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Structured Abstract

- Purpose: Individuals can improve their task performance by using information and communications technology (ICT). However, individuals who use ICT may also suffer from negative outcomes, such as burnout and anxiety, which lead to poorer performance and well-being. While researchers have studied the positive outcomes of ICT use in the aggregate, the same has not been done for negative outcomes.

- Design/methodology: This study uses a meta-analysis of 52 studies to examine the relationship between ICT use and negative outcomes, and the influence of job autonomy on ICT use and the negative outcomes of ICT use. Job autonomy is relevant because a higher level of job autonomy allows individuals to decide how, how often, and when they will use ICT that is causing negative outcomes for their work.

- Findings: The results of the meta-analysis revealed that ICT use increased negative job outcomes and that, unexpectedly, autonomy exacerbated this effect.

- Research limitations/implications: The results of this study point to the prevalence of negative outcomes from ICT use among individuals. Researchers should study how users may potentially restrict the value that organizations may be able to obtain from the implementation of new systems, especially whether individual-level negative outcomes could coalesce into a collective resistance. There also needs to be further research into the motivating and inhibiting roles of autonomy in enhancing ICT use, while mitigating its negative impacts simultaneously.

- Originality/value: The study provides an aggregate analysis of the negative impacts of ICT use among individuals and the role of autonomy in the relationship.

1 Introduction

Organizations use information and communications technology (ICT) to improve their handling of information. This makes organizations more effective by enhancing their ability to manage their customers, processes, and knowledge (Mithas *et al.*, 2011; Ray *et al.*, 2005; Tanriverdi, 2005). However, individuals have also encountered negative outcomes when they use ICT. Examples include the increased number of interruptions to their work, making them less productive and more stressed (Fonner and Roloff, 2012); a decrease in the level of team spirit between employees (Martin, 2011); and the job strain caused by receiving a huge number of emails and calls at work, and having technical difficulties due to the faults of their computer and other equipment (Stadin *et al.*, 2016).

The negative consequences of ICT use on employees' work experiences have been studied before (Robey and Boudreau, 1999), but the results have not been straightforward. For example, ICT use in organizations has been found to be related to stress, strain, and burnout (Day *et al.*, 2012; Lee *et al.*, 2014; Nam 2013), because it places demands on employees, such as the need to respond more quickly and learn new ICT systems, as well as a possibly increased workload. In contrast, other researchers have found that ICT use may not result in negative job outcomes such as exhaustion, distress, or stress (Chesley, 2005; Kraan *et al.*, 2014). For example, interacting with someone virtually using ICT, instead of meeting face-to-face, may be beneficial for at least three reasons: online interactions enhance self-presentation, lead to better perceptions of the corresponding party, and encourage more time to be spent on message construction (Walther, 1996; Walther, 2007). The first goal of this paper is to resolve these inconsistent findings by examining the relationships between the

constructs used to assess negative job outcomes[1] and those used to capture IT use, which incorporate the actual use of a range of different ICTs.

The second goal of this paper draws from the phenomenon of employee discretion. The tension between the benefits and impositions of ICT use has led to employees directing their own work through attempts to make work-related decisions and regain freedom in how they do their jobs (Avgar *et al.*, 2010). Being able to decide how your job is done is referred to as "job autonomy" (Hackman and Oldman, 1975), and job autonomy and its related terms, such as job control, have occasionally been studied as moderators, mediators, or predictors of the relationship between ICT use and negative work outcomes. This paper argues that job autonomy can ameliorate the negative impacts of ICT use. This argument builds on the findings that high job control negatively buffers the relationship between high job demands and strain (Karasek, 1979), and may reduce the impact of job stressors (Jones and Fletcher, 1996).

More broadly, the concepts of ICT use, negative work outcomes, and job autonomy have not been well-integrated in the literature, and the paper's second goal provides a framework for doing this. Employees who have higher levels of control and autonomy over various aspects of their job may be able exert more influence over potentially stress-provoking areas of their workplace (Day *et al.*, 2010). Similarly, the extent to which negative outcomes are experienced by individuals when they use a particular ICT for their work varies by the level of job autonomy they have. For example, employees with more control over how they do their job may decide to forego that specific technology and use an alternative one to accomplish their tasks, thus alleviating the negative outcomes. Even if there is no alternative technology, such employees

[1] This paper's focus is on motivation-related negative outcomes, not task-related ones, such as interruptions and interaction richness or quality.

could diminish the potential negative outcomes by perhaps spending more time learning how to use the ICT in a way that makes the negative outcomes less likely.

The research questions this paper asks are: 1) what is the overall impact of ICT use on employees' negative job outcomes? and 2) what is the impact of autonomy on the relationship between ICT use and the negative outcomes of ICT use? A key challenge with these questions is that the focal constructs (ICT use, negative outcomes of ICT use and autonomy) have been measured in the literature with a variety of related constructs. To answer the research questions, we carry out a meta-analysis of the literature on the negative outcomes of ICT use and adoption and run a meta-regression analysis to examine the moderating role of job autonomy. This meta-analysis offers three contributions. First, the study summarizes research on the range of negative outcomes experienced by individuals when they use ICT in a work context. Second, it evaluates how job autonomy moderates the relationship between ICT use and negative job outcomes. Third, the results of our research synthesis provide theoretical and practical implications by summarizing existing empirical research on the relationship between ICT use and the negative outcomes experienced by individuals. By consolidating the findings of individual studies, we locate effects that may be practically and theoretically significant. Also, by thoroughly summarising the literature, we identify gaps in the literature and list potential research topics for future researchers.

The next section introduces the transactional theory of stress (Lazarus and Folkman, 1984), and the paper continues by using this theory to frame the prior literature on the negative effects of ICT use on individuals. We then describe the meta-analysis methodology and after presenting the results, the paper concludes with a discussion of their implications and suggestions for future research.

2 Theoretical Conceptualization

In this section, we begin by providing an overview of the transactional theory of stress, a widely used framework for understanding stress.

2.1 Transactional Theory of Stress

The transactional theory of stress is a well-known framework for understanding job stress (Lazarus, 2006), and has been used to conceptualize negative job outcomes perceived by employees, such as work stress, strain, distress, and work exhaustion (Crawford *et al.*, 2010; Boswell *et al.*, 2004; Elliot *et al.*, 1994; Fox and Stallworth, 2010; Webster *et al.*, 2011). Stress is viewed as a complex cognitive, affective, physiological, and behavioural process in response to stimuli that are perceived to be threatening or harmful (Lazarus, 1990; Lazarus, 2006). This theory implies that stress is not directly created by environmental conditions, but instead depends on how an individual perceives and interprets threatening or challenging situations and decides how to respond to those situations. The potentially harmful stimuli are called "stressors" (Jex and Yankelevich, 2008). Examples of stressors are workload, interpersonal conflict, lack of personal control, and organizational constraints. The maladaptive psychological, physical, and behavioural responses of individuals to these stimuli is termed "strain", "distress", and "work exhaustion". Drawing upon the transactional theory of stress, Day *et al.* (2010) argue that the extent to which the new work conditions that ICT imposes are perceived as taxing and exceeding employees' resources will determine how intensely employees view ICT as being negative and harmful. Therefore, it is likely that the use of ICT and the related physical and psychological efforts employees expend on tackling ICT-caused changes will lead to negative job outcomes, such as strain or stress. Thus, this meta-analysis uses the transactional theory of stress to examine the effects of technology use on employees' experiences of negative job outcomes.

2.2 Negative Work-Related Outcomes of Technology Use

A key underlying cause of work stress for employees is a changing work environment (Jex and Yankelevich, 2008). Work environments have changed in numerous ways over the past decades since information and communication technology (ICT) emerged; for example, the boundaries of employees' roles (Day *et al.*, 2012) have shifted, as well as the flexibility in how they do their work (O'Driscoll *et al.*, 2010). Employees have been exposed more frequently to new ways of accomplishing tasks, making it likely that they will experience one or more of these stressors: changes in their workload, increased time pressure, physical and psychological conflicts, or heightened uncertainty (O'Driscoll *et al.*, 2010; Thomée *et al.*, 2012).

