International Journal of Management and Sustainability Practices
Vol. 1, Issue 3 (July–Sept 2026): Pages 90-96
e-ISSN (Online): 3139-5449
Website: https://ijmsp.com/

Technostress and Productivity in the Digital Workplace: A Narrative Review

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Article Information

Submission History:

Received: 13 August, 2026
Revised: 22 August, 2026
Published: 24 August, 2026

Keywords:

Technostress
Productivity
Information and Communication technologies
Technostress inhibitors
Occupational stress
Remote Work

Abstract

The advancement in digital technologies has not only redefined how tasks are accomplished and supervised but has created a novel source of stress referred to as technostress. The present paper presents a chronological description of the development of the construct of technostress, which started with its initial formulation through becoming established as an information systems research construct. It also describes the interrelationship between technostress and productivity at both the organizational and individual levels. With reference to the transactional theory of stress, the paper analyzes the technostress agents, which include overload, invasion, complexity, uncertainty, and insecurity, as well as the processes through which they contribute to poor performance. Special focus will be placed on the increasing impact of technostress in the context of the move towards remote and hybrid working conditions and the organizational and individual actions, or technostress inhibitors, suggested in order to reduce the negative implications of technostress. The article ends up demonstrating that technostress is not a random effect of digitalization but the result of a certain mismatch between the technological pressure and the human ability to cope with such pressure.

1. Introduction

Each wave of technology in the work environment comes with an accompanying promise of liberation from mundane tasks along with its own price tag for the individual adapting to such technology. Personal computers, mobile phones, enterprise software, and now the collaboration platform have all been presented as tools to increase productivity, but all have redefined the skills needed by the individual to master and use the technology in question. The name for the stress experienced in such a process of adaptation is known as technostress; it is a term that entered the popular lexicon many years before it received any empirical attention.

This term was coined by the clinical psychologist Craig Brod, who defined technostress as an adaptation disease of the contemporary age resulting from the inability to adapt healthily to new computer technologies (Brod, 1984). Brod identified two different trends among the people he examined; either they resisted or were afraid of the new technology, or they got so obsessed with it that their very identity and mode of communication started resembling that of the machine. Although Brod did not envision the emergence of smartphones, cloud computing, and algorithmic performance management when he wrote this almost four decades ago, the main point he was trying to make about the limitations of human adaptability to technological changes and organizational tendency to go beyond these limitations in pursuit of increased efficiency has stood the test of time.

A construct that started out as a common diagnosis has now been formalized in literature on information systems and organizational behavior. Technostress has been defined by researchers and associated empirically with job satisfaction, organizational commitment, and performance, and the elements of ICT that cause technostress have also been identified (Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Tarafdar et al., 2007). All this research has led to one common conclusion, which is that the technologies adopted by organizations to produce more output may, once a particular level of intensity is reached, subvert their very objective.
The significance of the question has risen along with the scale of the digital transformation process. While Brod (1984) was concerned with a relatively small number of office employees dealing with their first use of a computer terminal, today's worker uses a dozen or more applications daily, gets constant notifications from never-off devices, and is usually expected to be accessible throughout the whole process beyond the traditional working hours. The benefits of each application within the ecosystem are proven separately and very convincingly—a certain messaging service, project management software, or automation tool can, indeed, save a considerable amount of time and effort. However, what remains largely unexplored is the overall cost of the mental burden of mastering all of the applications together, and this overall cost is what the technostress literature is designed to address.

This study is structured as a narrative synthesis of the body of knowledge on the topic by means of a unifying question: How do technostress undermine productivity, and what can be done about it? The paper follows an organized progression as follows. First, technostress will be placed in the broader context of stress theory, from which it derives. Then, it will briefly describe the predominant conceptual framework regarding technostress: it is considered a collection of technology-enabled causes that induce mental distress. Next, two particular mechanisms through which productivity suffers as a result of technostress will be examined: The paper will first discuss information overload, interruptions, and the breakdown of boundaries between work and private spheres; afterwards, it will turn to a more accelerated example of technostress: the recent remote and hybrid work practices during and after COVID.

