
# HOW DOES THE USE OF INFORMATION COMMUNICATION TECHNOLOGY AFFECT INDIVIDUALS? A WORK DESIGN PERSPECTIVE


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# HOW DOES THE USE OF INFORMATION COMMUNICATION TECHNOLOGY AFFECT INDIVIDUALS? A WORK DESIGN PERSPECTIVE

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**ABSTRACT**

People design and use technology for work. In return, technology shapes work and people. As information communication technology (ICT) becomes ever more embedded in today's increasingly digital organizations, the nature of our jobs, and employees' work experiences, are strongly affected by ICT use. This cross-disciplinary review focuses on work design as a central explanatory vehicle for exploring how individual ICT usage influences employees' effectiveness and well-being. We evaluated 83 empirical studies. Results show that ICT use affects employees through shaping three key work design aspects: job demands, job autonomy, and relational aspects. To reconcile previous mixed findings on the effects of ICT use on individual workers, we identify two categories of factors that moderate the effects of ICT use on work design: user-technology fit factors and social-technology fit factors. We consolidate the review findings into a comprehensive framework that delineates both the work design processes linking ICT use and employee outcomes and the moderating factors. The review fosters an intellectual conversation across different disciplines, including organizational behavior, management information systems, and computer-mediated communication. The findings and proposed framework help to guide future research and to design high quality work in the digital era.

*An evolution so slow—it still occurs at the rhythm of "genetic drift"—that one can hardly imagine the human as its operator, that is, as its inventor; rather, one much more readily imagines the human as what is invented.*

*— Bernard Stiegler*

## INTRODUCTION

In the work context, technologies support the achievement of our tasks and, in turn, our tasks are sculpted by technologies (Cascio & Montealegre, 2016; Parker, Van den Broeck, & Holman, 2017). For example, assembly line technology was designed to improve productivity in manufacturing, but the nature of work tasks was also dramatically changed with this technology (Forman, King, & Lyytinen, 2014). The same applied when we moved from the industrial age to the current information age: ICT, defined as "any electronic device or technology that has the ability to gather, store, or send information" (Day, Paquet, Scott, & Hambley, 2012, p.473), has come to the forefront. Examples of ICT include mobile phones, email, Skype, and office automation systems. Just like earlier forms of production technology, ICT potentially enables productivity, but it also shapes how work is done in profound ways, therefore affecting the quality of people's work lives. In the book, *Technics and Time: The Fault of Epimetheus*, which we quote from above, Bernard Stiegler was keenly aware that humans are tremendously influenced by technology, and it is this core idea that we explore here.

Most scholars have tended to explore the direct relationship between ICT and individual behaviors and outcomes and have kept the effect on work per se out of the loop. Thus, in one stream of studies, scholars have focused on the "potential for actions that new technologies provide to users" (Leonardi & Vaast, 2017, p. 152), such as the

idea that ICT gives people the opportunity to share knowledge online (Haas, Criscuolo, & George, 2015). Another stream of studies has focused on the direct psychological effects of ICT use on users, such as psychological gratification (e.g., fulfilment of needs for autonomy, relatedness, and competence; Cascio & Montealegre, 2016) or the cognitive biases induced by ICT (e.g., Clark, Robert, & Hampton, 2016; Elsbach & Stigliani, 2019).

However, what is missing is a clarity as to how ICT affects the nature and quality of work, and in turn, employees' work effectiveness and well-being (Orlikowski & Scott, 2008). As Bandura (2001) pointed out, if we only focus on the direct psychological effects of ICT use, or the potential actions afforded by ICT, we will overlook the underlying processes embedded in its unique social context, in this case, the effects of technology on work. In the work context, ICT use not only affects user experiences directly, but also deeply changes individuals' connections to tasks and to colleagues, and the nature of their tasks. In essence, ICT can shape employees' work designs. Focusing on this process will help to explain the effect of ICT on individual outcomes.