2.2.1 Stressors

Employees feel overloaded at work when their job demands exceed their limits (Leiter *et al.* 2003) and they have to do too much in too little time with too few resources (Moore and Love, 2005). Technologies have been found to increase work overload; for example, email systems can distract employees from their work because they are afraid of missing important information that they would be accountable for if they do not respond to emails or check for them frequently (Barley *et al.*, 2011). Role ambiguity and role conflict can also create stress and may be the result of adoption of technology. For example, the adoption of sales force automation technologies may increase the ambiguity of employees' roles, making them more complicated (Rangarajan *et al.*, 2005). Role ambiguity depends on the extent to which employees increase the effort they spend learning how to integrate technology into their routine tasks, and how to confront the uncertainties associated with the process of learning technology (Day *et al.*, 2012; Zigurs and Buckland, 1998). Role conflict occurs when employees have to decide between using their time to learn a new ICT system and carrying out their routine duties. Technology alters employees' normal tasks, and if something wrong occurs, it is difficult for

them to undo and return to essentially the same conditions in the original tasks to make a new decision. Stress, strain, and distress can be created by work overload, role ambiguity, and role conflict (Goldfinch *et al.*, 2011; Tarafdar *et al.*, 2014; Tarafdar *et al.*, 2015).

Table 1 lists studies where ICT use in the workplace has been shown to have negative impacts on employees. ICT use reinforces the impression among employees that they need to work harder and faster, contributing to a perception that they are overloaded with work (Chesley, 2010; Tarafdar *et al.*, 2011). In such a situation, employees may find it difficult to recognize the useful aspects of technology, which, in turn, results in them experiencing stress. For example, frequently checking email at work causes employees to experience stress (Kushlev and Dunn, 2015). Employees who use laptops or mobile devices to carry out work-related activities usually report work-related stress (Goldfinch *et al.*, 2011; Nam, 2013). Following the transactional model of stress, employees who adjust or manage their cognition, affection, and behaviour to adapt to higher ICT demands and exert additional effort to use technology experience greater strain (Day *et al.*, 2012; Stadin *et al.*, 2016).

---------- Table 1 here----------

2.2.2 Psychological Strain

Strain is defined as affective, feeling states of individuals characterized by depleted emotional resources and lack of energy (Lee and Ashforth, 1996). The psychological strain variables that have been frequently investigated are distress and work exhaustion (Boswell, *et al.*, 2004). Distress is the result of a negative perception of the demand placed on a person and occurs if the levels of stress exceed the person's physical and psychological capacity (Selye, 1964; Selye, 1987). Psychological distress describes moods and emotions that occur intentionally, and have no specific referents (Bagozzi *et al.*, 1999; Frijda, 1986). Psychological distress encompasses evaluative components, (e.g. "good-bad" and "like-dislike"), the presence of symptoms

associated with depression, such as sadness, restlessness, and nervousness (Beaudry and Pinsonneault, 2010; Chesley, 2005), or emotional states experienced by individuals, such as boredom, fatigue, and anxiety (Carayon-Sainfort, 1992; Day *et al.*, 2012; Eastin *et al.*, 2007). Work exhaustion[2] or job burnout is defined as the physical, emotional, and mental exhaustion characterized by physical depletion, feelings of helplessness and hopelessness, emotional drain, and the development of negative self-concept and attitudes toward work, life, and people (Pines and Aronson, 1981). Burnout is caused by long-term involvement in demanding situations (Kilpatrick, 1989; Leiter and Maslach, 2003; Leiter and Schaufeli, 1996; Lu *et al.*, 2012; Moore, 2000a; Moore, 2000b; Zhang *et al.*, 2014).

Work exhaustion, both emotional and physical, has been studied in several occupations, such as physicians, technologists, social service workers, and teachers (Kilpatrick, 1989; Leiter and Maslach, 2003; Leiter and Schaufeli, 1996; Lu *et al.*, 2012; Moore, 2000a; Zhang *et al.*, 2014).The intensive use of technology has also been found to be positively related to burnout, in the form of exhaustion, reduced personal accomplishment, and depersonalization (Schaufeli *et al.*, 1995). Schaufeli *et al.* (1995) found that nurses working at intensive care units where technology was used more intensively were more likely to experience burnout symptoms. Information systems (IS) research on the negative effects of the technology use has also paid attention to psychological distress and strain. For example, Beaudry and Pinsonneault (2010) considered the array of emotions, such as anger, anxiety, excitement, and happiness, that employees experience in response to ICT artefacts. Strain describes how much employees feel overwhelmed by the use of ICT at work (Chesley, 2014). Examples of psychological strain include user error, user frustration and aversive stress reactions (Coyle and Gould, 2002,

[2] Work exhaustion and job burnout can be used interchangeably (Moore, 2000a).

Konradt *et al.*, 2006; Otter and Johnson, 2000). Moreover, employees experience strain at their workplace when confronted with too many emails and calls, which makes them work at a higher intensity, and when facing technical issues on their systems, which results in low control over how they can fulfil their work tasks (Stadin *et al.*, 2016).

While the use of technology has been found to be positively linked to increases in employees' distress, strain, and stress, this effect can be ameliorated if employees are free to decide the best ways to match the new ICT to their routine tasks (Beaudry and Pinsonneault, 2010; Day *et al.*, 2010; Konradt *et al.*, 2006; Messersmith, 2007; Nam, 2013; Sauter *et al.*, 1983)[3]. Strain or stress can be managed by enhancing the extent to which employees have a great deal of discretion, job control, and autonomy in making job-related decisions to get their work done.

2.3 Autonomy

Autonomy is "the degree to which the job provides substantial freedom, interdependence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" (pg. 162, Hackman and Oldham, 1975). Other terms related to autonomy include job control (Day *et al.,* 2012) and decision latitude (Korunka and Vitouch, 1999), which refers to the breadth of possibilities of decisions regarding action steps, the content of goals and plans, and time frames (Zapf, 1993), and empowerment, which refers to sharing power or giving more responsibility and autonomy to subordinates (Kirkman and Rosen, 1999). A lack of autonomy affects employees' job attitudes and causes them to experience work overload and

[3] In most workplaces, some ICTs are mandatory in certain job roles or to complete certain work tasks, while other ICTs can be used voluntarily at the discretion of individual workers. However, even in contexts where the use of a certain ICT is imposed or made compulsory, users may have some latitude in how they use it; for example, they may use it in a limited or surface manner, instead of infusing it into their work practices. To incorporate this range of understandings of the concept of "ICT use", the concept's use in this paper covers both mandated and voluntary use contexts.

burnout (Lee *et al.*, 2003; Maslach and Jackson, 1981; Moore, 2000b; Pines and Aronson, 1983).

Jex and Yankelevich (2008) assert that job-related discretion is influential in reducing negative job outcomes. Drawing on various models proposed in the literature, such as the job demand control model (Karasek, 1979), the effort-reward model (Siegrist, 1996), and job demands-resources model (Bakker and Demerouti, 2007), the most important factors that reduce the impact of stress creators on employees' negative job outcomes (e.g., strain) are job control (e.g., skill discretion and decision latitude) and job resources (e.g., autonomy). Autonomy, job control, and job-related decision making can be used as facilitators to encourage employees to engage in using technologies and to buffer the relationship between technology use and negative job outcomes (Day *et al.,* 2010; Day *et al.*, 2012).

Researchers on the role of autonomy in technology use (Table 2) have reported that autonomy and a lack of job control are positively associated with technology use (Ahuja and Thatcher, 2005; Kraan *et al.,* 2014; Sardeshmukh *et al.*, 2012). For example, professionals who perceive no control over the conditions, processes, procedures, or contents of their work are less keen to use electronic medical records (Walter and Lopez, 2008). Conversely, employees whose managers or work environments support autonomy are more confident about continuing to use the Internet or computers than employees who work within environments that are more controlling (Roca and Gagné, 2008). Much research has concluded that a lack of autonomy is problematic for employees experiencing work stress when adopting new software or dealing with current ICT systems. At the same time, employees with greater autonomy may have lower levels of work stress: they may find it easier to set aside time to learn the features of newly-adopted applications or new technology upgrades, or be able to use ICT-based flexible work options (Day *et al.*, 2012; Esmaeilzadeh and Sambasivan, 2012; Kraan *et al.*, 2014; Sambasivan

et al., 2012). Research on autonomy has also shown that negative job outcomes that results from technology use are mitigated when employees have freedom in their work-time schedule, access to adequate resources, and control over work-related tasks (Ahuja and Thatcher, 2005; Chesley, 2014; Salanova *et al.*, 2013).

---------- ***Table 2 here***----------

Autonomy has also been found to reduce the negative impacts of technology use on employees, such as work exhaustion, work overload, psychological distress, role ambiguity, role conflict, and psychological strain (Table 3) (Ahuja and Thatcher, 2005; Kraan *et al.,* 2014). Kraan *et al.* (2014) view perceived autonomy as a standardization mechanism, which can modify and control the effects of computer use on employees' work stress. Higher autonomy enables employees to arrange a more proportionate division of work, use less coercive methods, and organize tasks to ameliorate the negative effects of computer use. Autonomy also supports learning about technology, encourages a healthy environment, and undermines work stress when new features are introduced. When ICT professionals are provided with autonomy, they carry out their work independently, resulting in a lower incidence of work exhaustion (Ahuja *et al.,* 2007). Likewise, autonomy interacts with the level of work overload, so that employees with greater autonomy do not feel overburdened in having to find novel ways to use ICT (Ahuja and Thatcher, 2005).

