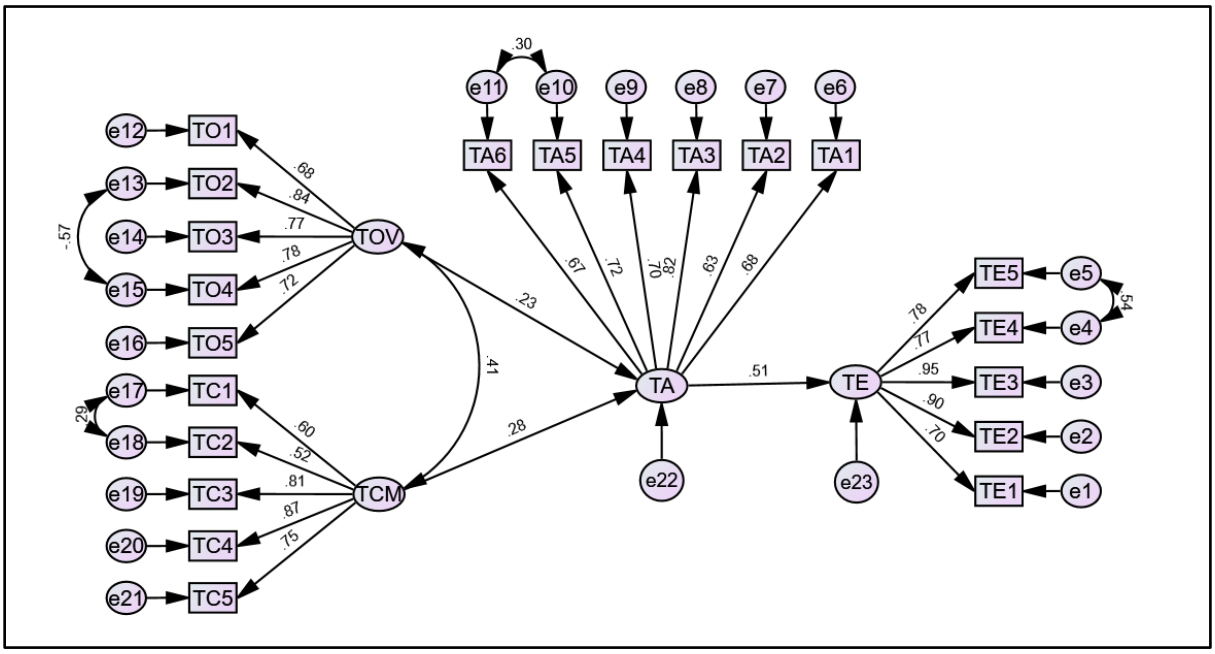
Hypothesis	Relationship	SRW	*t*-value	Supported?
H1	Techno-Overload → Techno-Anxiety	0.229*	2.364	Yes
H2	Techno-Complexity → Techno-Anxiety	0.281**	2.724	Yes
H3	Techno-Anxiety → Techno-Exhaustion	0.510***	5.082	Yes
Squared Multiple Correlation (R^2): Techno-Anxiety = 0 .185 (18.5%); Techno-Exhaustion = 0.261 (26.1%)				
Model Fit Statistics: CMIN/*df* = 1.654, GFI= .920, CFI= .936, NFI= .926, TLI= .935, SRMR= .069, and RMSEA= .065.				

Source. The authors

Note. [a] Standardized coefficients reported; [b] * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The hypothesized relationships were empirically tested, and the result revealed that techno overload (SRW = 0.229, $p < 0.05$) and techno-complexity (SRW = 0.281, $p < 0.01$) significantly and positively affected techno-anxiety, thereby supporting H1 and H2. Further, the positive and significant impact of techno-anxiety on techno-exhaustion had also been established (SRW = 0.510, $p < 0.001$). Hence, H3 was also accepted. The results are presented in Table 6, which includes the strength of the relationship—SRW, *t*-value, and significance value ($p < 0.05$). Figure 2 displays the results of the structural path model.

Figure 2: *Structural Path Model*



Source. The authors

Note. TOV = Techno-overload; TCM = Techno-complexity; TA = Techno-anxiety; TE = Techno-exhaustion

Mediation Analysis

The bootstrap technique, provided by Preacher and Hayes (2004), was used to test mediation. According to Collier (2020), this is the most trusted approach for testing the indirect effect in mediation models. This technique uses a random sample with replacement to assess whether the indirect impact is within a confidence interval (Preacher & Hayes, 2004). Five thousand (5,000) bootstrapping samples were requested at a 95% confidence interval to compute the indirect effect of techno-overload and techno-complexity on techno-exhaustion through techno-anxiety as a mediator.