2. Theoretical Foundations: Stress and the Rise of Technostress

It would be beneficial to start from the general idea of the concept of stress itself in order to comprehend how technology can cause stress. According to the

transactional model proposed by Lazarus and Folkman (1984), stress does not exist in an object outside of oneself or within one's own body but as the connection between the individual and the environment he or she exists in. Stress occurs when an individual perceives demands of a certain situation as taxing or greater than his or her resources for coping with it. There are two types of appraisal involved in that model: primary and secondary appraisals, the former of which refers to threat, whereas the latter refers to coping with that threat.

The model carries easily into the realm of technology usage. There are pressures associated with digital technologies in the form of the need for learning new interfaces, processing an ever-increasing number of communications, and being available beyond standard working hours, and workers differ in the availability of coping skills—technical, organizational, and psychological—to cope with such pressures. Technostress occurs when there is a mismatch between pressure and coping skills. Subsequent IS research has made explicit use of this transactional approach to technostress by conceiving of it as an example of the more general stress process in which the stressor is digital rather than social or physical in nature (Ragu-Nathan et al., 2008).

The original description by Brod (1984) had a similar framework, but in less technical terms. According to Brod, technostress could manifest itself in two ways: as a visible problem coping with the computer technology, involving anxiety, hostility towards machines or even psychosomatic reactions; and as an over-identification with technology, resulting in deterioration of a person's patience, tolerance to ambiguity, and even the way of communication because of excessive exposure to machine reasoning. For Brod, both scenarios led to reduced effectiveness of the individual—the former through avoidance, the latter through the decreased capacity for cognition and social interaction, which, as a result, reduced the ability to perform tasks requiring patience and cooperation. While methodologically, Brod's work was more clinical and impressionistic than statistical, other authors agree that he identified a basic assumption, which would drive further research, even though the necessary empirical foundations were yet to be developed. It took approximately two decades for scholars in information systems to convert this postulate into a testable model applicable to the organizational computing context of the early twenty-first century. The outcome of this process was the transformation of technostress from a personal psychological maladjustment to technostress as an organizational issue with clearly defined precursors, consequences, and, most importantly, levers of change that management could manipulate.

3. Conceptualizing Technostress: Creators, Strain, and Inhibitors

Technostress is currently formulated in an extensive research program carried out by Tarafdar, Ragu-Nathan and their co-authors. Tarafdar et al. (2007), in one of the earliest studies that specifically targeted the working environment, offered the following definition of technostress, which has been subsequently developed and validated into a multidimensional scale by Ragu-Nathan et al. (2008): technostress is generated by five different states caused by the use of ICT, which include techno-overload (the experience of pressure to work faster and for longer due to technology); techno-invasion (the belief that technology invaded one's private life and blurring boundaries between home and office); techno-complexity (the notion of the complexity of technology making one feel inadequate and the need to spend time mastering new software); techno-insecurity (the anxiety of loosing the job not only to more skillful peers but also due to the replacement of workers by computers); and techno-uncertainty (the uneasiness caused by continuous unwanted changes and updates that require constant learning). As a whole, all these five factors are commonly termed "technostress creators" in academic literature, and numerous studies have been conducted since then using these predictors individually or collectively for predicting various outcomes.

Using a perspective focused more on person-environment fit than just the creative aspect alone, Ayyagari et al. (2011) further advanced the study of technostress by identifying what particular aspects of technology create stress. From surveys conducted among a few hundred working professionals, they formulated a model connecting three categories of technology characteristics – usability factors like usefulness, complexity, and reliability; intrusive factors like constant observability and anonymity collapse; and speed of technological change or dynamism – to well-known organizational stressors such as work overload, role ambiguity, privacy invasion, work-life conflict, and job insecurity. Their findings found work overload and role ambiguity to be the most important sources of stress, while intrusive technology characteristics emerged to be the best predictors of stress among technology-related stressors (Ayyagari et al., 2011). Here, the responsibility for explaining technostress is partly shifted away from the ability to cope with stress to decisions organizations make regarding the use of technology.