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2.4 Summary

ICT use has been linked to a range of negative outcomes in a variety of work contexts, as discussed above. The growing prevalence of ICT indicates that these negative outcomes will be experienced by more individuals over time. The increased incidence of such negative outcomes may dampen the potential advantages that organizations may gain from their ICT investments.

If not attended to, these negative outcomes may undermine organisational effectiveness. Thus, one reason for carrying out this meta-analysis is that it is a first step in addressing this critical issue. At the same time, there is a bifurcating trend in the level of autonomy in work (Spreitzer *et al.*, 2017). Some jobs can be carried out remotely, providing more autonomy to the individuals doing them (Sardeshmukh *et al.*, 2012), and more employees in such jobs are able to do so. On the other hand, other jobs are becoming more routinised, reducing the amount of discretion of workers (Kraan *et al.*, 2014. Both changes are occurring in contexts where ICT is being used more intensively, and both of these shifts could reduce employee well-being (Kubicek *et al.*, 2017; Sloan and Unnever, 2016). So, the second reason for doing this meta-analysis is understand how autonomy influences the occurrence of negative outcomes when ICT is used, as this may guide us in evaluating how to prevent or limit these consequences.

Figure 1 illustrates the theoretical framework proposed for this study. In this framework, ICT use is studied as both overall ICT use and specific ICT use, autonomy as employees' own efforts, initiatives, and decisions towards ICT use, and stress as any individual responses to stressful situations caused by ICT use.

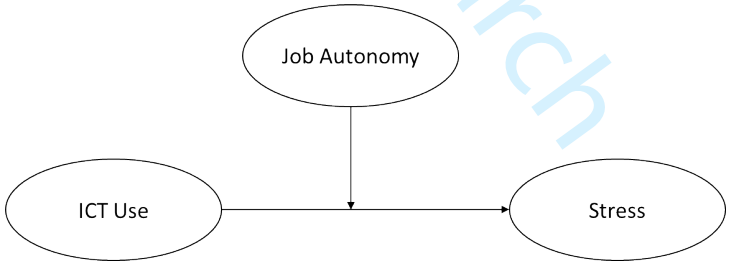

Figure 1. Theoretical Framework

The goals of this study are to provide a meta-analytic review of the negative outcomes of ICT use and to examine the impact of job autonomy on ICT use and negative job outcomes. Doing so will bring together two different streams of research on ICT use in the workplace. Examining the overall progress that has been made in this field would also help to suggest directions for future study.

3 Methodology

A set of meta-analyses were utilized to synthesize the findings from prior research on the negative outcomes that individuals experience when using technology at work. A meta-regression was also performed to assess the impact of the moderating role of autonomy-related constructs, including job autonomy, job control, and decision latitude, on the relationship between ICT and negative job outcomes, such as stress, strain, distress, and exhaustion. Mixed-effects meta-regression was employed to analyse mean levels of autonomy-related constructs as the continuous variables in the consideration of the presence of residual heterogeneity.

Meta-analysis is a quantitative approach for aggregating findings from individual studies that study similar research questions (Hunter and Schmidt, 2004). Compared to a narrative review of a field, the advantage of meta-analysis is to reconcile conflicting results across studies to understand the strength of the variables' underlying relations and causalities (Hunter and Schmidt, 2004). Meta-analysis has been used by information systems scholars to review topics as diverse as ICT-business strategic alignment (Gerow *et al.*, 2014), ICT turnover intentions (Joseph *et al.*, 2007), ICT innovation adoption (Lee and Xia, 2006), IS implementation success (Sharma and Yetton, 2003), and firm-level ICT payoff (Kohli and Devaraj, 2003). By combining results across studies, meta-analysis also "rescues" data-sets that would normally not be considered for analysis because they had a small sample size or insignificant results that did not warrant publication in a journal (Rosenthal and DiMatteo, 2001). Meta-analysis is useful because it helps overcome methodological issues, such as sampling error and poor reliability of measures, which may have dampened the relationship between the variables being studied. This meta-analysis followed Hunter and Schmidt's (2004) recommendations and the study was conducted in line with these steps: 1) Identifying and selecting relevant studies, 2) Coding variables from the samples, and 3) Performing the statistical meta-analysis.

3.1 Literature Search

Our goal was to identify empirical studies on the impacts of technology use on negative job outcomes, including stress creators (role ambiguity, role conflict, and workload), burnout (exhaustion, depersonalization, and reduced personal accomplishment), psychological distress, and strain. We also searched for studies on ICT use and negative job outcomes to find out how job autonomy (including its related terms) influenced either ICT use or work-related negative job outcomes, as well as the relationship between ICT use and negative job outcomes. Following established practice in prior meta-analytical studies (Dulebohn *et al.*, 2011; Jackson and Schuler, 1985; Podsakoff *et al.*, 2014), the literature search process began by searching electronic databases, such as ScienceDirect, JSTOR, Scopus, Web of Science, Springer Link, EBSCO Host, ACM Digital Library, IEEE Explore, Google Scholar, and Emerald. This was done from March 2015 to March 2016. The keywords used to search for "ICT use" were: "information technology use", "information and communication technology use", "ICT", "ICT use", "ICT use at work", and "information technology adoption", while the keywords used for negative outcomes were: exhaustion, depersonalization, reduced personal accomplishment, psychological distress, stress, and strain. The search terms for stress creators were: role ambiguity, role conflict, and workload. For job autonomy, these search terms were used: autonomy, decision latitude, discretion, job control, and empowerment. These search procedures yielded a total of approximately 208 relevant studies.

3.2 Study Selection

To make our review robust, certain criteria were used to exclude irrelevant studies from the initial pool. First, studies that used non-employee respondents were also excluded, as this study focuses on ICT use at work. Second, qualitative and conceptual studies were dropped from the pool. Third, studies that examined the negative impact of ICT use but did not measure ICT use

specifically (such as Ragu-Nathan *et al.*, 2008; Tarafdar *et al.,* 2007; Tarafdar *et al.,* 2011) were excluded. Studies were included in the meta-analysis if their data collection instrument had at least one item that measured the extent of technology use. Fourth, studies that only focused on physical discomfort, such as the quantity of sleep (such as Lanaj *et al.*, 2014) or the state of an individual's physical health (such as Mino *et al.*, 1999), were omitted. Finally, studies were included in the meta-analysis only if they reported their sample size, the reliability or composite reliability indices, and correlation coefficients, and included a correlation matrix. In addition, attempts were made to overcome the "file drawer problem" by sending a request for unpublished manuscripts on this topic to AIS World, a popular mailing list for IS academics. Two studies were received after making that request, but they were not relevant to this study as they were not quantitative studies. The final sample consisted of 50 journal papers and two conference papers.

3.3 Coding Variables

A meta-analysis was conducted using the formulae developed by Hunter *et al.,* (1982) for a total of 13 constructs: seven negative job outcomes (Table 4), four autonomy-related constructs, and two constructs for ICT use. The two constructs for ICT use were: overall ICT use and specific ICT use. "Overall ICT use" incorporates studies that did not specifically name the type of ICT that was used (Ahuja and Thatcher, 2005; Ayyagari *et al.*, 2011; Beam *et al.*, 2003; Chesley, 2014; Compeau and Higgins, 1995; Fuglseth and Sørebø, 2014; Schaufeli *et al.*, 1995). "Specific ICT use" was used to classify studies which indicated the use of a particular ICT, such as "computer", "email", "mobile phone" (devices that receive or transmit voice calls and text messages only), "internet", "smartphone" (internet-connected devices with high-resolution touch screens), "Electronic Data Processing" (EDP), and "Video Display Terminal" (VDT).

Table 5 delineates seven indicators of ICT use which have been long argued across the literature as a source of employees' negative work experiences.

To clarify the role of autonomy, we searched the sample of studies for papers that also investigated the role of autonomy. Among the 52 studies in the sample, we identified 137 relationships between the use of various technologies, negative job outcomes, and stress creators, and 36 relationships where autonomy affected the level of technology use among employees. Within these 36 relationships, autonomy's role differed: it acted as a moderating, mediating, independent, or control variable. Before analysing the data, we excluded variables that were studied only once, and were thus understudied and did not fit the criteria for running a meta-analysis (Joseph *et al.*, 2007), such as discretion and empowerment. One variable, "EDP use", was found only in one study (Table 5) but it was retained because data had been collected from three samples in the same study (Korunka and Vitouch, 1999). For each study, the following information was collected: sample size, the reliability of constructs (as reported using Cronbach's alpha) and correlation (r) or standardized regression coefficient (β) for each pair of relationships.

