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Technology Characteristics as Predictors of Psychological Strain

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ABSTRACT

Drawing on the work system misfit model, the present research developed and tested a model consisting of three technology characteristics (usefulness, presenteeism, and responsiveness) as antecedents, five techno-stressors (techno-overload, techno-complexity, techno-uncertainty, techno-invasion, and techno-insecurity) as mediators, and psychological strain as an outcome. A web-based survey questionnaire was utilized by surveying 163 employees from different financial and technological organizations. Two contributions with practical and theoretical significance were offered by the current research. First, this research delivered new insights for organizations to develop their technological environments and consequently improve their employees' mental health. Second, this research developed a short measure of a new dynamic technology feature (i.e., responsiveness) that may be used by scholars and practitioners in the broad information systems discipline.

KEYWORDS

Psychological Strain, Technology Characteristics, Work-System Misfit Model

INTRODUCTION

At present times, we are engaged in a "digitally-driven environment" that is characterized by excessive use of technology. Many employees perceive technology as beneficial, whereas others perceive technology as damaging. Till today, there are still debates about whether technology is useful or harmful. Thus, recently, there has been a shift in research for examining the negative effects of technology rather than the positive effects, especially since technology has shown to create threats rather than only opportunities for organizations (Lai, 2016).

Recent surveys showed 45% of employees feel socially disconnected because of technology; 18% identify the use of technology as a significant source of stress; 20% relate to technology as a cause of more stress when functioning improperly; 86% remain digitally connected; thus, high levels of stress have emerged (APA, 2017). Indeed, technology is not entirely replacing the human labor force, but it is demanding new sets of cognitive skills since work demands are transitioning from physical to mental loads. As a consequence, advances in technology have intensified the existence of psychological stress/strain.

Earlier and recent studies in the technology and stress literature have mainly focused on examining various job outcomes (e.g., productivity, user satisfaction, innovation, performance, and organizational

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commitment, etc.) rather than employees' psychological well-being (e.g., Brooks, 2015; Hwang & Cha, 2018; Chandra, Shirish, & Srivastava, 2019). Because of such limited studies (e.g., Ayyagari, Grover, & Purvis, 2011), estimating the impact of technology on individual well-being has been challenging. In a recent report by Forbes (2019), organizations and businesses are incurring annual losses in billions of dollars because of focusing more on their growth and less on their employees' mental health. Therefore, the current research attempts to answer the following main research question:

RQ: Is technology perceived as a significant cause of psychological strain at work?

Drawing on the work system misfit model, the present research develops and tests a model consisting of three different technology characteristics (usefulness, presenteeism, and responsiveness) as antecedents, five techno-stressors (techno-overload, techno-complexity, techno-uncertainty, techno-invasion, and techno-insecurity) as mediators, and psychological strain as an outcome. A web-based survey questionnaire was utilized to test the twelve proposed hypotheses by surveying 163 employees from different financial and technological organizations.

This research offers two contributions with practical and theoretical significance. First, technology research has been integrated more thoroughly with the psychological stress domain. Specifically, the current research adopts a multi-disciplinary exchange framework to investigate which specific technology characteristic or feature is perceived as the most significant antecedent or cause of psychological strain. Such studies have been relatively rare in literature, which led to limited findings and a lack of practical awareness. Thus, this research delivers new insights for organizations to develop their technological environments and consequently, improve their employees' mental health. By doing so, organizations are able to significantly reduce their annual losses. Second, because of global competition, the constant need for growth, and rapid technological advancements, new technology features have recently emerged without any empirical measurements to support their practicalities. Therefore, this research develops a short measure of a new dynamic technology feature (i.e., responsiveness) that may be used by scholars and practitioners in the broad Information Systems (IS) discipline.

The remainder of this research is structured as follows: the next section expands on the concepts of technostress, techno-stressors, and psychological strain. Then, the author presents arguments for the proposed research model and the hypotheses development preceded by the work system misfit model. These are followed by the methodology section. The author then elaborates on the results and conclude with a discussion of the findings.

LITERATURE REVIEW

Technology Characteristics

Developing a model with technology characteristics that is generalizable across various types of technologies has been identified as a challenge (Ayyagari et al., 2011). Thus, this research adopts the same conceptualization of technology characteristics as shown in the work of Ayyagari et al. (2011). Technology has been identified under three main features (i.e., usability, intrusive, and dynamic). The usability feature includes usefulness, complexity, and reliability characteristics, whereas the intrusive feature includes presenteeism and anonymity characteristics, and the dynamic feature includes pace of change characteristic.

One characteristic from each technology feature was examined in this research. First, usefulness has been identified as the primary characteristic that reduces the stressful impacts of technology (Ayyagari et al., 2011). This research attempts to validate if such a statement is true with psychological strain as an outcome. Second, the concept of presenteeism has been widely discussed in the literature. Nevertheless, the work of Ayyagari et al. (2011) was the first and only study to develop a scale for presenteeism. The study further suggested paying attention to this construct in future technology and stress-related studies. To address such calls, this research attempted to validate if such a construct holds a strong basis for further empirical examination. Third, this research developed a short measure of the responsiveness characteristic as a new dynamic feature instead of pace of change. Pace of change, the degree to which an individual perceives technological changes to be rapid, has been widely investigated in the technology and the stress literature (e.g., Ragu-Nathan, Tarafdar, Ragu-Nathan, & Qiang, 2007; 2008). Examining such a characteristic adds no value to this research.

Technostress and Techno-Stressors

It is important to identify the negative consequences that may emerge from the use of technology in the workplace, such as merging of the home-work boundaries, dependency on technology, loss of physical contact, social isolation, absenteeism, decreased commitment/performance, and stress (Speier & Venkatesh, 2002). As a consequence, the term technostress has emerged. Technostress has been defined as mental stress from technology (Weil & Rosen, 1997); the failure to cope with organizational technical demands (Tarafdar, Tu, & Ragu-Nathan, 2010); a collection of interrelated psychosocial constructs that negatively affect employees (Ragu-Nathan et al., 2008); a psychosomatic problem (Riedl 2013); or a negative psychological state (Salanova, Rodriguez-Sanchez, Schaufeli, & Cifre, 2014).