Productivity impacts of these creators have been studied in a parallel research study conducted by Tarafdar et al. (2007), where the link between technostress and role stress, and finally productivity, was studied in organizational contexts. The authors' model views technostress as an antecedent of role conflict and role overload, both well-established productivity detractors in organizational behavior research; hence, technostress does not exert its impact on productivity in a direct manner but indirectly through exacerbating these role-related factors which have already been identified as performance inhibitors in organizations. In a related study, the impact of technostress was investigated in the context of end user satisfaction and task performance, revealing that the negative cognition and affect created by technostress are manifested in poorer utilization of technology by the end users, the very technology which is supposed to enhance their performance (Tarafdar et al., 2010).

The next innovation introduced by the above research agenda has been the notion of technostress inhibitors – organizational processes that counterbalance the adverse impact of technostress creators. Focusing on the examination of technostress creators together with organizational resources that could potentially help employees counterbalance their impact, Tarafdar et al. (2011) have claimed that certain mechanisms, such as provision of technical support, facilitation of involvement in technological decision-making, and literacy facilitation through training can alleviate the strain caused by technostress creators, even in the absence of the latter. Instead of focusing on the inevitable adverse impact of technostress creators, the inhibitors framework redefines the issue – technostress is perceived no more as an inevitable consequence of digitalization, but rather as an adverse state whose level of intensity can be controlled by the organization through its conscious investments in supporting processes.

A final thing that needs to be mentioned about technostress creators based on this literature is the fact that overload and invasion are typically the creators most strongly linked to negative consequences across the literature. In a range of studies which break down the technostress construct into the specific five creators, it is clear that overload and invasion tend to have the strongest association with negative results, while complexity and insecurity also have an influence, albeit slightly weaker in comparison (Ayyagari et al., 2011; Tarafdar et al., 2007). This finding is interesting because overload and invasion are also the two technostress creators that are the easiest for management to affect within an organization. However, complexity and insecurity, in turn, are the result of broader processes, namely, the speed of technological change within an industry and the market possibilities of a particular skill set that are more difficult for any particular firm to influence. The fact that the harmful effects are concentrated on the two most controllable producers may thus be regarded as a positive discovery, because it implies that some portion of the productivity loss caused by technostress can be managed without decelerating the technological process but rather the rate of its implementation in regard to each particular worker.

All in all, technostress is a multi-dimensional construct with its origins in the technology attributes and organizational pressures, as well as its empirically confirmed link with lower job satisfaction, commitment, and performance; last but not least, there is also some evidence of an effective way to counteract the negative effects of technostress, which is the support on the part of organizations. And it is precisely this structure – creators, stress, consequences, and inhibitors – that further studies built upon when applying it to various technologies.

4. Information Overload and Interruption: The Cognitive Roots of Lost Productivity

Perhaps the most consistent link between technostress and loss of productivity is through the very cognitive structure of attention. Even before technostress was officially defined within the organizational context, scholars in diverse fields such as accounting, marketing, and organization science had already identified the problem of information overload, which refers to instances wherein information available to the decision maker is more than he or she can handle. In an exhaustive literature review summarizing the research conducted over a period of three decades, Eppler and Mengis (2004) demonstrated that information overload has been researched under various nomenclatures and through a number of academic disciplines; however, the central concept behind information overload was found to be very consistent: after a certain point, additional information no longer improves decision quality; rather, it impairs the same and generates mistakes, delay, and a feeling of being overwhelmed. The literature review also identified the situational determinants that make the problem of information overload worse, such as task complexity, time constraints, and the multitude of sources of information that the employee needs to attend to (Eppler & Mengis, 2004).

ICT in the modern age adds to this trend in two ways. In the first place, ICT makes more routes available for the influx of information, such as emails, instant messaging, project management software, videoconferencing and social media updates, all of which clamor for the attention of the employee at once, a trend of growth that fits closely into the techno-overload and techno-complexity experienced by creators identified by Ragu-Nathan et al. (2008). In the second place, these information conduits are generally made in such a way as to intrude rather than wait.