---------- ***Table 4 here***----------

---------- ***Table 5 here***----------

The variety of terms related to negative job outcomes, such as strain, distress, and work exhaustion, are conceptualized in the literature as individual responses to stressful situations; given that, stress is regarded in this study as a complex rubric rather than a simple variable (Lazarus *et al.*, 1985). Therefore, stress refers to the operation of many variables which reveal processes of how individuals cognitively, affectively, and behaviourally respond to ICT-caused changes. Job autonomy is also similarly considered to be a rubric variable that encompasses the operation of job control and decision latitude (Hackman and Oldham, 1975). In this study, work

stress is composed of seven negative job constructs, and the autonomy-related constructs are autonomy, job control and decision latitude.

3.4 Analysing Data

To analyse the data, we used the Comprehensive Meta-Analysis package (Borenstein *et al.*, 2009) and ran a meta-regression analysis in R (Chen and Peace, 2013). A corrected population correlation ρ was estimated for each pair of relationships, based on the reported correlation coefficients r or standardized regression coefficients β and sample size. Following Hunter and Schmidt (2004), we corrected correlations for sample error and for measurement error. A random effects model was used, as recommended by Borenstein *et al.* (2010) and Hunter and Schmidt (2000). A fixed-effects model would reflect an assumption that the researchers believed all the studies in their meta-analysis share a common effect size, and that sampling variation was the only reason for effect sizes to be different. Random effects models allow researchers to generalize beyond the results of one study, unlike a fixed effects model.

First, we used the index of reliability of independent and dependent variables to compute the artefact multiplier (A[4]) for each study:

$A = \sqrt{r_{xx}}\ \sqrt{r_{yy}}$, where r_{xx} represents the reliability coefficient for the independent variable, and r_{yy} represents the reliability coefficient for the dependent variable.

Second, according to Hunter and Schmidt (2004), the corrected observed correlation for measurement error (r_c) can be calculated by:

- $r_{ci} = r_i/A_i$, where r is the correlation between the independent and dependent variables reported in studies and obtained from the strength of the relationship between each pair

[4] The artefact multiplier (A) is the ratio of the attenuated to the unattenuated effect and describes the impact of the artefact on the effect size. It is called an artefact multiplier because the magnitude of the observed (attenuated) effect size is equal to the (artefact multiplier) multiplied by (the unattenuated effect size) (Borenstein et al., 2009).

of independent and dependent variables, A represents the artefact multiplier, and i refers to different studies.

Third, we calculate the sample size weights that take into account both sample sizes (N) and artefact multipliers (A) across studies:

- $W_i = N_i A_i^2$, where N is the sample size of each study, (i) demonstrates the different studies, and A is the artefact multiplier for each study.

Finally, we determined the population estimate corrected (ρ), computing the corrected observed correlation (r_c) and weighted sample size (W) to account for sampling error and measurement error for each pair of variables. The formula for ρ is:

- $\rho = \Sigma W_i r_{ci} / \Sigma W_i$, where W is the weighted sample size of each study, (i) refers to the different studies and r_c is the corrected observed correlation for measurement error for each study.

4 Results

The results of the meta-analyses are presented on Tables 6, 7, and 8, and the results of meta-regression analysis in Table 9. All tables report the sample size, the number of studies, population correlation (ρ), the 95% lower and upper confidence intervals and p-value. Table 6 demonstrates the impact of overall ICT use on work stress. Using Cohen's (1992) guidelines on effect size intervals, the meta-analysis results supported a significant relationship between ICT use and work stress. The average magnitude of the correlations of ICT use and work stress reflected a small effect size (ρ= 0.07).

---------- ***Table 6 here*** ----------

4.1 Overall Technology Use and Different Negative Job Outcomes

Table 7 shows the relationships between ICT use and distinct negative job outcomes. The variable "ICT use" was created by grouping studies on specific technologies with studies that

did not mention any particular technology, such as studies on "ICT use" or "ICT systems use". The results indicate that ICT use is significantly correlated with stress (ρ= 0.20, p-value =0.000), workload (ρ= 0.15, p-value =0.000), and role conflict (ρ= -0.50, p-value =0.000). Although the relationship between ICT use and stress and workload is positive, the relationship between ICT use and role conflict, a stressor, is negative. For other negative job outcomes, the meta-analysis showed that the effects were ambiguous, as the confidence intervals for each of them included zero.

---------- Table 7 here----------

4.2 Different Types of Technology Use and Negative Job Outcomes

Table 8 depicts the impact of using particular technologies on negative job outcomes, such as stress, distress, strain, and workload. Except for the relationship between EDP use and stress, and VDT use and distress, all the technologies had a positive effect on negative job outcomes. However, only the use of email, internet, VDT, and smartphones were significantly related to negative job outcomes. The meta-analysis results indicated that the average magnitude of the correlations of computer use showed a small effect size across studies with stress, psychological distress and workload, and did not support a significant relationship between computer use and stress, psychological distress, and workload. Email use was found to have a highly significant relationship with stress (p-value=0.000), and a small effect size with stress (ρ= 0.28). Also, email use had a significant relationship with distress (p-value=0.009) and workload (p-value=0.012), and a small effect size with distress (ρ= 0.10) and workload (ρ= 0.28).

The relationships between internet use and both independent variables, stress and strain, were significant (p=0.008 and p=0.001), with a small effect size (ρ= 0.26 and ρ= 0.18), respectively. Smartphone use was strongly related to stress (p-value =0.000), with a large effect size (ρ= 0.87), while its relationship with burnout (ρ= 0.42, p-value =0.003) and workload (ρ= 0.36, p-

value =0.009) was significant and had a medium effect size. Analysing the effect of relationships that different IS systems have on negative job outcomes, only VDT use yielded a significant relationship with workload (p-value =0.006) with a medium effect size (ρ= 0.38).

---------- *Table 8 here*----------

4.3 Autonomy

Table 9 depicts the results of the meta-regression analysis on the moderating role of autonomy on the relationship between ICT use and negative job outcomes. While autonomy significantly moderated the relationship between ICT use and work stress (β=0.111, p-value=0.038), the relationship was in the opposite direction from the one that was expected (see Figure 2). In other words, instead of demonstrating that autonomy mitigated the level of work stress among employees using ICT, the findings revealed that, as the level of autonomy increased, the effect of ICT use on work stress increased. The level of autonomy explains 13.6 percent of the variance in the correlation between ICT use and work stress.

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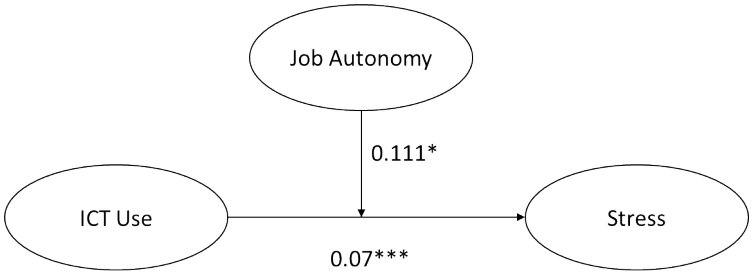
5 Discussion

This paper clarifies the effect of ICT use on employees and the negative challenges and experiences they deal with by incorporating the power of multiple primary empirical studies via a meta-analysis. Also, this study provides an insight into the moderating role of job autonomy in which job autonomy appears as an amplifier to further augment the levels of stress among employees using ICT. Our findings show the extent to which technology use has a negative impact on employees, the different consequences that may occur, and how autonomy influences the occurrence of these effects (see Figure 2). The results are discussed in the following sections in detail.



Legend: p<0.05, p<0.01**, p<0.001****

Figure 2. Summary of Relationships between ICT Use, Job Autonomy and Stress

5.1 Impact of ICT use on work stress

This study shows that using ICT creates work stress, supporting research which has demonstrated that ICT use is related to negative job outcomes, such as strain, distress, or work exhaustion (Day *et al.*, 2012; Lee *et al.*, 2014; Nam, 2013). This meta-analysis included studies that had general measures of the use of ICT (see Tables 1 and 4), as well as those that measured specific technologies such as smartphones or the Internet (see Tables 1 and 5). When the results are aggregated across the different technologies used by employees, the results of the meta-analysis indicate that ICT use was significantly correlated with stress and workload, as well as a stressor, role conflict.