The results indicated a positive and significant indirect effect of techno-overload (SRW = 0.105, $p < 0.01$) and techno-complexity (SRW = 0.120, $p < 0.01$) on techno-exhaustion through techno-anxiety. Additionally, the nonzero values in the lower and upper bound limits at a 95% confidence interval affirmed the significance of the results (see Table 7). Hence, H4a and H4b were accepted.

Table 7. *Test of Mediation Using a Bootstrap Analysis With a 95% Confidence Interval*

Hypothesis	Relationship	Total Effect	Direct Effect	Indirect Effect	Confidence Interval		Mediation Type
					Lower	Upper	
H4[a]	TOV→TA→TE	0.444**	0.339**	0.105**	0.038	0.186	Partial mediation
H4[b]	TCM→TA→TE	0.568**	0.448**	0.120**	0.048	0.210	Partial mediation

Source. The authors

Note. [a] Standardized coefficients reported, Bootstrap samples = 5000 with replacement; [b] TOV = techno-overload; TA = techno-anxiety; TE = techno-exhaustion; TCM = techno-complexity; [c] ** $p < 0.01$

Discussion

Based on the transactional theory of stress (Lazarus & Folkman, 1984), this study's findings provided significant insights into techno-stress dynamics and its impact on techno-anxiety and techno-exhaustion.

Research Question 1 (RQ1)

For RQ1, the findings of this study provided robust empirical evidence supporting the positive influence of techno-overload and techno-complexity on techno-anxiety. These results align with prior literature, which suggested that the excessive demands imposed by technology (techno-overload) and the challenges associated with understanding and using complex technologies (techno-complexity) significantly contribute to elevated anxiety levels among employees (Cheng et al., 2023).

This study showed that when employees face high workloads, they often experience anxiety due to their perception of these stressors as threats, which can be coupled with doubts about their ability to manage stressors effectively (Kumar, 2024; Yang & Lin, 2018). Additionally, the findings of Al-Youzbaky and Hanna (2022) and Yang and Lin (2018) have underscored the role of information overload in influencing anxiety.

Furthermore, our findings highlighted that employees who lack the necessary skills and time to manage technology are particularly vulnerable and can experience heightened psychological distress. In their systematic review, Marsh et al. (2022) and Nisafani et al. (2020) mentioned that interpersonal factors, such as insufficient training, increasing complexity, and work changes due to technological advancements, heighten anxiety levels.

Research Question 2 (RQ2)

For RQ2, the study findings confirmed that techno-anxiety significantly leads to techno-exhaustion. This implies that prolonged psychological strain from techno-anxiety manifests as techno-exhaustion, which causes individuals to experience fatigue due to their inability to manage technological demands effectively. The observed relationship in this study aligned with existing literature (Cazan et al., 2016; Powell, 2013; Rahmani et al., 2023) and demonstrated the link between techno-anxiety and negative outcomes such as reduced job performance, emotional exhaustion, and burnout.

This study also found that techno-anxiety exacerbates cognitive overload, as employees allocate substantial mental resources to mitigate their anxiety and navigate complex technological interfaces. Additionally, it was

found that cognitive overload leads to avoidance behaviors or excessive time spent on tasks, compounding feelings of exhaustion (Zhao et al., 2020).

Reasearch Question 3 (RQ3)

The findings for RQ3 revealed that techno-anxiety serves as a mediating factor in the relationship between techno-stressors (techno-overload and techno-complexity) and techno-exhaustion, which aligns with Gaudioso et al. (2017), who highlighted the mediating role of technological strain between techno-stressors and work exhaustion. Later, researchers Cheng et al. (2023) empirically validated the mediating role of techno-anxiety between techno-stressors and avoidance behaviors.

In this study, insufficient technological skills, work overload, and the pressure to perform under tight schedules were found to exacerbate employee threat, uneasiness, and inadequacy perception and to culminate in techno-exhaustion. Additionally—and consistent with the tractional theory of stress and coping (Lazarus & Folkman, 1984)—the results reveal that overwhelming stressors and insufficient resources lead to heightened anxiety and eventual exhaustion.

Theoretical Implications

By addressing gaps in the techno-stress literature, we provided crucial insights into the interplay among stressors, emotional responses, and subsequent outcomes in the workplace. The theoretical implications of this study included the following relationships, affective responses, and understandings.