Productivity losses associated with this second pattern have actually been quantified directly. In an experiment involving interrupted tasks conducted in a lab setting, Mark, Gudith, and Klocke (2008) observed that interruptions did not just lead to a slower completion rate of tasks but the participants made up for this time loss by speeding up their pace when getting back to the task, thus completing the interrupted tasks in as much time as non-interrupted ones, and without any reduction in the quality of their output. However, behind the veil of the lack of productivity losses, there was a very real cost: Participants under interruptions experienced a much higher level of stress, frustration, time pressure, and effort (Mark et al., 2008).

In terms of the relationship between productivity and technostress, this observation is particularly relevant since it indicates that productivity and technostress do not necessarily appear simultaneously. An individual who frequently receives distractions in the form of notification reminders will still be able to meet deadlines and generate work of average quality, thereby hiding from his or her supervisor – and even himself or herself – the toll that is being taken psychologically to produce that result. The losses in productivity related to technostress, therefore, do not always manifest themselves in the process itself, but instead later on in terms of fatigue, disengagement, mistakes, or turnover.

Such differentiation between tangible outcomes and intangible stress provides a rationale for the failure of companies to recognize the relationship between technostress and productivity in the past. Productivity measures of traditional companies – produced goods and services, finished tasks, adherence to deadlines – do not provide sufficient means of measuring an expense that is expressed in increased workload and decreased well-being but not in terms of shortage. Only when the consequences of excessive load and constant interruptions are realized in terms of burnout, absenteeism, and turnover, the productivity costs of technostress become visible to companies.

What should also be noted is that the literature on interruptions is inconsistent with the simplistic storyline in which technology is always harmful and lack thereof is always protective. The fact that employees who experienced interruptions finished their work tasks without spending any additional time and losing quality proves that humans have an underestimated ability to cope with fragmented flow of information, at least for a while (Mark et al., 2008). It is not the issue of being unable to complete work because of interruptions, but the issue of being able to do that with the help of the particular coping mechanism that costs some psychic energy resources. In a review of information overload, Eppler and Mengis (2004) also arrived at a structurally similar conclusion, observing that the link between the quantity of information and the quality of decision-making is usually curvilinear rather than simple inverse, since there comes a point beyond which extra information does harm; until this point, however, extra information helps make better decisions. In this sense, both bodies of literature reach the same practical conclusion: one should not seek to stop all technology-assisted flows of information and thereby lose out on its legitimate gains, but to find and adhere to a cutoff point beyond which flow becomes unhelpful.

5. The Blurring of Boundaries: Always-On Culture and Productivity Spillover

The second main way in which technostress causes low productivity is through blurring of the boundaries between work and home life, a process closely linked to the concept of techno-invasion, which was established in the technostress literature as one of the major creators of technostress (Ragu-Nathan et al., 2008). In particular, portable devices make it extremely easy for work demands to travel with workers back home, and there is much research on this issue.

In a study using diaries to follow employees on several consecutive days, Derks and Bakker (2014) discovered that intensive use of the phone for work reasons during leisure time was connected with work-home conflict, which, in turn, led to higher levels of burnout. The key component of their argument was psychological detachment – the ability of employees to detach themselves psychologically from work during leisure time, which is regarded as an important recovery mechanism in occupational health psychology due to its ability to help recover from work fatigue. Employees who intensively used their phones during leisure time were less able to engage in recovery behaviors in response to work-home conflict compared to those who restricted their phone use, and thus it is not only about adding working hours to the regular day but about interrupting the process of recovery that allows an employee to return to work completely recovered the next day (Derks & Bakker, 2014).

It is clear, however, that this effect varies among workers to some extent, and that organizational and psychological variables have been demonstrated in further studies as moderators of its intensity. In a diary-based follow-up experiment, Derks et al. (2015) discovered that the association between the use of one's phone daily and work-home interference daily was affected by the social norm in the workplace and by the work engagement level of the worker in question. Specifically,

where the expectation of constant availability was implicit or explicit, the negative effect of the use of the smartphone on work-home interference was more intense; where the employee was very work-engaged, they seemed somewhat better at using the smartphone without any interference during non-work hours (Derks et al., 2015). This modulation is important to consider with regard to productivity, since it suggests that the damage done by the blurring of boundaries driven by technology is not an intrinsic property of the devices but is determined by organizational culture to a large extent.