One possible reason for these findings is that the use of ICTs, ranging from emails, ERP systems, or news feeds, may lead to employees experiencing work overload and role conflict in at least three ways (Lee *et al.*, 2016). First, employees find it difficult to accomplish their assigned tasks using existing technologies or systems that are updated with complex or newly designed features (Karr-Wisniewski and Lu, 2010). Employees encounter different degrees of strain or distress when they need to spend effort to adapt to and learn new technical features (Lee *et al.*, 2016). Second, communication demands from ICT channels may exceed employees' communication capacities (Cho *et al.*, 2011). Employees who have difficulties in managing a certain level of communication load with other peers may incur distress or strain (Lee *et al.*,

2016). This would be problematic if their peers do not use the same ICTs (Stich *et al.*, 2018). Third, employees are confronted with a vast amount of information, often diverse types or sometimes equivocal, which exceeds their information processing capability, leading to a need to carry out more online communication with their peers to avoid further ambiguity (Eppler and Mengis, 2004).

This result complements research on technostress. The literature in that domain (such as Ragu-Nathan *et al.*, 2008; Tarafdar *et al.*, 2007; and Tarafdar *et al.*, 2011) asserts that ICT use is related to five "technostress creators" (techno-overload, techno-invasion, techno-complexity, techno-insecurity and techno-uncertainty) which affect outcomes, such as job satisfaction, organizational commitment, role conflict, and role overload. This study supports that stream of research by demonstrating how ICT use directly leads to negative consequences.

5.2 The effects of different types of ICTs

5.2.1 Computer Use

Several samples in our dataset studied 'computer use', instead of a specific type of ICT, such as email or the Internet. Some of these studies indicated that employees using computers experience stress, distress (e.g., anxiety), and an increase in their workload (Carayon-Sainfort, 1992; Chesley, 2005; Chesley, 2010; Thomée *et al.,* 2012), while others found no relationship between using computers and employees stress or distress (e.g., anxiety) (Compeau and Higgins, 1995; Goldfinch *et al.,* 2011; Kraan *et al.,* 2014). The results of our meta-analysis support the latter view. The increase in work stress is fundamentally driven by the increased pace of work that computerization leads to (Kraan *et al*., 2014). In work environments where computers operate at high speed, employees incur intense levels of workload, followed by work stress. In knowledge-intensive work environments, the amount of information computers produce and which employees have to translate and transform may exceed their cognitive

capacity, leading to information and communication overload, resulting in work stress or strain (Karr-Wisniewski and Lu, 2010; Lee *et al.*, 2016). This effect is aggravated if the new computer-set pace of work is accompanied by rigid bureaucratic control, the standardisation of working methods, the close monitoring of worker performance, and mandatory use of systems which do not allow more flexibility in workflows and work routines (Kraan *et al.*, 2014). These arguments are convincing, making it surprising that our meta-analysis found no relationship between computer use and stress. However, our analysis of the studies that used the construct "computer use" provides some explanation. Table 10 below shows the details of these studies and it can be observed that one of the studies (Thomée *et al.*, 2012) did not have a sample made up exclusively of working adults and that another study (Kraan *et al.,* 2014) did not measure the extent of use, only asking if computers were being used. These differences mean that the mechanisms presented above that link computer use to stress may not have been captured by those studies. These mechanisms are related to work environments, which was not in the scope of Thomée *et al.* (2012), and the intensity of computer use, which was not assessed by Kraan *et al.* (2014).

---------- ***Table 10*** ----------

5.2.2 Email Use

Our meta-analysis results support the findings of prior studies that receiving and sending emails causes employees to feel stressed and distracted (Barley *et al.*, 2011; Kushlev and Dunn, 2015; Mark *et al.*, 2012; Thomée *et al.*, 2012). The reasons can be explained in a few ways. First, employees who receive or send a high number of work-related emails may spend most of their working hours checking or replying to these emails, which creates stress, psychological distress, and a high volume of work overload for them. Second, email, as a type of computer-mediated

communication, intrinsically has a high level of content ambiguity, which may lead to work stress (Byron, 2008). Third, the actual and desired level of use of email together make employees feel stressed for a few reasons: first, employees are obliged to use email because of organizational norms and policies, even if email is inappropriate for their tasks or when the more appropriate media is not available, and second, employees have to communicate with their peers who may have different preferences for media use (Stich *et al.,* 2017). Stress was also found among knowledge professionals who use email intensively; while they can work anywhere and anytime with email, email use has also constrained their autonomy because they are now always available to their colleagues and clients (Mazmanian *et al.*, 2013).

5.2.3 Mobile Phone Use

Some researchers found that employees who use mobile phones to receive or send calls and messages to accomplish their tasks experience stress or a high level of workload (Barley *et al.*, 2011; Chesley, 2010; Nam, 2013). In contrast, several other studies found that the use of mobile phones by employees at their workplace does not lead to negative job outcomes (Thomée *et al.*, 2012). The results of our meta-analysis did not find a significant correlation between mobile use and stress, and workload (Table 8). This finding supports the view that while employees are distracted during their working day when they answer mobile phones, this distraction is not significant enough to make them experience stress or work overload. Indeed, the extent to which the use of ICTs, such as computer and mobile phone, makes employees feel overburdened or overloaded is determined by the frequency and broad features of ICT use (Chesley, 2010).

5.2.4 Internet Use

Some researchers point out that pervasive internet usage among employees makes them experience negative job outcomes, such as stress, strain, and workload. Some examples of such negative job outcomes created by internet usage are user errors, user frustration and aversive

stress reactions (Chesley, 2010; Konradt *et al.*, 2006; Nam, 2013). Our meta-analysis findings supported these results and highlighted the small but significant link between Internet use and work stress and strain.

5.2.5 Smartphone Use

The meta-analysis results were consistent with previous findings that smartphone use increased work-related exhaustion and stress among employees (Derks *et al.*, 2014; Lee *et al.*, 2014). One of the most interesting findings of our study was that smartphone usage had the largest effect on some negative job outcomes, especially work stress. The results of our study may indicate that regularly using some technologies such as smartphones may lead to employees facing exhaustion daily and being psychologically detached at their workplace (Derks *et al.,* 2014).

It is worth noting that individual experiences of ICT use change dramatically over time. Employees may find technology adoption stressful, but after some time, they become accustomed to the new ways of working with newly adopted technologies. Thus, the use of ICTs whose life span is more than 20 years, and are thus no longer novel and innovative, cannot be stressful as before (Day *et al.*, 2010). This explains why while employees do not feel stressful when using mobile phones and laptop or desktop computers, they do experience stress when using smartphones (Table 8).

5.2.6 Specific ICT System Use

Korunka and Vitouch (1999) found across three samples that working with EDP systems does not lead to employees experiencing stress, distress, or an increased workload. When the results from their three samples were meta-analysed, their findings were supported, showing no overall effect of EDP use on negative job outcomes. Research on the use of video display terminals (VDT) had contradictory findings on whether employees were negatively affected by using them (Lindstrom *et al.*, 1997; Sauter *et al.*, 1983). While our results showed that VDT use was

negatively correlated with distress, the only significant correlation was with workload, following Lindstrom *et al.* (1997) (Table 8). While the terms "VDT" and "EDP" systems may seem archaic now, their relevance for this study lies in them providing evidence of the impact of ICT on individual employees when such systems were in use in workplaces.

5.2.6 Comparing the Effects of Different Types of ICT Use on Negative Outcomes

The preceding discussion, where general ICT, email, internet, and smartphone use increase stress, but computer and mobile phone use did not, leads to prompts an examination as to the reasons behind these discrepant results. The reasons for the surprising result for computer use have been explained in Section 5.2.1. The missing impact of mobile phone use could be due to a contextual issue too, because two of the studies on mobile phones (Barley *et al.,* 2011 and Chesley, 2010) used data collected in 2000 and 2001. Mobile phone use was much less pervasive societally then and mobile phones themselves were also used less often: Barley *et al.*, (2011) mention that after accounting for all other forms of communication, the balance of "… 5% … (was) allocated across the use of pagers, voicemail, video-conferences, and instant messaging technologies." (pg. 891). Thus, while employees may have been distracted when they answered mobile phones, this distraction was not significant enough at that point in time to make them experience stress or work overload. In contrast, studies on smartphone use have taken place more recently and they do find that smartphone use, like other ICTs, is related to negative outcomes.