The goal of this review is to understand how ICT use affects individuals' work effectiveness and well-being through changing the nature and organization of their work tasks, activities, and employee relationships (in sum, their work design). To achieve this goal, we collated and reviewed a diverse set of studies from the disciplines of organizational behavior, industrial and organizational psychology, management information systems, and computer-mediated communication studies. Importantly, to obtain a coherent understanding of this broad-ranging literature, we used the perspective

of work design because, as we elaborate shortly, we see this as the most relevant for understanding how work is affected by ICT.

Considerable evidence shows that technology defined more broadly shapes work design (e.g., Bala & Venkatesh, 2013; Rousseau, 1977; Wall, Corbett, Clegg, Jackson, & Martin, 1990). At the same time, well-established literature exists that theorizes and demonstrates the effects of work design on individual outcomes (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Grant & Parker, 2009; Hackman & Oldham, 1975; Karasek, 1979; Parker, 2014; Parker, Morgeson, & Johns, 2017). Therefore, we have organized the literature in such a way as to understand what, how, and when work design elements of one's job or role are influenced by ICT use, to provide insight into the underlying work processes linking ICT use and individual outcomes. Importantly, we recognize that, consistent with other perspectives on ICT (e.g., sociomateriality; Orlikowski & Scott, 2008), ICT use effects on work design and outcomes are likely to be conditioned by various individual and contextual factors. We therefore also note and synthesize moderating factors.

In sum, our review addresses the following theoretical questions: *What aspects of work design are changed by the adoption of ICTs at work, and what effects do these changes have on individual outcomes? What are the contextual or individual factors that can strengthen or weaken the effects of ICT use on work design and employee outcomes?*

In what follows, we articulate why we have adopted the perspective of work design to organize our review and describe our approach to the review. We then consider how ICT use has been, and should be, conceptualized at the individual level, and review existing empirical studies to address how and when ICT use influences employees

through the lens of work design. Finally, we present insights from the review, including an integrative framework (summarized in **Figure 1**), and suggest future directions.

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Insert Figure 1 here

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## REVIEW APPROACH

We draw on the theoretical lens of work design to organize the literature on how ICT affects individuals. Work design is defined as "the content and organization of one's work tasks, activities, relationships, and responsibilities" (Parker, 2014, p. 662). Well-designed work is typically conceptualized (e.g., Morgeson & Humphrey, 2006; Parker et al., 2017) as involving the presence of particular motivational task characteristics (e.g., job autonomy), stimulating knowledge characteristics (e.g., the chance to use one's skills), and beneficial social characteristics (e.g., social support), as well as moderate levels of job demands (e.g., work load). At the individual level, high quality work design is a vehicle through which individuals achieve desirable outcomes, such as better job performance, positive work attitudes, and greater well-being (see, for example, the meta-analysis by Humphrey, Nahrgang, & Morgeson, 2007).

In the existing literature on work design, research attention has been given to its various antecedents, one of which is technology (see Parker et al., 2017 for a review). Research has also examined how changes in work design act as a mechanism that links technology use and employee outcomes (e.g., Bala & Venkatesh, 2013; Gibson, Gibbs, Stanko, Tesluk, & Cohen, 2011; Rousseau, 1977; Wall et al., 1990). For instance, building on work design theories, Wall et al. (1990) introduced a theoretical framework articulating how advanced manufacturing technology can affect key work characteristics, with subsequent effects on employee outcomes. We draw on such perspectives to

examine which elements of one's job or role are influenced by ICT use so as to provide insight into the underlying processes linking ICT use and employee outcomes (Grant & Parker, 2009; Parker, 2014; Parker, Morgeson, & Johns, 2017).

We selected journals based on the 2018 UK Association of Business Schools (ABS) Academic Journal Guide. The ABS journal list identifies a range of high quality journals in which business and management academics publish their research. All journals rated as 4 and 4* (i.e., the top two tiers) in management[1] and information management categories were included in our search. In addition, however, compared with other academic journal guides (such as the *Financial Times* Top 50 and University of Texas at Dallas's list of 24 leading business journals), the ABS journal list goes beyond high quality journals in the management and organization area to include other journals from fields relevant to ICT, which we also included (these were: *New Technology*, *Work and Employment*, *Communication Research*, *Computers in Human Behavior*, and *Journal of Computer-Mediated Communication*).