As far as the productivity implications of boundary erosion go, this takes place with a time delay akin to what happens with interruptions. In the short term, an employee responding to his emails at ten PM might look more attentive and productive compared to one who doesn't. Yet over time, the depletion of time for recovery accumulates in fatigue, which is a known predictor of lower levels of concentration, decision-making ability, and mistakes made the next day. What in the one moment of time looks like increased productivity as a result of always being connected turns out to be stolen productivity in the long term?

6. Technostress in the Age of Remote and Hybrid Work

These theoretical links mentioned above were tested on a grand scale due to the emergence of the pandemic of the COVID-19 disease, during which millions of employees found themselves working remotely without any preparation or intention to do that. This phenomenon was so unexpected, so much dependent upon ICTs that it can be considered almost a natural experiment for technostress research.

In one such investigation carried out on a sample of Italian respondents and utilizing a translated version of the well-known technostress creators scale, it was discovered that the wellbeing consequences of the sudden move to working from home during the pandemic were associated with the existence of the same technostress creators found in previous organizational studies, despite the emergency nature of the remote working context (Molino et al., 2020). Given that the respondents had not generally chosen working remotely and were not well-prepared for it, this is a prime example of the consequences that follow from having the demand side of the person-environment fit equation increase, but not the resource side.

While a parallel study focused on a longitudinal study of the Finnish workforce regarding the changing nature of technostress during the pandemic as opposed to taking an analysis at one particular point of time, longitudinal studies like these are useful when dealing with the productivity issue since they would help in distinguishing an acute adjustment reaction from a chronic one (Oksanen et al., 2021). The former may be considered a passing phase during which workers and organizations will adjust themselves to their new condition, whereas the latter may persist even after adaptation takes place. In fact, studies such as these have indicated that although some adaptation did take place, digital stressors related to remote work did not simply dissipate during the course of the pandemic, showing that a significant part of technostress experienced during this period was chronic in nature.

Later studies have shifted from looking at the immediate effects of the pandemic itself to examining the organizational practices that it left behind, referred to broadly as "new ways of working," which involve flexibility in both time and place alongside significant use of digital collaboration technologies. In a study using data collected from Dutch workers, Andrulli and Gerards (2023) used structural equation modeling to examine how the new ways of working had an indirect effect on the wellbeing of the employees through their effect on technostress, need for recovery, and work engagement. While flexibility in the time and place of working had a generally positive effect on the affective wellbeing of employees, the effect seemed to depend significantly on the type of flexibility employed: aspects such as clear management of outputs and continued access to colleagues and information were related to higher wellbeing, while complete time and place flexibility was related to lower positive wellbeing; much of the total effect of new ways of working on wellbeing was mediated through reduced, or increased, technostress and need for recovery (Andrulli & Gerards, 2023). This subtle finding warns against viewing remote and hybrid working as a wholly good or bad factor influencing productivity; the effects seem to vary depending on the particular design of flexibility, communication, and technology support implemented by the organization, similar to the moderation role played by organizational norms previously found in the context of smartphones (Derks et al., 2015).

When taken together, these post- and pandemic-era studies imply three lessons related to productivity. First, technostress generators found in pre-pandemic organizational research generalize well to remote and hybrid settings; overload, invasion, complexity, uncertainty, and insecurity do not go away just because work leaves the office, and in many ways, these generators increase, since the spatial boundary between the office and home, which was previously a natural buffer against techno-invasion, is no longer present. Second, remote work productivity effects are not predetermined but rather are contingent on technostress and recovery activities, which means that two organizations providing similar flexibility can produce highly disparate results regarding productivity. Third, given the fact that remote and hybrid arrangements seem to become a permanent fixture of many labor markets, technostress generated by such settings should not be viewed as a temporary crisis but rather as a continuous problem of organizational design.