5.3 Autonomy

The second objective of this study was to measure the moderating impact of autonomy on the negative outcomes that employees face when they use technology. Prior research has shown that job autonomy, job control, and decision latitude are positively associated with ICT use, and

negatively correlated with stress, strain, distress, and work exhaustion (Appendix A). This suggests that employees with greater autonomy, such as those who have access to additional resources or flexible work schedules, use ICT to the extent that they consider appropriate, after considering its potential negative impacts (Ahuja and Thatcher, 2005). While some studies have found that autonomy buffers the relationship between ICT use and negative job outcomes (Chesley, 2014; Day *et al.*, 2012), our findings contribute to the literature by showing that high levels of autonomy escalate work stress among employees using ICT. Although this result is surprising, it can be understood if we relate it to the properties of ICT systems at work. Gerten *et al.*, (2019) found that the complexities created by the implementation of ICT systems can constrain the strength of autonomy. ICT systems may contain features that enforce work routines which are different from those individuals with high levels of job autonomy prefer, increasing their workload. Instead of providing them freedom to choose the tools for their job, autonomy may increase the cognitive load they experience when they do their work. A less autonomous worker may be more receptive to the introduction of IT in their work practices because it may reduce the occurrence of uncertainty and volatility in their workflows. Similarly, organizations sometimes use ICT to monitor their employees, to ensure the ICT is used appropriately and that they receive a reasonable return on their investment. This is also incompatible with the preferences of individuals with high levels of job autonomy. For them, the introduction of such systems may lead to a struggle in reconciling their differences with management in terms of the type of work environment they want to work in. Thus, while ICT use increases the stress faced by individual employees, those with higher levels of autonomy may be overburdened by a higher workload because of features of ICT systems that detract from autonomy rather than enhance it. From an organisational communication perspective, using ICT systems may be more difficult in a workplace where employees have more autonomy

because not everyone may be using them, or using them differently. Highly autonomous employees who have more and/or a better choice of ICT systems may feel stressed if their counterparts have no access to the same ICT systems, diminishing their future interaction. Having to figure out how to communicate with different people (based on whether they use ICTs) can create another layer of stress for an employee (Stich *et al.,* 2018), giving rise to the correlation between ICT use and role conflict and between ICT use and workload.

6. Implications and future research

Researchers have studied the negative effects of ICT use on employees (Tarafdar *et al.*, 2007; Thomée *et al.*, 2012), and how these effects reduce employees' outcomes, such as technology-enabled behavioural performance and innovation (Tarafdar *et al.*, 2014, 2015). By meta-analysing the findings from 52 studies, our research has shed further light on the impact of ICT on negative job outcomes (such as strain, psychological distress and work exhaustion) and stress creators (such as work overload, role ambiguity and role conflict). Before offering implications and potential avenues for future research, we present the limitations of our research.

6.1 Limitations

First, this meta-analytic study relied on the statistical results of many other studies to arrive at its findings. It is thus dependent on the quality of the prior studies. While we carried out the precautionary practices recommended for meta-analyses to avoid any possible biases, it is worth keeping in mind this intrinsic inadequacy of the meta-analytic method. Similarly, we did not include the results of case studies because of the requirements of meta-analysis. To capture unpublished studies in this domain, we contacted the information systems community by posting on the AIS World listserv. However, we did not do the same with organisational communication researchers, some of whom also study ICT's impact at work. This could have

been overcome by sending out a similar request on CRTNET, a listserv for communication researchers.[5]

Second, when selecting the sample, we did not specify any time period between the use of ICT and the occurrence of negative outcomes. The reason was that very few studies reported the time lag between the use of an ICT and when the negative outcomes were assessed. While some outcomes, such as an increased workload and exhaustion, may appear quickly after the introduction of an ICT, others, such as stress and burnout, may only manifest themselves after a certain time period. Thus, it is possible that the specific pattern of negative outcomes found in each study would have been affected by the gap between the use of the ICT and the measurement of negative outcomes.

Another consequence of not specifying a time period is that the data encompassed a wide range of ICTs and about a thirty-year time span. These means the features of ICTs listed in this paper cover a variety of modes of communication (audio, video, and text), and their relative prevalence has shifted over time as technological innovations were developed. The upshot of this is that the importance of the various ICTs features, contexts, and impacts has changed over time. For example, comparing the impact on individuals of using social media in the 2010s versus email in the 2000s is itself fraught with difficulties: what is the baseline for employees when we ask them about the negative impacts of ICT use? Can we reasonably compare the experiences of someone using a cell phone in 1992 with another person using a smartphone in 2014?

Third, the changing nature of ICT, reflected in the variety of technologies studied (from VDTs to smartphones), also reflects how ICT use has expanded from workplaces to family and other

[5] We would like to thank an anonymous reviewer for this point.

non-work contexts. While the study has aggregated results from studies over the past three decades, individuals are using technology more intensively and frequently now than in the past, and this may make it difficult to identify the source of the negative outcomes. For example, are negative outcomes more closely related to the use of ICT for managing family and personal activities, or for work routines? The general quickening in the pace of work and non-work life (Sonnentag, 2005) and the blurring of work-life boundaries (O'Driscoll *et al.*, 2010) makes it difficult to disentangle the role of ICT use in exacerbating negative outcomes, such as stress and burnout.

6.2 Implications and Further Research

The current meta-analysis provides a qualitatively comprehensive review of the literature regarding ICT use, autonomy, and negative job outcomes. Building on the theory of transactional stress (Section 2.1) and the findings, we argue that ICT use is related to new work conditions, characterised by these stressors: workload, role ambiguity and role conflict. Employees adjust their cognition, affection, and behaviour to adapt to the increased ICT demands to learn and use ICT. This in turn leads to an increase in the strain, distress, and work exhaustion experienced by employees, who begin viewing ICT as a negative and harmful object. The results of our meta-analysis of the data from 52 studies show that ICT use among individuals tends to give rise to negative outcomes, but that this effect varies across different types of technologies. We also found that job autonomy exacerbates the levels of stress among employees using ICT.

Since outcomes such as increased workload may predict the extent to which individuals resist new systems (Laumer *et al.*, 2016), future researchers should pay greater attention to the role of individual users in impeding the potential value that can accrue to organizations from the implementation of new systems. Such research can draw on studies of ICT use and system

success (e.g. Sabherwal *et al.*, 2006), which link use-related and system-related constructs to system success and extend the nomological network to include negative outcomes of ICT use.

Future researchers should also investigate the unique characteristics of various ICTs, for example, their visual or aural cues, due to the stress process that can be influenced by those characteristics. The benefits of focusing on the modality of ICTs (text, audio, video, etc.) rather than specific channels (e.g. email, Skype, social media etc.) among ICT users is well-established. For example, Walther's (1996) hyperpersonal model indicates that using asynchronous, editable text-based channels allows ICT users to plan and revise messages before sending them, thereby easing anxiety-provoking situations (Parks, 2017). ICT users' cognitive processing abilities, including working memory capacity, controlled attention, and speed of processing, differ when recognizing text and images (Belk *et al.*, 2013). Researchers should consider emphasizing the value of putting in place the least stressful modes for users when designing features for new systems, so as to potentially reduce negative outcomes.

One critical aspect would be to examine the accumulative impact of individually-felt negative outcomes. Marakas and Hornik (1996) view resistance as a means through which users express their disquiet with a potentially flawed system. From this perspective, stress is a precursor to resistance, with resistance being a withdrawal behaviour due to stress (Lapointe and Rivard, 2005). Given that the enactment of ICT use by interdependent individuals can be conceptually aggregated into collective system use (Burton-Jones and Gallivan, 2007), can the negative outcomes of individual ICT be summed in the same way, perhaps as "collective resistance"? This involves examining the conceptual nature of collective ICT-related negative outcomes: is it global, shared or configural, following the multilevel language of Kozlowski and Klein (2000)? Another avenue of research could be whether ICT-related negative outcomes form part of the switching costs from existing systems, which have been found to increase user resistance

(Kim and Kankanhalli, 2009; Polites and Karahanna, 2012). This is particularly relevant as organizations are beginning to use digital technologies to dramatically reshape their business strategies in terms of the scope, scale, speed, and sources of business value creation (Bharadwaj *et al.*, 2013).

As the digitization of work processes increases (Overby, 2008), understanding the match between an individual's work and ICT user roles becomes crucial for managing the level of negative outcomes they experience. Future researchers could also examine how these relationships differed when users participated in the implementation of an ICT, as that experience has been found to make them more satisfied with their ICT (Carayon and Karsh, 2000). Notions of organizational justice (Colquitt *et al.*, 2001) and equity (Joshi, 1991) could be applied to better understand the link between participation and the manifestation of negative outcomes from ICT use.

Research on ICT use, the negative outcomes of ICT use, and autonomy indicates that further investigation in this domain is necessary to extricate the competing effects of ICT. For example, ICT may make individual users more autonomous while also increasing their workload and their dependence on the technology (Carayon and Karsh, 2000). While the benefits of autonomy have been extensively discussed among researchers, the results of this study call for further investigation to examine how being autonomous through ICT would be related to negative job outcomes that employees experience (Mazmanian *et al.,* 2013; van Zoonen and Rice, 2017). This combination of consequences is potentially exacerbated if we view individual users as social actors, who draw on resources, such as relationships in professional and social networks, to overcome negative outcomes when they are encountered (Lamb and Kling, 2003). The increased autonomy brought about by ICT implies a decrease in the need to interact with others while performing one's job duties, weakening the existence of such networks and their role as

organizational ballast. Future researchers could draw on the job demand-control (Karasek, 1979), the effort-reward (Siegrist, 1996), and the job demands-resources models (Bakker and Demerouti, 2007) to examine the relationship between ICT use, autonomy, and negative job outcomes.