In the stress literature, stressors have been categorized into role stressors, task stressors, and technology stressors (Tarafdar et al., 2011). This research focused on technology stressors (i.e., techno-stressors). Techno-stressors are defined as the failure to cope with the demands of organizational technology use and are considered damaging (Tarafdar et al., 2010). Tarafdar, Tu, & Ragu-Nathan (2007) identiðed ðve techno-stressors: techno-overload (TO), techno-invasion (TINV), techno-complexity (TC), techno-insecurity (TINS), and techno-uncertainty (TUN). TO forces the user to do more technology-related tasks, to follow additional security requirements (D'arcy, Herath, & Mindy, 2014), or to deal with excess information and data (Zhang et al., 2017). TINV occurs when private time is invaded by work demands (Tarafdar et al., 2007), when faced with continuous availability, and when privacy is invaded by constant monitoring (Day, Paquet, Scott, & Hambley, 2012; Barber & Santuzzi, 2015). TUN is observed when technologies change quickly (Tarafdar et al., 2007; Maier, Laumer, Weinert, & Weitzel, 2015), or there is an absence of technology-related communication or decisions (Day et al., 2012; Barber & Santuzzi, 2015) or a lack of control over technology use policies or security (D'Arcy et al., 2014). TINS represents the feeling of insecurity towards using new technology or towards other more skillful individuals (Tarafdar et al., 2007). TC is the stressor due to constant learning over how to use technology (Tarafdar et al., 2007; Barber & Santuzzi, 2015), difficulty in understanding technology use policies (D'Arcy et al., 2014), or the presence of too many technical interruptions and complications (Barber & Santuzzi, 2015).

Psychological Strain

Strains are of two types (i.e., psychological or behavioral). Both strains are characterized as emotional reactions to stressors. Similarly, techno-stressors cause psychological and behavioral strains (Maier et al., 2015). Psychological strains include exhaustion, whereas behavioral strains include productivity and performance (Tarafdar et al., 2010). Techno-stressors increase both types of strains because of advanced systems, automation, complex work processes, etc. (Tarafdar et al., 2011). This research focused on measuring psychological strain as a response to the encountered techno-stressors.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

Multiple conceptual and theoretical models have been utilized in the technology-stress (i.e., technostress) literature (e.g., five-factor model, social cognitive theory, person-environment fit model, role theory, sociotechnical theory, coping theory, transaction-based approach, transaction theory of stress, transactional model of stress and coping, job strain model, etc.). Despite their noteworthy contributions to the literature, all models theorize the effects of stress or other variables (e.g., work demands/tasks, job characteristics, work activities, etc.) on different job outcomes rather than on individuals' psychological well-being. Moreover, most models were adapted to fit the technological environment (i.e., shifting from work/task demands to technological/technical demands). For instance, in the work of Ayyagari et al. (2011), the person-environment fit model was converted to the person-technology fit model to better support the theme of the research and the hypotheses development.

On the other hand, the work-system misfit model specifically theorizes the effects of technology on psychological strain. The model posits the relationships between different characteristics (antecedents), individual capacity, the demands (loads), and strain (outcome). The antecedents of the model consist of four separate characteristics (task, technology, environment, and work organization). The technology characteristic is the sole focus of this research.

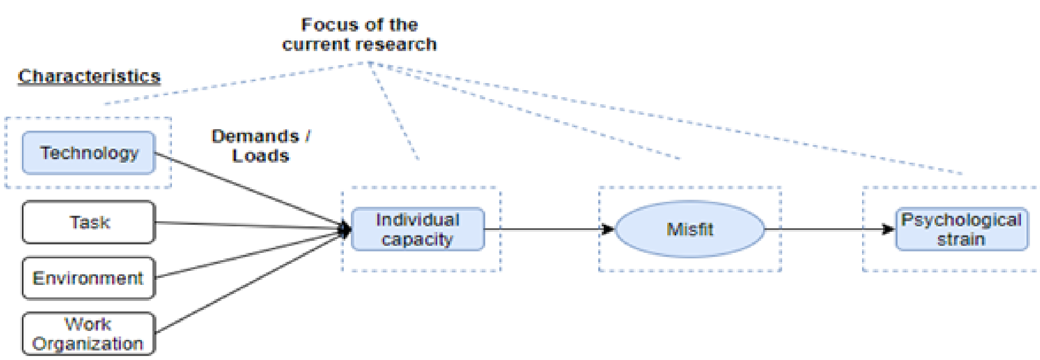
According to the model, technology characteristics may lead to psychological stress. If the demanding loads are exceeding the individual's ability or capacity, then a misfit will emerge; hence, leading to strain (Smith & Carayon, 1996). Thus, the work system misfit model is based on the principle that there is a balance between an individual's capacities and his/her environmental demands (Edwards, Cable, Williamson, Lambert, & Shipp, 2006). When this relationship is out of balance, a misfit may arise; thus, resulting in strain (Cooper, Dewe, & O'Driscoll, 2001) (see Figure 1).

In this research, the three technology characteristics (usefulness, presenteeism, and responsiveness) are the antecedents, the five techno-stressors (techno-overload, techno-complexity, techno-uncertainty, techno-invasion, and techno-insecurity) are the emerging misfits, and psychological strain is the outcome.