For all journals, we searched the Web of Science for articles containing "information communication technology" or "ICT" in their titles, abstracts, or keywords. As most articles in information systems focused on ICT-related phenomena, we narrowed the search by including articles containing both "information communication technology" or "ICT" and work design terms, with the latter defined broadly (e.g., "work design", "job autonomy", "job demands", "task interdependence", "social support", etc.) In total, this research yielded 762 articles. After excluding literature reviews, meta-analyses,

[1] Specifically, the management category includes four fields in the ABS Academic Journal List: General Management, Ethics, Gender and Social Responsibility; Human Resource Management and Employment Studies; Organizational Studies; and Psychology (organizational).

theory-building papers, organization- or team- level studies, studies that did not involve work design, and other irrelevant studies, we identified 47 articles relevant to the current research.

We then identified a further 36 relevant articles using the following approach. First, because management information system research tends to use very different terms to capture changes at work caused by ICT use, we conducted back-searching using terms identified in benchmark review articles (e.g., Cascio & Montealegre, 2016; Day, Scott, & Kevin Kelloway, 2010). For example, the term "technostress" is used to describe job demands created by technology use (Ragu-Nathan, Tarafdar, Ragu-Nathan, & Tu, 2008), whereas such technology-related stressors are usually theorized as job demands in organizational behavioral studies (Day et al., 2012). Second, some studies focused on specific ICT use behaviors such as work-related smartphone use (Derks, van Mierlo, & Schmitz, 2014) and so were not captured with general ICT terms. We therefore also searched for specific ICTs such as "email", "smartphone", "mobile ICT" and "mobile technology". Third, we added frequently cited articles that we had found in previous literature reviews or empirical studies that were not picked up in the journal-based literature search. Altogether, these processes rendered 83 articles focusing on individual level ICT use and work design.

## CONCEPTUALIZING ICT USE

Although there are diverse definitions of ICT use (Burton-Jones & Straub, 2006), to better understand this phenomenon at the individual level, we followed Burton-Jones and Straub's (2006, p 231) conceptualization of individual level ICT use as "*an individual user's employment of one or more features of an ICT to perform a task"*. We

chose this definition because it captures "ICT use in practice" (Leonardi, 2012; Orlikowski, 2007; Orlikowski & Scott, 2008). That is, according to Orlikowski and colleagues' theoretical work (Orlikowski, 2007; Orlikowski & Scott, 2008), technology use is not just "using something" but is a practice in which users, social goals, and technical characteristics are imbricated. We therefore consider that "ICT use" behaviors can be understood by the *extent to which the user employs ICT* (which we refer to as "ICT use intensity") as well as the *ways ICT is used to carry out tasks* (which we refer to as "functions of ICT use"). Next we elaborate on each of these elements of ICT use, and how they have typically been operationalized.

***ICT use intensity.*** ICT use intensity reflects the depth of, or frequency of, ICT use at the individual level. In previous studies, both objective indicators (e.g., frequency of ICT use or time spent on ICT) and subjective perceptions have been used to measure ICT use intensity. Typical items include "For how many minutes did you use your Blackberry/Smartphone for work after 9 PM last night?" (Lanaj, Johnson, & Barnes, 2014) or "Today, I checked my work-related emails until I went to sleep" (Derks, Bakker, Peters, & van Wingerden, 2015). Some researchers have also used the depth of usage to assess ICT use intensity with more specific indicators. For example, to measure ICT-facilitated multi-communication intensity, Cameron and Webster (2013) measured the number of overlapping conversations, the pace of switching conversations, segmentation of social roles, diversity of topics, and complexity of topics. Generally, and as we will elaborate in more depth in the review per se, the higher the intensity of ICT use, the stronger its effects on individuals. For example, in a diary study among 100 employees, it was found that the extent of daily smartphone use (ICT use intensity) was

positively related to the degree of work-home interference experienced by individuals (Derks, van Duin, Tims, & Bakker, 2015).