This points to a further direction for research: integrating the positive and negative outcomes of ICT use to examine how they complement or offset the motivation to continue using an ICT. Researchers could investigate whether user satisfaction and perceived usefulness can co-exist with stress, increased workload, and role conflict. If so, how do individuals reconcile these opposing outcomes? Are there any common predictors for these outcomes? The findings of this study and future research in this area will be useful for designers of ICT systems. Designers will receive guidance as to how they can design systems not just to achieve the desired outcomes, but also avoid the undesirable ones (O'Driscoll *et al.*, 2010). At the organizational level, our findings motivate the need for more empirical research on the tension between individual and organizational responses to the deployment of new technologies.

A possible research model that can be developed for future research is the application of autonomy and its related terms as to how employees cope with the shock of the adoption of new ICTs. Despite the importance of the role of employees' perceived values in comparing switching costs and benefits when they decide to adopt new ICTs (Mahmud *et al.,* 2017), a new set of autonomy-related constructs can ameliorate disruptive behaviours that employees often show at their workplace. In broader contexts in which employees are more likely to feel constrained by the advent of a new generation of ICTs, organizations need to put in more effort to understand the role of autonomy through which employees can experiment with their own designed subsystems while also using externally-provided IT services (Vithayathil, 2018). Organisations may choose to establish portals for employees to communicate with the

organization about their interaction with new ICTs, so they can learn more about difficult-to-use systems or involve employees in making decisions about investing and deploying complex systems. Had employees been given such an avenue, organisations may have achieved better outcomes with their new ICT adopting projects, rather than facing resistance or disinterest. Therefore, this study calls for research to provide conceptual and empirical insights into the motivating and inhibiting roles of autonomy in enhancing ICT use, while mitigating its negative impacts simultaneously.

5 Conclusion

This meta-analytic study supports the link between technology usage and negative job outcomes. As the technologies used in organizations have changed from VDTs to smartphones, these negative effects have occurred in parallel with improvements in work outcomes. Contrary to the prevailing literature and our expectations, job autonomy and its similar terms amplified the negative impacts of ICT use. The results of the meta-regression analysis suggested that autonomy-related constructs increase the levels of stress employees experience when using ICT. The study's results point to the need to develop a more integrated nomological network of the outcomes of ICT use, incorporating both negative and positive outcomes, across both individual and organizational levels. The results also demonstrate the clear need for future researchers to consider the influence of the research contexts on their results. Taken together, these actions will contribute towards our collective understanding of the impact of ICT in organizations.

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*(A * besides the reference indicates that it was included in the meta-analysis.)*

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Appendix A:

Relationships between ICT Use, Autonomy-related Constructs, and Negative Job Outcomes

---------- Table 11 here----------

rNEGATIVE OUTCOMES OF ICT USE AT WORK: META-ANALYTIC EVIDENCE AND THE ROLE OF JOB AUTONOMY

Tables

Table 1. Studies on the Negative Effects of Technology Use *

Type of ICT Use	Negative Outcomes	K**	Relationship***	Studies
Email	Stress	5	+ + + +, -	Jerejian et al., 2013 Kushlev and Dunn, 2015 Mano and Mesch, 2010 Thomée et al., 2012
	Exhaustion	1	+	Reinke and Chamorro-Premuzic, 2014
	Workload	2	+ +	Reinke and Chamorro-Premuzic, 2014 Barley et al., 2011
	Distress	2	- +	Jerejian et al., 2013 Mano and Mesch, 2010
Electronic data processing	Stress	3	+, -	Korunka and Vitouch, 1999
Video Display Terminals	Distress	2	+, - -	Lindstrom et al., 1997 Sauter et al., 1983
Computer (e.g., Laptop, Desktop)	Stress	5	+ + - +	Carayon-Sainfort, 1992 Goldfinch et al., 2011 Kraan et al., 2014 Thomée et al., 2012
	Distress	2	+,- -	Chesley, 2005 Compeau and Higgins, 1995
	Workload	2	+ +, -	Carayon-Sainfort, 1992 Chesley, 2010
Internet	Stress	3	+ + -	Chen et al., 2014 Nam, 2013 Garrett and Danziger, 2008
	Strain	2	+ +	Chen et al., 2014 Konradt et al., 2006
	Workload	3	+ + +	Quinones et al., 2016 Nam, 2013 Chesley, 2010
Mobile phones	Stress	3	+ +, -	Nam, 2013 Thomée et al., 2012
	Workload	3	+ + +	Nam, 2013 Barley et al., 2011 Chesley, 2010

Smartphones	Stress	1	+	Lee et al., 2014
	Exhaustion	1	+	Derks et al., 2014
Overall ICT use (Technology Use/ ICT Use/ System Use) ****	Stress	4	+ + + +	Beam et al., 2003 Day et al., 2012 Fuglseth et al., 2014 Wright et al., 2014
	Distress	4	- - - +	Chesley, 2014 Beaudry and Pinsonneault, 2010 Day et al., 2012 Eastin et al., 2007
	Strain	3	+ - -	Chesley, 2014 Day et al., 2012 Konradt et al., 2006
	Burnout (Depersonalization) and Exhaustion	5	+ + - - -	Schaufeli et al., 1995 Wright et al., 2014 Beam et al., 2003 Day et al., 2012 Sardeshmukh et al., 2012
	Workload	6	+ + +, - - -	Ahuja and Thatcher, 2005 Ayyagari et al., 2011 Day et al., 2012 Salanova et al., 2013 Sardeshmukh et al., 2012
	Role Ambiguity	5	+ - - - +	Ayyagari et al., 2011 Day et al., 2012 Rangarajan et al., 2005 Salanova et al., 2013 Sardeshmukh et al., 2012
	Role Conflict	3	- - -	Rangarajan et al., 2005 Salanova et al., 2013 Sardeshmukh et al., 2012

Legend:

* Some studies, such as Chesley (2014) and Day et al. (2012), studied more than one outcome, while other studies, such as Thomée et al. (2012) and Nam (2013), focused on different types of ICT.

** K is the number of studies

*** The plus and minus signs indicate whether the correlation between ICT and negative job outcomes is positive or negative.

**** "*Overall ICT use*" refers to the types of ICT whose names were not mentioned in studies.

Table 2. Studies of Autonomy and Technology Use

Aspect of Job Autonomy	Type of ICT Use	K*	Relationship**	Paper/s
Autonomy	Behavioural Intention to Use, Technology Use, Effective ICT Use	7	+ + + + + +	Ahuja et al., 2007; Barczak et al., 2007; Batt and Valcour, 2003; Deng et al., 2004; Durcikova et al., 2010; Sørebø et al., 2009

Autonomy	Internet Use, Technology Use, Computer Use, Innovation with IS use	6	+ + +,- + + +	Chesley, 2014; Kraan et al., 2014; Nam, 2013; Salanova et al., 2013; Sardeshmukh et al., 2012; Wang et al., 2014
Decision Latitude	Electronic Data Processing	3	-	Korunka and Vitouch, 1999
Discretion	Electronic Medical Records Usage	1	+	Avgar et al., 2010
Empowerment (Leadership)	Knowledge Management System Usage	1	+	Kuo et al., 2011
Job Schedule Control	Computer, Internet, Mobile Phone	1	+	Chesley, 2010
Lack of Control	Video Display Terminal	1	+	Lindstrom et al., 1997
Lack of Job Control	ICT Use	1	-	Day et al., 2012
Perceived Behavioural Control	Intention to Use New Enterprise-wide Systems	1	+	Moore et al., 2005
Perceived Behavioural Control	Intention to Use Personal Digital Assistants to Provide Healthcare	1	+	Yi et al., 2006
Perceived Behavioural Control	Intention to Use Mobile Devices to Provide Healthcare	1	+	Wu et al., 2011
Perceived Loss of Control	Mobile Phones	1	-	Lee et al., 2008
Perceived Threat to Professional Autonomy	Intention to Use Clinical Decision Support Systems	1	-	Walter and Lopez, 2008
Perceived Threat to Professional Autonomy	Intention to Use New Computer-based Clinical Decision Support Systems	2	- -	Esmaeilzadeh et al., 2012; Sambasivan et al., 2012
Supervisor Autonomy Support	IS Use Continuance	1	+	Roca and Gagné, 2008

Legend:
* K is the number of studies
** The plus and minus signs indicate whether the correlation between job autonomy and ICT use is positive or negative

Table 3. Studies of Negative Job Conditions, Autonomy and Technology Use

Technology	Negative Job Condition	Relationship with Technology Use*	Role of Job Autonomy	Paper/s	N
ICT Use	Workload (predictor of ICT use)	+ (male) , - (female)	Predictor of ICT use (positively related)	Ahuja and Thatcher, 2005	263
Computer Use	Stress (outcome of ICT use)	-	Moderator (negative)#	Kraan et al., 2014	18,723
Telework	Role ambiguity, role	+, -, - (+, +, +)	Outcome of telework	Sardeshmukh et al., 2012	417

	conflict, time pressure (all three outcomes are predictors of exhaustion)		(positively related), predictor of exhaustion (negatively related)		

Legend:
N is the total number of respondents in each study.
* The plus and minus signs indicate whether the correlation between ICT use and negative job outcomes is positive or negative.
# This indicates that autonomy weakens the relationship between technology use and negative job outcomes.