Usability Feature: Usefulness

The research proposes that technology usefulness impacts techno-overload since this characteristic forecasts voluntary technology adoption and use. However, in the work environment, there is no choice of using or not using a specific technology due to work norms. In other words, employees might perceive low usability features, but still use the technology because of the job specifications, constraints, and rules. This condition activates perceptions of working more to satisfy job requirements (Aborg & Billing, 2003). In regards to the work system misfit model, technology characteristic that improves usability will also develop the individual capacity without relatively affecting the load; thus, leading to a lower perceived misfit. Based on the evidence, compliance, use of technologies builds conflict in the values-supplies that can result in strain, while the involuntary use of non-useful technology may also create a value-supplies conflict (Sami & Pangannaiah, 2006). As technologies are perceived to be useful, employees tend to work faster and better; thus, decreasing the overload

Figure 1. Work system misfit theoretical model (Adapted from Smith & Crayon, 1996)



perception. Whereas, employee's capacities are diminished if they do not perceive technology as useful in addressing the work demands (Straub & Karahanna, 1998). Therefore, the research hypothesizes:

Hypothesis 1: Perception of technology as useful negatively relates to perceived techno-overload.

Intrusive Feature: Presenteeism

Hyper-connectivity refers to the numerous methods of communication and interaction that overcome time and space boundaries by virtualizing experience and physical presence (Fredette, Marom, Steinert, & Witters, 2012). Hyper-connectivity can also be described as the degree to which technology enables users to be accessible anywhere and anytime (Fredette et al., 2012), referred to as presenteeism (Ayyagari et al., 2011; McGee, 1996). In technology and stress literature, presenteeism is a widely conversed concept by researchers (i.e., Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Based on the evidence, the concept of constant connectivity leads to various harmful outcomes (i.e., strain, burn-out, reduced efficiency) (Van de Heuvel, Van der Werf, Verhoef, De Wit, Berendse, & Wolters, 2010). For instance, an increase in the flow of communication may further result in task indecisiveness and uncertainty (Ayyagari et al., 2011); thus, perceived as a source of frustration (Straub & Karahanna, 1998). This research relates to the fact that being regularly available results in strain through three techno-stressors: techno-overload, techno-uncertainty, and techno-invasion.

Presenteeism may be evident in perceptions of techno-overload. Increases in the speed of workflow and productivity are dependent on connectivity developments of technologies (Clark & Kein, 1996). Employees will be required to work under pressure to complete tasks under limited time, which has been demonstrated to be a source of overload (Cooper et al., 2001). Constant accessibility increases the loads on employees that lead to the broadening of the misfit between an individual's capabilities and the technological demands; hence, resulting in higher perceived techno-overload (Ayyagari et al., 2011). Therefore, the research hypothesizes:

Hypothesis 2: Perception of technology as intrusive (presenteeism) positively relates to perceived techno-overload.

The continuous need for attention may also be created by technologies (Davis, 2002). Reminders and alerts are a few of the tools that require the individual to respond immediately, which is driven by the concept of presenteeism. This time-consuming need may eventually distract the individual away from work. Uncertainty is created by the loads positioned by the interruptions; thus, limiting the employee's ability in completing a certain task (Ayyagari et al., 2011). Furthermore, additional stages of decision making are supplemented because of the technology's nature of multitasking (Kakabadse, Kouzmin, & Kakabadse, 2000). Despite the choice of disconnecting from all technologies, it's impossible because of the work norms and competition within motivated co-workers. The degree to which employees appreciate certainty, presenteeism (constant connectivity), on the other hand, leads to uncertainty and may not live up to the individual's expectancies; hence, creating an increase in the misfit (Ayyagari et al., 2011). Therefore, the research hypothesizes:

Hypothesis 3: Perception of technology as intrusive (presenteeism) positively relates to perceived techno-uncertainty.

Due to work pressure, invasion of privacy has become a major concern for individuals as technologies are becoming more intrusive (Best, Krueger, & Ladewig, 2006) inside and outside the work environment. For instance, an employee might be on holiday, but still, he/she is expected to answer and manage their work tasks as if they are at work. Thus, dependency on such technologies may eventually lead to low mental health, whereas individuals who try to disconnect are reported to be more efficient and productive in the long-run (Ayyagari et al., 2011). Recently, few high-end hotels and restaurants have started implementing policies that prohibit the use of mobile phones during the individual's stay. They intend to offer privacy without any technological attachment for some time. Individuals value their time, to a degree that technologies might negatively impact their decision and not meet their expectations; hence, leading to an increased misfit in the demands-capabilities. Therefore, the research hypothesizes:

Hypothesis 4: Perception of technology as intrusive (presenteeism) positively relates to perceived techno-invasion.

Dynamic Feature: Responsiveness

The concept of responsiveness originated in the 19th century within the academic (educational) field, further advanced to the IS-strategy disciplines (Rondeau, Ragu-Nathan, & Vonderembse, 2010) as an IT/IS department function, and has been linked to system use, adaptability, and effectiveness (Delone & Mclean, 2008). However, despite the extensive literature on responsiveness, to date, no prior studies empirically developed this construct as a technology characteristic with its array of item measurements.

Technology responsiveness is defined as the technical capacity to respond to work demands timely and flexibly (Iberahim, Mohd Taufik, Mohd Adzmir, & Saharuddin, 2016). Timeliness is about successfully handling environmental demands within a limited timeframe, whereas flexibility is the structural ability to respond to environmental changes (Maatook & Maruping, 2014). Flexibility is associated with technology compatibility, modularity, and connectivity features (Benitez, Ray, & Henseler, 2018). Evidence from IS literature suggests that technologies are expected to be informative, flexible, integrative, and responsive to any external environmental demands (Russell & Taylor, 2007). These characteristics assist in building IS abilities and functionality. Technology must be responsive to the fast-paced demands, which may eventually help in enabling training, developing skills, and improving productivity and performance (Rondeau et al., 2010). Absence of the responsiveness function (e.g., hardware malfunctions, software errors/problems, program lags, technology complexity level, upgrades, and internal networking issues) is a source of user frustration because of the technology's inability to deliver useful and efficient results within a limited time frame and under work pressure (Rondeau et al., 2010). Thus, creating stress, delays in production, decrease in performance, and possible displacement of IS strategies. This research relates to the fact that the technology responsiveness characteristic may result in strain through three techno-stressors: techno-overload, techno-complexity, and techno-insecurity.