Confirmed Techno-Stressor Relationships

This study made significant contributions to the techno-stress literature, as it was among the first to empirically confirm the relationship between techno-stressors—specifically techno-overload and techno-complexity—with techno-anxiety and the subsequent psychological outcome (i.e., techno-exhaustion). In addition, the study findings enriched the literature by uncovering the mediating role of techno-anxiety in linking techno-stressors to techno-exhaustion using the transactional theory of stress and coping (Lazarus & Folkman, 1984).

Linked Techno-Stressors and Affective Responses

This research further laid a foundation for better conceptualizing and operationalizing techno-stressors and their link to affective responses such as techno-anxiety. Although prior studies (Nisafani et al., 2020) conceptually explained the association between techno-stressors and techno-anxiety, empirical validation still needed to be provided. By confirming the relationship among techno-overload, techno-complexity, and techno-anxiety, this study advanced the empirical understanding of how specific stressors influence employees' emotional responses to technology (i.e., techno-anxiety).

Extended Understanding of Negative Psychological Outcomes

This research further extended the understanding of the negative psychological outcomes (i.e., techno-anxiety and techno-exhaustion). By empirically establishing the relationship between these two constructs, the study offered valuable insights into how negative emotional responses to technology contribute to employee distress. By doing so, we addressed the suggestions in previous studies, including Agogo and Hess (2018) and Marsh et al. (2022), who emphasized the need to explore employees' psychological outcomes, such as techno-anxiety and techno-exhaustion, and their interconnections.

Practical Implications

The findings of this study highlighted the critical role of technological factors in shaping employees' psychological responses and, therefore, underscored the need for organizations and policy makers to alleviate or reduce the potential adverse effects of technology on employees' lives. Notably, the study provided managerial implications, employee-related implications, and socio-technical implications.

Managerial Implications: Alleviating Employees' Techno-Stress
Employees can adjust to new technologies more easily if they are introduced gradually and supported by efficient change management techniques and feedback systems. Regular technology audits and iterative upgrades, based on employee feedback, must be conducted to ensure that technological systems remain user-friendly and efficient. This eventually improves employees' techno-anxiety and exhaustion. By addressing the sources of techno-stress and implementing effective coping strategies, managers can mitigate the adverse effects of psychological outcomes and maintain a sustainable workforce amid the ongoing digital transformation.

- ***Implement effective intervention strategies.*** Identifying emerging anxiety during the early stages of technological implementation will help organizations implement effective intervention strategies. A reverse mentoring system, in addition to a peer-to-peer mentoring program, can play a crucial role in determining which tech-savvy employees will mentor their colleagues on technology usage. This informal learning approach fosters employee collaboration and knowledge sharing, thereby reducing anxiety.

- ***Offer digital detox strategies.*** To counteract techno-stressors and their negative impact on employees' well-being (here, techno-anxiety and techno-exhaustion), digital detox strategies, such as emotion management, mindfulness training, and digital well-being applications can be implemented. Digital detox involves periodically disconnecting from technology and finding ways to limit involvement with it (Mirbabaie et al., 2022).

- ***Educate before integrating.*** Complex and intricate technology makes employees anxious and evokes feelings of inadequacy, hopelessness, FOMO (fear of missing out), and envy. Managers must make deliberate decisions on this issue to identify relevant technology literacy programs that can help reduce the level of techno-complexity among their employees. For example, concerned employees must be oriented to (or made aware of) the new or updated technology before introducing it in the organization.

- ***Create microlearning opportunities.*** The organization can create bite-sized microlearning modules that focus on specific technology-related topics or tasks, which can be accessed on demand. These modules will help employees learn independently and at their own pace, which allows them to fit learning into their busy schedules more effectively.

- ***Engage learning through badging, credentialing, and gaming.*** To keep employees motivated, organizations can implement a digital badging and credentialing system. This system helps recognize and validate employees' technological skills and achievements. Organizations can also develop interactive and gamified learning modules that simulate real-world technology scenarios to minimize distress and make the learning experience smooth and engaging.

Employee-Related Implications: Learning to Reduce Techno-Stress
The findings of this study offered actionable insights for employees to manage the psychological challenges associated with techno-stress.

- ***Develop time management skills.*** To effectively address techno-overload, employees can develop time management skills, such as time blocking (i.e., allocating specific periods for focused work). Employees can also utilize the Eisenhower matrix, which helps prioritize tasks based on urgency and importance.