***Functions of ICT use.*** ICTs have various functions. Capturing ICT use functions is critical as the influences of ICT on work are likely to differ depending on the functions of the actual ICT use. At a broad level, two basic ICT functions have been identified: accomplishing information-related tasks (i.e., production/task function, or task focus) and communicating with others (i.e., social function, or communication focus) (Rice & Leonardi, 2013). This idea is consistent with Rice and Leonardi (2013, p. 429), who stated: "information and communication technologies… receive, distribute, process and store, retrieve and analyze digital information between people and machines (as information) or among people (as communication)".

Using different functions will further lead to different processes in which work elements are changed. First, when ICT is used as equipment to help accomplish tasks (production/ task function), ICT influences people through affecting the actual *work or tasks they engage in*. This process is referred to as *human-ICT interaction*. For instance, individuals can use a search engine (e.g., Google) to improve their work efficiency by reducing tedious processes. Second, when ICT is used as a *communication medium*, or has a social function, ICT influences people by affecting their interactions and social connections with others at work. This process is referred to as *ICT-mediated communication*. For example, people can use instant messaging platforms or social network services to connect with their colleagues.

As explained later, this distinction in purpose or function is important from the work design perspective because the task and/or technical aspects of work are more likely to be

changed in the human-ICT interaction process (the production/ task function of ICT), while social aspects of work are often changed in the ICT-mediated communication process (the social function of ICT).

***Summary and synthesis.*** In sum, at least on a theoretical level, "ICT use" consists of both "ICT use intensity" and "functions of ICT use", with both types of use conveying unique information. For instance, we cannot predict the consequences of someone's ICT use behavior if we only know "Jack spends more than five hours on his smartphone every day" (intensity only) or "Jack uses his smartphone for social connections" (function only). Ideally, we need to know how much, or how intensely, Jack uses his smartphone for various purposes (intensity and function). Nevertheless, as discussed later, our review shows that empirical studies have mostly adopted indices to measure ICT use intensity alone (e.g., perceived intensity, frequency, and objective time spent on ICT), with ICT use function being captured only broadly and often implicitly. That is, only the basic function and/or purpose of production and/or task versus communication can be identified from these studies. In the rest of the review, we therefore use the term "ICT use" in a generic way when referring to the concept, and we spell out, as much as possible, how this concept has been operationalized within each particular study. We revisit this issue in the final section recommending directions for future research.

## ICT USE, WORK CHARACTERISTICS, AND EMPLOYEE OUTCOMES

Based on our cross-disciplinary review (n = 83 articles), we identified three broad streams of research demonstrating how ICT affects work characteristics, as summarized in Table 1 and Table 2. The first stream, primarily derived from the management information systems literature, focuses on job demands as the underlying mechanism to

explain the relationships between ICT use and employee outcomes. The second stream, coming more from the management and organization literature, is centered on the impact of ICT use on job autonomy, which is then theorized to influence work effectiveness and well-being. The third stream, obtained from multiple perspectives, hones in on changes in the social and relational aspects of work due to ICT use. Each of these streams is now discussed in more detail.

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Insert Table 1&2 here

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**ICT Use and Job Demands**

We identified 23 papers focusing on how ICT can affect job demands, which is 28% of the total set of studies. Job demands refer to "those physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs (e.g., exhaustion)" (Demerouti et al., 2001, p. 501). Compared with technologies in the industrial age, which were primarily designed to save physical efforts, ICTs in the information age are mainly used to save cognitive and social efforts. However, as to the actual influence of ICT use on individuals' job demands, the effects are mixed. On one hand, as a type of equipment or tool that is used to do the work (i.e., the production/task function of ICT use), ICT has dramatically changed the cognitive aspects of work by helping individuals to accomplish tasks with a lower level of cognitive resource consumption. On the other hand, however, ICT use has also increased some job demands, or has brought in a range of new job demands, such as information overload, enhanced learning expectations, and ICT-related hassles (Ragu-Nathan et al., 2008). We elaborate these mixed effects next.