Two approaches can be provided in terms of the responsiveness characteristic. The first approach is that the higher the individuals' perceptions of technology responsiveness to the demands or loads, the lower the perceptions of the stressors that may result in strain; hence, minor misfit occurring in the work-system misfit model. As technologies are perceived to be more responsive, employees tend to finish more work, feel more secure about their technical capabilities, and are more capable of adjusting to complex features; thus, decreasing the perceptions of technological overload, insecurity, and complexity. However, the second approach is that perceiving higher technology responsiveness may also lead to a) high perceptions of overload since the employee might be expected to finish more tasks due to the technology's ability in fulfilling numerous tasks (multi-tasking); b) high perceptions of complexity due to new implemented upgrades to keep the technology at full responsivenesses (employee will be forced to update his technical knowledge constantly); and c) high perceptions of insecurity due to peer-competition and fear of replacement. In this research, the second approach is more applicable in the real world since most organizations increase the workload on employees; thus, seeking to increase profits and productivity with lower costs, expenses, and staff workers due to global competition. Therefore, the research hypothesizes:

Hypothesis 5: Perception of technology as responsive positively relates to perceived techno-overload.
Hypothesis 6: Perception of technology as responsive positively relates to perceived techno-complexity.
Hypothesis 7: Perception of technology as responsive positively relates to perceived techno-insecurity.

Lastly, correlations between the perceived stressors/techno-stressors and psychological strain are well evident in the broad stress literature (e.g., Cooper et al., 2001) and technostress literature (e.g., Ayyagari et al., 2011; Galluch, Grover, & Thatcher, 2015). Therefore, the research hypothesizes:

Hypotheses 8-12: Perceived techno-stressors (techno-overload, techno-complexity, techno-uncertainty, techno-invasion, and techno-insecurity) are positively related to perceived psychological strain.

METHODOLOGY

Research Design

To examine the twelve proposed hypotheses, a web-based survey questionnaire was implemented. To encourage a high response rate, the questionnaire was developed to be compact and short in length. The survey consisted of 35 constructs' items and six demographics (gender, age, education, employment level, technology experience, and geographic location). All of the items followed a five-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree). Psychological strain was measured by another version of a five-point Likert-scale (1=Never, 2=Rarely, 3=Every once in a while, 4=Sometimes, and 5=Almost always). To ensure reliable and valid measures, a) all items were adapted from previously validated studies (except for the newly developed responsiveness construct); hence, showing good internal consistency; and b) a pilot study (pre-test) was conducted involving three academics and three Ph.D. candidates to further enhance the quality of the questionnaire before the data gathering.

Procedure and Participants

The participants were contacted and reached through "*automated messaging invitations*" from multiple professional networking sources (e.g., LinkedIn, PartnerUp, Data.com Connect). Participation was strictly voluntary and anonymous. After two months from initial contact and continuous follow-ups, 172 responses were collected from the 487 sent invitations (35% response rate). Due to several incomplete and missing responses (including the dropping of irrelevant outliers), 163 final responses were attained (see Table 1).

Figure 2. Research model and proposed hypotheses

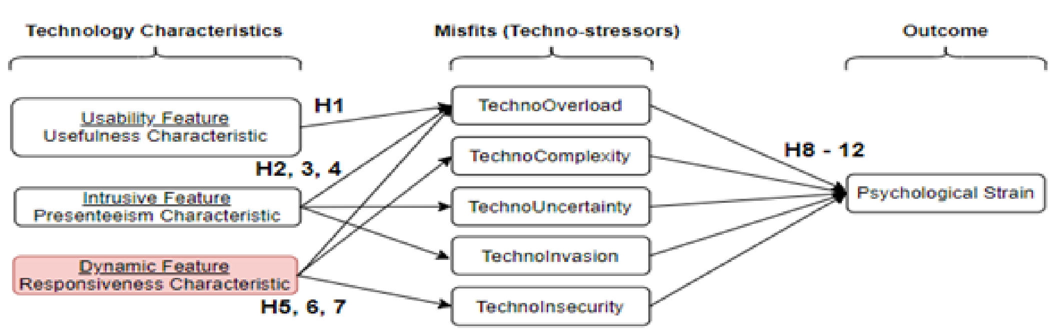


Table 1. Demographics

Measures	Descriptions	Frequency	%
Age	18 - 26 27 - 37 38 - 48 49 - 59 > 60	29 66 35 28 5	17.70 40.90 21.40 17.20 2.80
Gender	Male Female	56 107	34.40 65.60
Education	Technical degree High School diploma BA MBA DBA Double majors	10 32 47 37 29 8	6 20 28.6 22.6 18 4.80
Employment level	Lower Management Middle Management Upper Management	81 64 18	49.81 38.90 11.29
Technology experience	Less than 5 years 5 – 10 years More than 10 years	35 42 86	21.60 25.60 52.80
Geographic location	France UK Spain Germany	34 49 26 54	20.90 30.00 16.00 33.10
Total		**163**	**100**

Generally, the participants were employees of different financial and banking organizations. Recent reports have shown that financiers and bankers are the most stressful and most vulnerable to mental disorders because of poor work-life balance and frequent use of multiple types of technology (e.g., platforms, software, statistical tools, analytical programs, etc.) (e.g., EFC, 2018).

Specifically, the participants were related to Fintechs rather than traditional financial institutions. Fintechs involve a combination of financial services and the use of innovative technologies. Fintechs may take the form of either service-oriented (e.g., payments, services, wealth management), data-oriented (e.g., big data), or process-oriented (e.g., automation) structure. This research focused on the first form that deals with digital payments (e.g., mobile and B2B payments). However, it was unfeasible to differentiate between specific types of technologies used because of the nature of the research design and the diverse localities of the participants within the west of Europe.