7. Mapping the Evolution of the Field

Technostress research maturity described in the above sections has also become an area of investigation. Through the application of bibliometric and science mapping techniques on technostress publications collected to date, Salazar-Concha, Ficapal-Cusí, Boada-Grau, and Camacho (2021) tracked the growth and diversification of the field since its emergence, highlighting the evolution from early technostress works that are conceptual and clinical in nature, such as Brod (1984), to the more developed body of empirical research centered on the creators-and-outcomes model defined by Ragu-Nathan et al. (2008) and Tarafdar et al. (2007). With their analysis, technostress research is revealed as an increasingly interdisciplinary field receiving inputs from not just the disciplines of information systems and organizational behavior, but also occupational health psychology, education, and public health, while observing an evident growth in publication activity associated with smartphone adoption, social media usage, and most recently, technology for remote work (Salazar-Concha et al., 2021).

This evolutionary path is important for the productivity issue, since it implies that the technostress concept has evolved past its initial focus on computer anxiety in terms of office workers being introduced to personal computers. Current studies have increasingly shifted their attention to populations and circumstances that were not covered by the early researchers, such as healthcare professionals dealing with electronic medical records systems, educators adapting rapidly to the new era of distance learning, and knowledge workers who have to perform all their tasks on cloud computing and collaboration platforms. Along with a growing scope of contexts under examination, there has been an increase in the scope of productive outcome variables analyzed as well, ranging from job satisfaction and organizational commitment that were typical for the first technostress studies, to task performance, user system satisfaction, work engagement, and intention to leave the organization in recent research (Tarafdar et al., 2010). The reproducibility of the creators – strain – outcomes pathway regardless of different

circumstances is an evidence of construct's robustness per se: whatever technology and occupation context are involved, the same process of demand exceeding the coping capabilities repeats itself.

8. From Stress to Strain to Lost Output: A Narrative Synthesis

At this juncture, it would be helpful to put together the various threads outlined above into one cohesive story about how technostress diminishes productivity. In other words, the phenomenon can be described through a four-stage process, which is supported by the literature outlined above.

The first stage of the process is exposure. Technostress occurs due to employees being exposed to certain characteristics of technology such as complexity, dynamism, intrusiveness, and unreliability, all of which were shown to cause objective stress, regardless of an individual employee's disposition (Ayyagari et al., 2011). Organizational practices often increase the exposure to these factors because organizations believe that having more technologies, communication channels, and update frequencies means having more capabilities.

The second phase is that of appraisal and strain. As proposed in the transactional approach to stress, individuals appraise their ability to cope with the challenges imposed on them through exposure to such situations (Lazarus & Folkman, 1984). In case of inadequate coping resources, which include lack of training, lack of technical assistance, or lack of clear guidelines about availability, the outcome is the strain that is described by the technostress generators: overload, invasion, complexity, uncertainty, and insecurity (Ragu-Nathan et al., 2008). Such strain does not arise in one instant, but builds up throughout a day and beyond the work-life boundary due to the presence of mobile technology at work.

The third stage is compensation in behavior. Being under stress caused by overload and interruptions, employees usually do not just stop doing things; on the contrary, they compensate for this situation by working quicker or harder, or by giving up some leisure time. This is exactly what makes it hard to notice technostress with traditional output measures, since the symptom expected in the case of the stressed staff is not visible due to the compensation done by the employees themselves.

The fourth and final stage consists of delayed and cumulative productivity losses. Since compensation has a cost associated with it, this cost is ultimately paid through diminished job satisfaction and organizational commitment, both known antecedents of turnover (Ragu-Nathan et al., 2008); decreased end-user satisfaction and task performance as a result of deteriorated concentration and decision-making abilities; burnout due to inadequate recovery from the work-home conflict (Derks & Bakker, 2014); and, collectively, decreased productivity and performance levels as seen in various technostress and role stress studies (Tarafdar et al., 2007). Importantly, this final stage often only reveals itself to the organization long after the onset of strain since the behavior in the third stage serves to mask any deficiencies in productivity.

These four stages of analysis shed light on what is perhaps a recurring pattern in the empirical literature, one that is at first blush perplexing: the adoption of new technology and short-run productivity gains occur despite declining levels of well-being, with productivity falling only when the resulting stress manifests itself in the form of burnout, disengagement, or turnover. Organizations measuring the success of the technology based only on short-run productivity gains will fail to see this hidden cost, confusing short-run compensation for long-run productivity gains.