### *Reduced Job Demands*

ICTs are designed to be labor-saving (Day et al., 2012). Without a doubt, acting as the "external brain", ICT use can support employees to achieve their work-related goals more easily. Especially with the advent of the internet, social media, and artificial intelligence (AI), ICT use can help people effectively search, present, store, retrieve, and analyze digital information, thereby "rescuing" people from routine work (Chesley, 2010). As a result, employees can spend less time and cognitive or mental resources on information-related tasks.

Consistent with this reasoning, two studies have emphasized the role that ICT plays in reducing people's job demands, especially cognitive demands. For example, a cross-sectional study conducted in England found that the use of ICT made preparing teaching materials, collating assessment data and generating reports easier. Thus, most teachers reported that using ICT for teaching helped to reduce their workload and enabled them to be more productive (Selwood & Pilkington, 2005). Using cross-sectional data from nurses, Bautista, Rosenthal, Lin, and Theng (2018) also found that the frequency of ICT use for work purposes was associated with lower job demands. Nurses who used smartphones for work also reported higher productivity and a better quality of patient care, which the authors speculated was because mobile phones helped them save time in communication, coordination, and the management of medical information.

However, recent research has also found that utilizing ICT to save cognitive resources can lead to unintended consequences, such as superficial processing (i.e., "lazier" brains). For example, Wilmer, Sherman, and Chein (2017) reviewed 43 studies on the cognitive outcomes of mobile technology use, finding most studies demonstrated the detrimental

impacts of frequent mobile technology use on cognitive outcomes such as memory, attention, and cognitive functioning. In fact, scholars in the automation area have realized that labor-saving technology can lead to mental underload (i.e., employees invest less cognitive resources than the task requires). This, in turn, can increase safety risks and impair performance because employees cannot sustain their attention sufficiently in order to quickly and effectively respond when encountering automation malfunctions (Young & Stanton, 2002).

Similar effects have also been found for knowledge workers who use ICTs to do tasks. When processing ICT-mediated information (e.g., reading information on a screen), individuals tend to skim and scan the information rather than processing it deeply (Singer & Alexander, 2017a, 2017b). For example, Singer and Alexander's (2017a) laboratory study found that individuals could remember more information when reading printed materials than they could when reading the same materials on a computer screen. In Mueller and Oppenheimer's (2014) experiments, people are more likely to transcribe information rather than reframing it in their own words when they use laptops for learning. Thus, individuals who took notes with laptops showed poorer learning performance than those who took notes longhand.

In addition to laboratory evidence, Jarvenpaa and Lang (2005) suggested a detrimental impact of ICT use on employees' cognitive abilities based on qualitative data from 33 focus group interviews. Participants in their study reported that the frequent use of ICT for processing information made them less competent. Some typical expressions from the interviewees included "I used to remember a lot of phone numbers from

memory" and "SMS is impoverishing the language. It is a threat to language especially for young people" (Jarvenpaa & Lang, 2005, p. 14).

In general, as ICT is designed to reduce job demands, its bright side is usually taken for granted. Yet, only a few studies at the individual level have actually tested this assumption. The predominance of cross-sectional designs, rather than more rigorous research designs such as experimental or longitudinal designs, also limits the methodological rigor of the findings. For example, in both of the studies suggesting ICT reduces job demands, reverse causal processes might actually explain the cross-sectional associations (e.g., nurses and teachers who are more efficient make more use of ICT). Moreover, we observed that, while ICT has the potential to reduce job demands, it could also reduce demands excessively (Wilmer et al., 2017). Consistent with Wilmer et al.'s review on mobile technology, we also identified that ICT use at work could eliminate some necessary demands, which could bring about unintended consequences for individuals' cognitive functioning, as well as for outcomes such as safety.

***Increased Job Demands***

Several studies have shown that ICT use can create new demands for users, such as information overload, learning demands, and ICT-related hassles.

***Information overload.*** When the amount of information exceeds a human's capacity for processing it, this can be characterized in two broad ways (Farhoomand & Drury, 2002, p. 127). According to Farhoomand and Drury's (2002) qualitative study with a sample of 124 managers, the first is when employees are given more information than they can absorb. For instance, based on an online survey of working professionals, intensive social media use at work was found to expose them to more information than

they can actually take in (Yu, Cao, Liu, & Wang, 2018). Results also showed that raising the information overload further led to exhaustion and impeded subsequent performance.