- ***Prioritize well-being.*** In addition to managing workload, prioritizing physical and mental health through regular exercise, adequate sleep, and proper nutrition can significantly mitigate the negative effects of techno-stress. Emotion management and mindfulness techniques can further enable employees to manage emotional responses better and to maintain composure when confronted with technology-related stressors. Incorporating digital detox strategies, such as taking short tech-free breaks during the day, can also help reduce stress levels and refresh the mind.

- ***Foster open communications.*** Equally important is fostering open communication with human resources (HR) or managers by clearly identifying and articulating specific technology-related challenges, such as software issues or excessive workload due to technological demands. Employees can request targeted training to enhance their skills, such as workshops on software use or time management. Employees also can suggest adjustments to their workload or propose technological improvements, such as more intuitive interfaces or streamlined tools. By maintaining regular feedback and advocating for necessary changes, employees create a more accommodating and supportive work environment, promoting well-being and productivity.

Socio-Technical Implications: Managing IT- and Human-Related Work Factors

The findings of this study contributed to the socio-technical domain of healthcare systems, education systems, and work systems by offering actionable insights to tackle the psychological toll of techno-anxiety and techno-exhaustion, which negatively influence family dynamics, social relationships, and the overall quality of life.

- ***Actively address the root causes.*** Proactively addressing the root cause of the workplace issues could mitigate the potential spillover effects beyond the professional settings. Social awareness campaigns are needed as a way to ensure individuals can adapt to rapid technological advancements by promoting digital well-being and providing continuous digital literacy training at societal levels.

- ***Offer public digital detox strategies.*** Public digital detox strategies can aid in promoting a culture of sustainable technology use. These programs have broader societal relevance and may benefit communities by encouraging them to disconnect from technology to reduce cognitive and emotional strain periodically.

- ***Design curricula to foster techno-stressor resilience.*** Policymakers and educational institutions can also draw on the study's findings to design curricula and workshops to foster resilience to techno-stressors. For instance, incorporating mindfulness training, emotion management techniques, and practical digital skills into the education system can prepare individuals to navigate the demands of a technology-driven world more effectively.

- ***Tailor interventions to vulnerable groups.*** Tailoring interventions for vulnerable groups—such as older adults or those in resource-limited settings—can ensure inclusivity in the digital transformation. For older adults, specialized digital literacy programs with hands-on workshops and simplified tech interfaces can address their unique challenges. In resource-limited settings, affordable technology access and community-based training programs can bridge the digital divide to provide low-cost devices, internet solutions, and essential skills, all of which empower individuals and ensure

they benefit from technological advancements, which can contribute to a mentally resilient and digitally empowered society.

Limitations and Future Research Directions

While several initiatives were implemented to strengthen this study, certain limitations were identified that future research in the techno-stress field could address. Firstly, the study concentrated on a limited set of context-relevant predictor variables (i.e., techno-overload and techno-complexity). Future research should consider a broader set of stressors—such as techno-invasion, techno-uncertainty, and techno-insecurity—to explore stress dynamics in different contexts. Secondly, academicians can explore moderating variables from the literature of positive psychology (e.g., reverse mentoring, psychological capital) and information systems (e.g., digital literacy, techno-innovativeness). Thirdly, future researchers can conduct longitudinal studies to explore the evolving dynamics of techno-stress in response to continuous technological advancements. Finally, this study examined the relationship between two negative psychological responses to technology: techno-anxiety and techno-exhaustion. Further research is needed to refine and operationalize these concepts due to limited availability of existing literature. Additionally, scholars need to explore the connections of techno-stressors with other affective responses, such as techno-phobia, relational anxiety, resistance, disappointment, and fear.

Conclusion

In the era of rapid technological integration and digital transformation, employees encounter various techno-stressors that significantly impact their psychological well-being and workplace performance. This study advanced the techno-stress literature by addressing the overlooked role of techno-overload and techno-complexity in contributing to techno-anxiety and the subsequent psychological effects on employees. This study also provided a systemic understanding of how techno-anxiety mediates the relationship between techno-stressors and techno-exhaustion, and it offered insights into the mechanisms through which workplace technology-induced stress develops.

Drawing on empirical data from Indian IT employees, this research highlighted a technologically intensive context in which these stressors are prevalent, which added depth and relevance to its findings. The study offered theoretical implications and practical insights that address managerial, employee-related, and socio-technical aspects, and it emphasized the importance of organizational strategies, such as training programs and policies, to mitigate techno-stress by managing overload and complexity. These measures can reduce stress and fatigue, promoting a healthier and more productive work environment. Lastly, the study provided an agenda for future research and encourages deeper exploration into the evolving dynamics of techno-stress and its broader implications in an increasingly digital workplace.

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