9. Managing Technostress: Individual and Organizational Strategies

The following synthesis being correct, then efforts that are made with the intention of safeguarding productivity should focus on each of the above steps and not just treat technostress as an unavoidable consequence of digitalization. Literature provides pointers for the same both at the organizational and individual level.

In terms of organizations as a whole, the theory of technostress inhibitors proposed by Tarafdar et al. (2011) is the most suitable framework. The analysis by the authors identifies three types of organizational mechanisms that may reduce the strain related to technostress generators despite the fact that these creators can never be fully controlled and/or eliminated: literacy facilitation, which involves the continuous process of training that maintains the alignment between the technical skills of employees and their level of development and does not allow a gap between system capabilities and the skills of users to emerge; technical support delivery, which includes the help available for employees when a problem occurs in a system and reduces the sense of helplessness generated by techno-complexity; and involvement facilitation, which involves providing opportunities for employee participation in decision-making concerning what kind of technology will be utilized and how it will be used (Tarafdar et al., 2011).

As a result, since these processes work according to the principles defined by transactional stress theory, based on the balance between demands and resources, they can be controlled better by organizations than the rate of technological development, which is driven by competitive pressures beyond the control of any individual organization (Lazarus & Folkman, 1984).

As discussed above in relation to specific aspects of boundary erosion, another organizational lever lies in the area of norms about availability. Since the negative impact of the usage of smartphones after office hours on the problem of work-family conflict is known to be heavily dependent on the social and organizational norms of availability, which make this problem a function not of owning a smartphone but of the social context in which it is used, there is ample room for organizations to address the matter of technostress arising from this particular problem (Derks et al., 2015). Specifically, communication to workers that they do not need to respond to messages outside working hours, combined with leadership role modeling such boundaries, seems to be sufficient to greatly reduce work-family conflict caused by mobile phone availability.

The third level of levers relates to the introduction of flexible and remote work practices. It is important to notice the finding of the difference between particular aspects of innovative working practices' impact on the wellbeing of employees – specifically, clear output management and availability of colleagues and information have a positive effect on wellbeing, while full-time remote working without proper management has a negative effect (Andrulli & Gerards, 2023). As a result, organizations should consider flexible work practices as a system of separate aspects that need to be taken into account, especially performance management and maintaining relationships between colleagues (Andrulli & Gerards, 2023). Also, it is useful to note that the implementation of innovative working practices in case of an emergency can be considered a stressful situation for employees because of a lack of proper preparation, which causes negative wellbeing consequences even in the absence of advanced technologies (Molino et al., 2020).

The transactional theory of stress, therefore, implies that coping skills can tip the scales between demand and capacity regardless of how the technological environment has remained the same (Lazarus & Folkman, 1984). The implication here includes individual actions like intentionally carving out time for focused and uninterrupted work so as to alleviate the cumulative costs of interruptions (Mark et al., 2008), as well as creating a period after working hours to allow for psychological detachment that research has established as the main way through which people escape the burnout experienced due to work-home interference (Derks & Bakker, 2014). Since the engagement of an individual with his/her work has been established as the buffer against the harmful effects of using technology during after work hours, organizational efforts at creating engagement rather than availability have secondary benefits for technostress (Derks et al., 2015).

It should be noted that these levers are not substitutable but additive. In other words, an organization that focuses much on supporting and training its staff but ignores the reduction of the use of technology after work hours will experience limited benefits, since the techno-complexity issue can be addressed successfully but techno-invasion will continue; vice versa, an after-hours policy along with insufficient new system onboarding will help deal with invasion but leave complexity and uncertainty unresolved. It should be said that, according to the existing research, each of the technostress generators can be addressed differently, because, as was found out in research, they are relatively independent from one another in terms of their antecedents and, sometimes, strength of correlation with the outcome variables like satisfaction and performance. None of these techniques is effective in eradicating technostress entirely, and the literature fails to provide any information regarding an approach that would be capable of doing so alone. The implication of the inhibitor approach and its various offshoots, though, is that technostress is a problem that is solvable, rather than being a permanent cost to bear as part of working in a digitized environment, and that those organizations which are most successful in maintaining their productivity despite continuing technologically will be the ones which take the psychological impact just as seriously as the technical one.