The second type of information overload occurs "when information processing demand on an individual's time and internal calculations exceeds the supply or capability of time available for such processing" (Farhoomand & Drury, 2002, p. 127). According to Farhoomand and Drury's (2002) results, this type of overload can occur when there is simultaneous information flow from multiple channels. With ICT enabling multiple streams of information coming towards individuals simultaneously, individuals are often expected to, or have to, engage in various tasks and meet different goals at the same time (i.e., multitasking; Ragu-Nathan et al., 2008), which results in information overload.

Nevertheless, research also suggests that the impact of ICT-enabled multitasking on information demands might vary as a function of individuals' preferences and age. Using a sample of 1004 employees, Saunders, Wiener, Klett, and Sprenger's (2017) cross-sectional study controlled the influence of ICT use intensity and showed that individuals who prefer multitasking reported less information overload when dealing with a variety of information. Their study also found that, compared with younger users, older users reported more information overload, which the authors speculated to be because older users might find it hard to cope with multiple simultaneous information due to their declined cognitive capacities (Saunders et al., 2017).

König and Waller (2010) argued that using ICT for multitasking will enhance performance when the work environment required it. However, as humans really cannot carry out multiple tasks at one time because of their limited attention span (e.g., Pashler, 1994), multitasking actually means switching among multiple tasks quickly with short

intervals. Several neuroscientific studies have demonstrated the detrimental effects of multitasking on cognitive outcomes such as attention, memory, and learning (e.g., Ophir, Nass, & Wagner, 2009). For instance, using functional neuroimaging methodology, Foerde, Knowlton, and Poldrack (2006) found that the medial temporal lobe system in the brain (which is responsible for declarative memory) was disrupted in dual task conditions, whereas the striatum part of the brain (which is responsible for habit learning) was not diminished. These findings demonstrated the differences in memory mechanisms for participants engaged in a single task compared with those engaged two tasks at once. They also found that, although multitasking did not hurt task performance, it was harder for participants in the dual task condition to apply their learned knowledge into a new context, suggesting learning was impaired. In a similar vein, Ophir et al. (2009) examined the consequences of chronic multitasking and found that heaver multitaskers demonstrated worse task-switching abilities due to their susceptibility to interference from irrelevant environmental stimuli and from irrelevant representations in memory. All these studies challenge the idea that using ICT for multitasking will enhance performance.

Nevertheless, most of these studies were conducted in laboratory settings. In contrast, in their field study, Aral, Brynjolfsson, and Van Alstyne (2012) relied on three data sets (i.e., five-year accounting records, a 10-month email history, and a self-reported survey) and found curvilinear relationships between multitasking and employee outcomes. Results indicated that with moderate levels of multitasking, employees can use information and knowledge from one task to help accomplish other tasks productively, and thus will not perceive themselves as experiencing too many demands. When

multitasking exceeds a certain level, however, too many demands will reduce individuals' reaction time and increase error rates, which is detrimental for performance. Extrapolating from this study to the impact of ICT, it might be that – when ICT supports a moderate level of multitasking within an acceptable range – ICT use can be regarded as a job resource or a 'challenging demand'. However, when the ICT-induced information flow exceeds a certain level, it is likely to become a hindering job demand in the form of information overload. More research is needed to test this specific link between ICT use, multitasking, and information overload.

***Learning-induced demands***. The use of advanced ICTs usually leads to discrepancies between one's current skill sets or knowledge and those needed to meet future requirements, which raises employees' learning requirements (Parsons, Liden, O'Connor, & Nagao, 1991). Bala and Venkatesh (2013) conducted a longitudinal study to track the changes in work characteristics after ICT implementation and found that employees who used new electronic systems had to adapt to novel work routines to complete their tasks. At least in the early stage of ICT adoption, employees perceived that their work processes became more complex than before. In order to perform well, employees had to exert extra cognitive resources to get used to the new ICT (Lapointe & Rivard, 2005). Thus, employees perceived increased learning expectations were placed on them after the electronic system implementation (Bala & Venkatesh, 2013).