Table 4. Average Reliability Estimates for Independent and Dependent variables

Variable	K#	N@	Reliability(α)
Negative Job Outcomes			
Work Stress	16	31193	0.82
Work Strain	4	5553	0.83
Psychological Distress	12	7614	0.81
Burnout	7	2011	0.84
Stressors			
Workload	15	7276	0.77
Role Ambiguity	5	2544	0.86
Role Conflict	3	1639	0.82
ICT use-related constructs			
Overall ICT Use	14	7229	0.80
Specific ICT Use	25	35708	0.80
Autonomy-related constructs			
Autonomy	13	25114	0.81
Perceived threat to professional autonomy	3	941	0.83
Discretion *	1	962	0.80
Empowerment *	1	151	0.70
Decision Latitude	3	608	0.77
Perceived Loss of Control, Lack of Job Control, Job Schedule Control (Job Control)	3	2055	0.77

Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples.

Some research studied more than one negative job outcomes
@ Two studies used more than one sample size: Thomée et al. (2012) & Korunka and Vitouch (1999)
* Discretion and empowerment were removed from the pool because they were studied only once, and thus did not fit the criteria for running a meta-analysis.

Table 5. Average Reliability Estimates for Specific Types of ICT

Variable	K#	N	Reliability(α)
Computer Use	7	27351	0.80
Email Use	6	6682	0.79
Mobile Use	4	6754	0.80
Internet Use	6	7287	0.80
Smartphone Use	2	395	0.80
Electronic data processing (EDP) use@	1	608	0.80
Video display terminal (VDT) use	2	477	0.80
Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples. p<0.05*, p<0.01**, p<0.001*** # Some studies studied more than one specified type of ICT. @ EDP use is measured with three different sample sizes in Korunka and Vitouch's (1999) study.			

Table 6. Overall ICT Use and Stress

Independent Variables	Dependent Variables	N	K	ρ	95% Confidence Interval		p-value
					Lower limit	Upper limit	
ICT Use	Work Stress	35337	34	0.07***	0.031	0.103	0.000
Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples. p<0.05*, p<0.01**, p<0.001***							

Table 7. Impact of Overall Technology Use

Independent Variables	Dependent Variables	N	K	ρ	95% Confidence Interval		p-value
					Lower limit	Upper limit	
ICT Use	***Negative Job Outcomes***						
	Stress	31193	16	0.20***	0.106	0.291	0.000
	Strain	5553	4	-0.03	-0.093	0.148	0.652
	Distress	7614	12	0.11	-0.007	0.234	0.065
	Burnout	2011	7	0.14	-0.126	0.390	0.298
	Stressor						
	Workload	7276	15	0.15***	0.076	0.215	0.000
	Role Ambiguity	2544	5	-0.14	-0.442	0.195	0.418
	Role Conflict	1639	3	-0.50***	-0.568	-0.434	0.000
Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples. p<0.05*, p<0.01**, p<0.001***							

Table 8. Negative Job Outcomes Resulting from the Use of Specific Technologies

Independent Variables	Dependent Variables	N	K	ρ	95% Confidence Interval		p-value
					Lower limit	Upper limit	
Computer Use	Stress	23388	4	0.22	-0.044	0.451	0.102
Computer Use	Distress	2558	3	0.01	-0.036	0.054	0.688
Computer Use	Workload	1929	2	0.08	-0.003	0.165	0.060
Email Use	Stress	5404	4	0.28***	0.159	0.394	0.000
Email Use	Distress	1117	2	0.10**	0.027	0.182	0.009
Email Use	Workload	275	2	0.28*	0.063	0.472	0.012
Email Use	Burnout	201	1	0.09	-0.088	0.262	0.321
Mobile Use	Stress	5013	2	0.13	-0.048	0.302	0.150
Mobile Use	Workload	2591	2	0.08	-0.024	0.190	0.127
Internet Use	Stress	4600	3	0.26**	0.055	0.348	0.008
Internet Use	Strain	3067	2	0.18**	0.069	0.279	0.001
Internet Use	Workload	3020	3	0.04	-0.033	0.103	0.305
Smartphone Use	Stress	325	1	0.87***	0.834	0.899	0.000
Smartphone Use	Burnout	70	1	0.42**	0.148	0.633	0.003
Smartphone Use	Workload	70	1	0.36**	0.094	0.578	0.009
EDP Use	Stress	608	1	-0.04	-0.112	0.025	0.214
EDP Use	Distress	608	1	0.04	-0.032	0.115	0.270
EDP Use	Workload	608	1	0.05	-0.075	0.178	0.402
VDT Use	Distress	477	2	-0.07	-0.272	0.144	0.533
VDT Use	Workload	144	1	0.38**	0.114	0.597	0.006

Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples. p<0.05*, p<0.01**, p<0.001***

Table 9. Moderator Analysis of the Level of Autonomy

Level of Autonomy	N	K	se	t-value	β	95% Confidence Interval		p-value
						Lower limit	Upper limit	
ICT Use → Work Stress	23409	27	0.051	2.192	0.111*	0.007	0.216	0.038*

Legend: K is the number of samples for which reliability estimates were available; N is the total number of respondents across the K samples. p<0.05*, p<0.01**, p<0.001***

Table 10. Studies that Used the 'Computer Use' Construct

	Study	Sample	Items used to measure the 'computer use' construct
1	Carayon-Sainfort, 1992	US office workers	Number of hours spent at a computer per day at work
2	Chesley 2005/2010	US workers	Whether email, internet, cell-phones and pagers were being used regularly, persistently, or not at all
3	Garett and Danziger, 2008	US workers	Number of hours the computer was used for work
4	Goldfinch et al., 2011	New Zealand civil servants	Whether a desktop computer, a laptop computer, a mobile phone, and email were being used, and if so, for how many hours per day
5	Thomée et al., 2012	Young Swedish adults	The number of hours spent per day on general computer use, emailing or chatting in leisure, and computer gaming, as well as how often the computer was used for more than 2 hours without breaks
6	Kraan et al., 2014	European employees	Whether the respondents worked with personal computers, network computers, or mainframes

Table 11. Relationships between ICT Use, Autonomy-related Constructs, and Negative Job Outcomes

Negative Job Outcomes	Correlation between ICT Use and Negative Job Outcome	Aspect of Job Autonomy	Correlation between ICT Use and Job Autonomy	Technology	Studies	N
Stress	+	Decision Latitude as a predictor	-	Electronic data processing (EDP)	Korunka and Vitouch, 1999	608
	-	Job Control as a predictor	+	ICT Use	Day et al., 2012	244
	+	Autonomy as a predictor	+,-	Internet and mobile use	Nam, 2013	850
Strain	-	Autonomy as a control variabl`e	+	ICT Use	Chesley, 2014	2,242
	-	Job Control as a predictor	-	ICT Use	Day et al., 2012	244
Distress	-	Job Control as a predictor	-	ICT Use	Day et al., 2012	244
	-	Autonomy as a	+	ICT Use	Chesley, 2014	2,242

		control variable				
Exhaustion	-	Job Control as a predictor	-	ICT Use	Day et al., 2012	244
	-	Autonomy as a mediator	+	ICT Use	Sardeshmukh et al., 2012b	417
Workload	-	Job Control as a predictor	-	ICT Use	Day et al., 2012	244
	-	Job Schedule Control as a predictor	+	Computer, Internet, and Mobile phone	Chelsey, 2010	1667
	-	Autonomy as a predictor	+	ICT Use	Salanova et al., 2013	1,072
	-	Lack of Control as a predictor	+	Video Display Terminal (VDT)	Lindstrom et al., 1997	144
Role Ambiguity	-	Job Control as a predictor	-	ICT Use	Day et al., 2012	244
	-	Autonomy as a predictor	+	ICT Use	Salanova et al., 2013	1,072
Legend: N is the total number of respondents in each study.						