Measures

Preexisting and pre-validated scales were adapted for this research. 3 items for the usefulness characteristic (mean= 3.6440; St. Dev.= 0.934) were adapted from Moore & Benbasat (1991) and Davis, Bagozzi, & Warshaw (1989) (e.g., "Use of technologies enables me to accomplish tasks more quickly"). 3 items for the presenteeism characteristic (mean= 3.7083; St. Dev.= 0.800) were adapted from Ayyagari et al. (2011) (e.g., "The use of technologies enables others to have access to me"). 5 items for outcome psychological strain (mean= 2.67; St. Dev.= 1) were adapted from Moore (2000) (e.g., "I feel drained from activities that require me to use technologies"). Items for all 5 of the techno-stressors were adapted from Ragu-Nathan et al. (2008) and Tarafdar et al. (2007) (5 items for techno-overload (mean= 2.43; St. Dev.= 0.82) (e.g., "I am forced by this technology to work much faster"); 5 items for techno-insecurity (mean= 2.82; St. Dev.= 1.07) (e.g., "I feel constant threat to my job security due to new technologies"); 3 items of techno-uncertainty (mean= 3.23; St. Dev.= 0.99) (e.g., "There are always new developments in the technologies we use in our work"); 3 items for techno-invasion (mean= 2.65; St. Dev.= 1.02) (e.g., "I spend less time with my family due to this technology"); and 4 items for techno-complexity (mean= 3.51; St. Dev.= 0.74) (e.g., "Learning to use technologies is easy for me")).

4 items were measured for the responsiveness characteristic (mean= 3.5565; St.Dev.= 0.69) (e.g., "Technologies instantly respond to networking problems"; "Technologies are flexible in responding to work demands"; "Technologies are timely in performing work-related tasks"; and "Technologies promptly update and upgrade their applications"). The items reflect the meaning of perceived techno-stressors (misfits) through direct assessments (e.g., Ayyagari et al., 2011). According to Edwards et al. (2006), understanding the significance of a perceived fit is challenging. For instance, perceived fit on a techno-stressor directly refers to the effect of technology demands and indirectly refers to the limit of an individual's capabilities in fulfilling such demands. High estimates indicate excessiveness of technological demands (loads) on the individual's capabilities; hence, high levels of techno-stressors (or low perceived fit). Whereas, low estimates show moderation of technological demands; thus, low levels of techno-stressors (or high perceived fit).

Responsiveness Scale Development and Validity

In this research, a short measure of technology responsiveness characteristic was developed. The benefit of such a measure is the use of just a few items (not necessary full dimensions range) to evaluate the general level of technology responsiveness (Van Engen, 2017). In doing so, the research followed a systematic 3-phased process similar to the work of Van Engen (2017).

Phase 1

This research only developed a short measure of pre-validated original measures (Van Engen, 2017). The current measure of responsiveness characteristic is a short structure of the combined pre-validated measures of timeliness, flexibility (Benitez et al., 2018; Iberahim et al., 2016; Maatook & Maruping, 2014), system use, adaptability, and effectiveness (Delone & McLean, 2008). The research followed such an item-selection method (multi-dimensional approach) to allow for high rates of single integrated responses from the participants (Ironson, Smith, Brannick, Gibson, & Paul, 1989). Since the research adapted pre-existing items rather than developing new ones (Credé, Harms, Niehorster, & Gaye-Valentine, 2012), then the first requirement to develop a short measure was achieved.

Phase 2

Commonly, a short measure should involve at least three items to attain internal consistency and reliability (Liden, Wayne, Meuser, Hu, Wu, & Liao, 2015). Since there was no access to the datasets of the original measures, from the original 15-item measures, 4 items with the highest factor loadings and correlations (> .50) were selected as potential items. By doing so, the items with high error variance were omitted and an equal number of items were derived from each dimension. The analysis was processed based on a different sample or data set (n=22) excluding the other constructs in the model. The participants included research assistants, lecturers, and DBA students. The feedbacks, findings, and items validities were satisfying. Hence, the item pool was validated. Since the research obtained a final number of 4 items (> 3 items), no additional items were necessary. Besides, there was no reason to change the scale format since the original measures followed a 5-point Likert scale. Furthermore, although the reduced numbers of items may require more answers options, a 5-point Likert scale has been proven to be adequate for developing short measures (Van Engen, 2017). Therefore, satisfying all required standards, the proposed 4 items were ready to be analyzed.

Phase 3

All reliability and validity tests were adequate. All statistical tests included the 4 items of the responsiveness characteristic as a unidimensional construct (antecedent) and not as a second-order construct since the first approach provided the best fit with higher factor loadings. Hence, with the completion of the phases, the research proposed a valid and reliable short measure of the responsiveness characteristic. An additional dataset would have been required in this research to further cross-validate the proposed 4-item measurement in case unsatisfactory results were found (Van Engen, 2017). But since all estimates were satisfactory, no additional dataset was needed. Furthermore, the results section provided additional validity for the responsiveness characteristic.

RESULTS

Before the regression analysis, common method bias was not found to be a major issue in this research (see Table 5 in the Appendix). Furthermore, factor loadings showed significant correlations (see Table 6 in the Appendix). Moreover, convergent and discriminant validity showed satisfactory estimates (see Table 2).

Hypotheses Testing

The empirical analysis presented several interesting insights. H1 (Usefulness-TechnoOverload) was not supported (t= .744; β= .051; p> .05); H2 (Presenteeism-TechnoOverload) was supported (t= 2.464; β= .167; p< .01); H3 (Presenteeism-TechnoUncertainty) was not supported (t= 1.224; β= .087; p> .05); H4 (Presenteeism-TechnoInvasion) was supported (t =7.44; β =.469; p< .01); H5 (Responsiveness-TechnoOverload) was supported (t= 3.259; β= .224; p< .01); H6 (Responsiveness-TechnoComplexity) was supported (t= 3.609; β= .25; p< .01); H7 (Responsiveness-TechnoInsecurity) was supported (t= 3.24; β= .227; p< .01). As for hypotheses H8-H12, all were supported except for H8 and H11. H8 (TechnoOverload-Psychological strain) yielded (t= -.143; β= -.009; p> .05), while H11 (TechnoInvasion-Psychological stain) yielded (t= -2.597; β= -.163; p< .05) (see Table 3).