10. Discussion and Implications

These implications include the following: For organizations, the key implication is that technostress and productivity cannot be measured separately. A technological implementation that is successful and shows great productivity results in the early stages of its application can still cause a problem because it creates a potential risk that will manifest itself in the form of absenteeism, disengagement, or attrition; due to the fact that the negative impact on productivity resulting from technostress is revealed later than the moment when technology was implemented, and the delay in appearance of the latter's effects is confirmed by the literature review above (Mark et al., 2008; Derks & Bakker, 2014).

In the view of the researcher, the robustness and reliability of the creators-to-outcomes model across an expanding population base and technologies, as evidenced by the bibliometric analysis performed by Salazar-Concha et al. (2021), indicate that the core construct of technostress does not need any essential changes in light of new technologies. More ambiguous appears to be the speed of adaptation to a certain degree of technological pressure on organizations and employees and the potential to develop such adaptive capabilities either through training and organization's design or this is just an inherent limit (Oksanen et al., 2021). Only longitudinal studies of organizations and their employees facing different waves of technology introduction may bring about a satisfactory answer.

From an individual standpoint, the review reveals that the perception of busyness and being responsive and always reachable is not a dependable measure of productivity and can actually be seen as the compensatory behavior that precedes the burnout (Mark et al., 2008). It is tough for employees to accept such a notion in cultures where responsiveness is seen as an indication of devotion, but the existing evidence about work-life interference and recovery shows that the ability to detach psychologically is not something that stands against productivity but is its pre-condition (Derks & Bakker, 2014).

11. Demographic and Generational Variation in Behavioral Bias

These narrative reviews suffer from some limitations that stem from its format. First of all, the present paper is not a systematic review and hence does not aim to identify all the studies conducted in technostress and productivity and their relationship. It attempts to use a representative sample of sources from the past and present to create an informative review of the existing knowledge about the issue. A significant amount of the existing studies, especially those concerned with the identification of technostress creators, use self-report surveys, which are useful for the identification of the association but not the direction and the strength of the effect.

In addition, there are three areas for future research that seem particularly valuable. To begin with, increased reliance on longitudinal design and diary study design, which have already proven useful in the smartphone and boundary management literature, would be helpful in understanding the cumulative processes by which technostress affects productivity (Derks & Bakker, 2014; Derks et al., 2015). Secondly, the combination of self-report measures of stress and productivity with objective measures of productivity, including system usage log files or supervisor assessments, would reduce the threat of method bias posed by using self-report measure of both stress and productivity. Finally, with the proliferation of artificial intelligence systems alongside other collaboration and communication tools analyzed in the literature reviewed above, the technostress creator model will require further testing against this new class of technology, which incorporates a number of the known stressors of previous ICT – complexity, unreliability, and job security fears – in new combinations.

12. Conclusion

Technostress is not an idiosyncratic grievance or the inevitable cost of technological development in a digital age. Technostress represents a well-understood, theory-driven, and increasingly quantified psychological phenomenon, whereby the requirements imposed by ICT exceed the capacity of users to cope with them, and negatively impact their productivity directly and indirectly. In particular, starting from the pioneering observations of Brod (1984), up to the more sophisticated, multidimensional approaches proposed by Ragu-Nathan et al. (2008), Tarafdar et al. (2007, 2010, 2011), Ayyagari et al. (2011), and even faster-moving field experiments conducted during the pandemic-induced remote work era (Molino et al., 2020; Oksanen et al., 2021; Andrulli & Gerards, 2023), all of the literature reviewed in this paper points to one unambiguous conclusion: The association between ICT and productivity is not linear. Neither more technology, connectivity, nor speed means necessarily more production; beyond a point set by the limits of individual ability and organizational assistance, what it really means is stress, coping, and ultimately, the opposite of what the technology is supposed to prevent. If organizations want to realize the productivity potential of the digital revolution, and not just its mere appearance, they must attend as carefully to the psychology of digital transformation as they do to its technology.

Disclosure Statement: No potential conflict of interest was reported by the authors.
Funding: The author(s) received no financial support for the research, authorship, and/or publication of this article.

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