Mediation Analysis

Testing for mediation purely based on the Baron & Kenny method or the Sobel test has become more challenging and less recognized in academic research (Hayes, 2009). Therefore, this research used

Table 2. Convergent and Discriminant validity

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Maximum Shared Variance (MSV)
TechnoComplexity	.787	.862	.610	.340
TechnoInvasion	.779	.871	.693	.424
TechnoInsecurity	.884	.915	.683	.424
TechnoUncertainty	.805	.885	.719	.308
Presenteeism	.838	.670	.512	.005
Responsiveness	.842	.894	.679	.229
Psychological Strain	.929	.947	.780	.324
TechnoOverload	.837	.884	.607	.356
Usefulness	.906	.941	.841	.340

*CR > 0.70 & AVE > 0.50 (Fornell & Larcker, 1981), Convergent validity is satisfactory; MSV < AVE (Fornell & Larcker, 1981), Discriminant validity is satisfactory

Table 3. Regression analysis

Hypothesis	Relationship	Beta	t	Sig. (p Value)	Result
H1	Usefulness - TechnoOverload	.051	.744	>.05	***Not supported***
H2	Presenteeism - TechnoOverload	.167	2.464	<.01	Supported
H3	Presenteeism - TechnoUncertainty	.087	1.224	>.05	***Not supported***
H4	Presenteeism - TechnoInvasion	.469	7.440	<.01	Supported
H5	Responsiveness - TechnoOverload	.224	3.259	<.01	Supported
H6	Responsiveness - TechnoComplexity	.250	3.609	<.01	Supported
H7	Responsiveness - TechnoInsecurity	.227	3.240	<.01	Supported
H8	TechnoOverload - Psychological strain	-.009	-.143	>.05	***Not supported***
H9	TechnoComplexity - Psychological strain	.191	2.726	<.01	Supported
H10	TechnoUncertainty - Psychological strain	.211	3.002	<.01	Supported
H11	TechnoInvasion - Psychological strain	-.163	-2.597	<.05	***Not supported***
H12	TechnoInsecurity - Psychological strain	.328	4.370	<.01	Supported
Model Fit					
	CMIN/df < 3 (Hair el al., 2010)	*1.586*	*Satisfactory*		
	CFI > .90 (Hair et al., 2010)	*.93*	*Satisfactory*		
	RMSEA < .05 (Hooper et al., 2008)	*.05*	*Satisfactory*		

Medcurve macro analysis (SPSS), which is based on the concept of instantaneous indirect effects using bootstrapping procedures for inference. The bootstrapping method does not violate assumptions of normality and is recommended for small sample sizes. Medcurve is used to simplify the statistical computations and the analysis of the results by generating both percentile and bias-corrected bootstrap conðdence intervals, which tend to be asymmetric and closer to the true sampling distribution of products of normal random variables (Preacher & Hayes, 2004; 2008). If zero is not found within the interval, then there is a significant mediating effect (i.e., full mediation) (see Table 4).

The main interest of this research was investigating which specific technological characteristic or feature may be a possible cause of psychological strain rather than which techno-stressor is a

Table 4. Mediation analysis

Submodel	Lower CI	Upper CI	Point	P value	Result
(1) US-TC-PST	-.0984	.0686	-.0020	>.05	Partial mediation
(2) PR-TC-PST	.1714	.3891	.2631	<.05	Full mediation
(3) RS-TC-PST	.1669	.4415	.2778	<.05	Full mediation

*US= Usefulness; PR= Presenteeism; RS= Responsiveness; TC= Techno-stressors; PST= Psychological strain significant mediator. Thus, in the mediation analysis, techno-stressors were measured as a single construct rather than separate units.

DISCUSSION

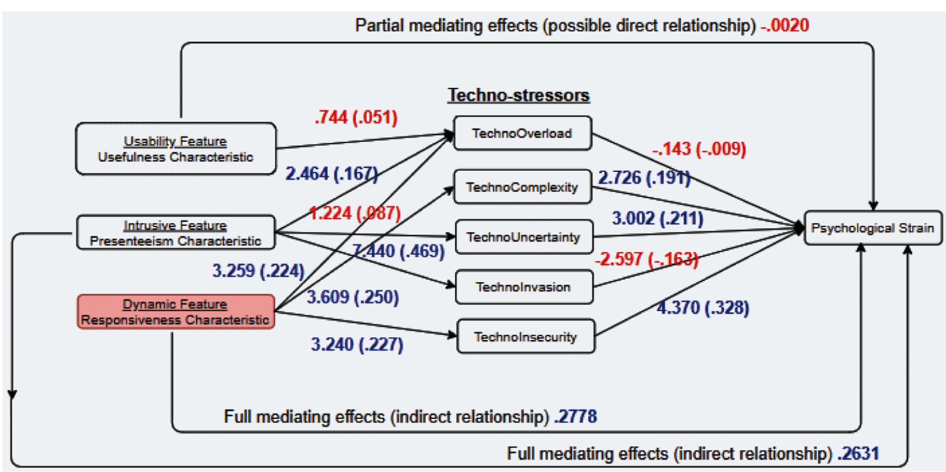
Most of the hypotheses were supported (i.e., 4 out of the 12 hypotheses were not supported) (see Figure 3). For H3, the perception of presenteeism showed no significant increase in perceived techno-uncertainty. This could be possible since presenteeism (i.e., being hyper-connected) may also support the employee in being always updated with the recent upgrades in the organization's software platforms. The concept of presenteeism does not necessarily apply only to work-related tasks. It could also play the role of an "alert mode" regarding any new technical or administrative policies/strategies implemented by the organization.

For H8, perceived techno-overload did not show any positive relationship with psychological strain. The main reason for such a finding may be related to cultural differences. For instance, Tu, Wang, & Shu (2005) conducted a study in China, which showed that techno-overload positively affected productivity (i.e., negatively affected stress and strain). This is due to the nature of the Chinese culture that often pushes for workload endurance. Therefore, it is very likely that because of the culturally diversified sample, techno-overload would negatively relate to psychological strain rather than positively.

For H11, perceived techno-invasion negatively related to psychological strain rather than positively. This finding complements Ayyagari et al. (2011) work that showed invasion of privacy did not significantly relate to strain. It has also been evident in studies showing that individuals have adapted to be more tolerant and acceptable to the concepts of techno-invasion, monitoring, and the intrusive nature of technologies due to work norms and production expectations (e.g., Best et al., 2006).

For the mediation analysis, submodel 1 showed partial mediation effects. Thus, there is a significant relationship between techno-stressors and psychological strain; and there is also some direct relationship between usefulness characteristic and psychological strain. Thus, usefulness characteristic has both direct and indirect relationships with psychological strain. On the other hand, submodels 2 and 3 showed full mediation effects. Techno-stressors tend to decrease the significance of the relationships between technology characteristics and psychological strain. Thus, both technology characteristics might no longer affect psychological strain after techno-stressors are controlled. In other words, presenteeism and responsiveness characteristics only have indirect effects on psychological strain.

Figure 3. Empirically tested research model (t values; Beta values)



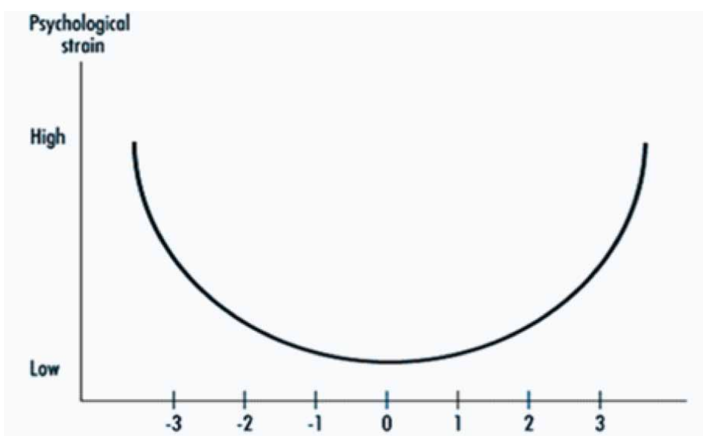
Research and Practical Implications

Recent characteristics and applicability of new emerging technologies are still practically unrealized and academically (theoretically and empirically) unaddressed. It is argued that emerging technologies are identified as not-yet fully understood or researched (Veletsianos, 2016). Because of global competition, the constant need for growth, and rapid technological advancements, new technology features have recently emerged without any empirical measurements to support their practicalities. Therefore, this research developed a short measure of a new dynamic technology feature (i.e., responsiveness) that may be used by scholars and practitioners in the broad IS discipline.

Unexpectedly, only usability feature showed to have a direct effect or relationship with psychological strain. Intrusive and dynamic features exhibited indirect relationships. Such a finding could be unusual, but worth investigating. The usability feature (usefulness characteristic) does not need to lead to increased psychological strain. The direct relationship between usability feature and psychological strain may be recognized as nonlinear (both positive and negative effects) rather than linear (either positive or negative effects). Thus, a curvilinear (U-shaped) relationship is expected (see Figure 4). In other words, low and high levels of usability feature (usefulness characteristic) show the same high levels of psychological strain, whereas moderate levels of usability feature (usefulness characteristic) exhibit low levels of psychological strain. High levels of psychological strain emerge from either perceiving technology as ineffective/useless or highly useful to a degree that employees are unable to complete tasks on time because of increased overload and pressure (i.e., additional effort is needed). This is also why H1 was not supported. Usefulness characteristic showed an insignificant linear relationship with perceived techno-overload; nevertheless, a nonlinear relationship might be in effect.

Most technical reports and academic studies suggested numerous interventions and approaches on how to cope and deal with technology-related stress in organizations. This research suggests that the main issue is not managing stress, but rather better designing the technologies to fit the work environment. In other words, as technology becomes useful, the harder it becomes to use/operate (i.e., more tasks and commands); thus, the longer it takes to learn how to use it. Thus, an increase in the usefulness characteristic does not necessarily lead to enhanced performance or positive mental health (i.e., low levels of stress). Therefore, organizations are recommended to maintain a balanced innovation rate of the usefulness characteristic that meets employees' mental capabilities rather than market/business requirements/demands.

Figure 4. U-shaped relationship between usefulness characteristic and psychological strain



LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Despite the significant contributions presented in this research, there are few limitations. First, the sample is considered relatively small. A larger sample is better to achieve more reliable results. Second, only three types of technology characteristics and features were analyzed. Future studies may consider perceived characteristics of innovation (i.e., technical compatibility, technical complexity, relative advantage, trialability, & observability) as probable causes to psychological strain. Third, the responses might be affected by different cultures, job specifications, work norms, and values since the data were not explicit to any specific location. Future studies are encouraged to replicate the same research under different conditions before final assumptions are formed, especially since further refinements for the newly developed short measure (responsiveness) are desirable. Fourthly, a response surface analysis (RSA) is strongly recommended. This way, scholars will be able to further contribute to research by examining *"How is a specific response (outcome) influenced by a given set of inputs (technology characteristics)?"*; *What is the nature of the response?"*; and *"To what degree does the input yield optimum response?"*.

CONCLUSION

Most IS studies investigated what technology can do *"for the user"* rather than *"to the user"*. This research attempted to examine the latter. By adopting a multi-disciplinary exchange framework (i.e., technology, stress, and psychology disciplines), this research is one of the very few studies that focused on investigating what specific type of technology characteristic may be the main cause for psychological strain. To conclude, this research suggests that technology should not be perceived as either beneficial or harmful, but rather a combination of both assumptions. Therefore, technology is effectively managed and controlled if considered as a continuous challenge rather than a definite promise or threat.

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APPENDIX

Table 5. Common method variance analysis

Indicators of constructs	Standardized Regression with CFL and Marker (R2)	Standardized Regression Weights (R1)	R1 – R2
US2 ← US	.750	.843	.093
US3 ← US	.798	.874	.076
US4 ← US	.818	.902	.084
RS1 ← RP	.660	.778	.118
RS2 ← RP	.735	.836	.101
RS3 ← RP	.495	.659	.164
RS4 ← RP	.559	.752	.193
TO1 ← TO	.427	.498	.071
TO2 ← TO	.714	.776	.062
TO3 ← TO	.782	.827	.045
TO4 ← TO	.559	.659	.100
TO5 ← TO	.719	.795	.076
TIN1 ← TIN	.719	.766	.047
TIN2 ← TIN	.616	.713	.097
TIN3 ← TIN	.775	.846	.071
TIN4 ← TIN	.735	.788	.053
TIN5 ← TIN	.715	.778	.063
TUN2 ← TUN	.641	.743	.102
TUN3 ← TUN	.729	.801	.072
TUN4 ← TUN	.664	.747	.083
TI1 ← TI	.562	.631	.069
TI2 ← TI	.792	.812	.020
TI3 ← TI	.744	.789	.045
TC1 ← TC	.685	.779	.094
TC2 ← TC	.566	.655	.089
TC3 ← TC	.657	.705	.048
TC4 ← TC	.519	.629	.110
PST1 ← PST	.674	.745	.071
PST2 ← PST	.752	.827	.075
PST3 ← PST	.824	.887	.063
PST4 ← PST	.830	.890	.060
PST5 ← PST	.853	.907	.054
PR1 ← PR	.738	.844	.106
PR2 ← PR	.865	.937	.072
PR3 ← PR	.534	.624	.090

*Common latent (method) factor (CLF) method was used by adding a latent factor to the CFA model; Differences between the estimates R1 and R2 did not exceed 0.200 (Podsakoff et al., 2003); thus, common method is not a serious concern

Table 6. Factor loadings

	1	2	3	4	5	6	7	8	9
Usefulness 1	-.050	.181	.094	.169	.280	**.769**	.257	.001	-.038
Usefulness 2	.003	.045	.053	.205	.154	**.866**	.176	-.006	.090
Usefulness 3	-.047	.086	.183	.217	.239	**.808**	.207	-.015	.014
Responsiveness 1	-.021	.016	.237	**.745**	.090	.221	.087	.017	-.010
Responsiveness 2	-.001	.027	.136	**.815**	.098	.043	.182	.003	.151
Responsiveness 3	.107	-.013	-.014	**.752**	.064	.155	.121	.047	.026
Responsiveness 4	.169	.218	.008	**.793**	.137	.097	.049	.084	.049
Techno-Overload 1	.032	.008	**.714**	.009	-.039	.108	.108	.081	.167
Techno-Overload 2	.346	.144	**.734**	.116	-.018	.009	-.097	.023	.086
Techno-Overload 3	.273	.222	**.761**	.147	.033	-.032	-.074	.001	.063
Techno-Overload 4	.106	.135	**.697**	.011	.139	.147	.229	.032	.199
Techno-Overload 5	.294	.333	**.661**	.180	.063	.124	.021	-.102	-.060
Techno-Insecurity 1	.244	**.726**	.223	.072	-.150	.105	.037	-.127	.163
Techno-Insecurity 2	.063	**.684**	.361	.161	.110	.159	.095	-.046	.073
Techno-Insecurity 3	.214	**.796**	.206	.059	.028	.063	.049	.056	.159
Techno-Insecurity 4	.304	**.787**	.001	.054	-.116	.033	.053	.024	.108
Techno-Insecurity 5	.307	**.705**	.054	-.069	.060	-.014	.200	-.002	.269
Techno-Uncertainty 1	-.095	.117	.144	.059	.159	.228	**.756**	.032	.092
Techno-Uncertainty 2	.068	.073	-.054	.145	.086	.183	**.845**	.004	.045
Techno-Uncertainty 3	-.073	.112	.074	.242	.137	.117	**.746**	-.054	-.069
Techno-Invasion 1	.321	.189	.245	.001	.030	-.085	.194	-.075	**.594**
Techno-Invasion 2	.262	.267	.070	.119	.057	.050	-.038	-.010	**.743**
Techno-Invasion 3	.128	.217	.206	.105	.023	.069	-.012	.055	**.818**
Techno-Complexity 1	-.078	-.099	.078	.153	**.694**	.176	.310	-.042	.174
Techno-Complexity 2	-.039	.007	.003	.193	**.754**	-.041	.168	-.025	.069
Techno-Complexity 3	.005	-.047	-.054	.036	**.797**	.215	.008	-.043	.021
Techno-Complexity 4	.026	.055	.132	.032	**.700**	.314	.008	.070	-.141
Psychological Strain 1	**.729**	.209	.113	.113	-.186	.077	.006	-.036	.152
Psychological Strain 2	**.807**	.198	.169	.111	-.011	.057	-.010	.040	.122
Psychological Strain 3	**.870**	.166	.130	.028	.006	-.041	.009	.021	.112
Psychological Strain 4	**.854**	.213	.150	.021	.050	-.066	-.066	.057	.141
Psychological Strain 5	**.854**	.172	.253	.004	.032	-.107	-.055	.014	.078
Presenteeism 1	.065	-.058	.075	.061	.062	-.058	.040	**.886**	.014
Presenteeism 2	.000	-.045	-.019	.003	.047	.005	.002	**.920**	.002
Presenteeism 3	.001	.049	.005	.058	-.140	.039	-.056	**.788**	-.018

* Factor loadings > 0.30 (Yusoff, Esa, Mat Pa, Mey, & Aziz, 2011); Satisfactory estimates

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