However, although demands increased during the shakedown period (the first two months after implementation), they then started to decrease afterwards. Venkatesh (2000) likewise found that individuals perceived more enjoyment, objective usability, and ease of use of an electronic system over time. Thus, it seems that, after an initial learning

demand, if ICT stays in its initial state, and is not updated to a more advanced and sophisticated version after the adaptive phase, perceived learning demands tend to decrease with increased user familiarity. Of course, given the fast changing nature of ICT, updates are likely, which creates cyclical learning demands for employees (Day et al., 2010; Tsai, Compeau, & Haggerty, 2007). These new learning cycles might therefore raise learning demands again and again.

As well as time moderating the effects of ICT use on learning-induced demands, studies have also shown that individual differences and work experiences can play moderating roles. Research has indicated that older individuals are more resistant to technological change, and they usually show poorer performance in technological training due to the lack of confidence in their abilities to learn new technologies (e.g., Gist, Rosen, & Schwoerer, 1988; Tu, Wang, & Shu, 2005). Marler and Liang (2012) compared individuals' perceptions before and after the implementation of new electronic systems and found that employees in low-level clerical service jobs perceived more learning demands after using the new electronic systems, whereas technical workers and managers reported no overall change. This could be explained by the difference in prior experience with ICT between entry-level service employees and knowledge workers. That is, knowledge workers are more likely to have experience with using ICT, whereas entry-level service employees might have insufficient experience or knowledge with ICT, which required them to invest more cognitive resources to learn the new systems (Young & Stanton, 2006).

Consistent with work design theory, although empirical evidence has shown that learning-induced demands can bring about stress and hurt employees' well-being as well

as their performance (e.g., Tarafdar et al., 2007; Wang, Shu, & Tu, 2008), these detrimental effects can also be alleviated for individuals with higher levels of technology self-efficacy (Tarafdar, Pullins, & Ragu-Nathan, 2015) and positive cognitive appraisals (i.e., those who view technical skill updating as enjoyable and pursue learning for its own sake; Tsai et al., 2007). In essence, individuals with high self-efficacy and positive appraisal patterns appear to experience learning demands more as demands which challenge them.

In theory, one might also expect that supportive organizational factors could also buffer the negative effects of learning-induced workloads on stress outcomes, yet the results have been far from conclusive. For example, in the relationships between ICT-related demands and employee outcomes (i.e., job satisfaction and satisfaction with the use of ICT), empirical evidence (Fuglseth & Sørebø, 2014; Ragu-Nathan et al., 2008) does not support the moderating roles of literacy facilitation (i.e., providing training and guidance), information technology (IT) technical support, and involvement facilitation (i.e., involving end users during system planning and implementation phase). Some work design scholars have suggested that specific job resources (e.g., ICT-related support) help to buffer specific ICT-related demands (Bakker, Demerouti, & Euwema, 2005). Consistent with this, Day et al. (2012) proposed the moderating roles of personal assistance and technological resources support (e.g., technical training) and found that technological resources support indeed mitigated the negative effects of learning demands on burnout.

***ICT hassle-induced demands and interruptions***. Intensive ICT use can mean that individuals encounter more ICT-related hassles, which is a new type of job demand in the

workplace (Day et al., 2012; O'Driscoll, Brough, Timms, & Sawang, 2010). Hassles are defined as "the irritating, frustrating, distressing demands that to some degree characterize everyday transactions with the environment" (Kanner, Coyne, Schaefer, & Lazarus, 1981, p: 3). Examples of traditional hassles include traffic jams, losing things and bad weather.

ICT use brings new vexations into the workplace such as technological incompatibility, information security threats, and ICT malfunctions (Day et al., 2010; Ragu-Nathan et al., 2008). Given that ICT is so widely used in today's workplaces and employees have to grasp different technologies, it is more common for individuals to encounter incompatibilities between technologies (e.g., the incompatibility of software or documents between Macs and PCs; Al-Fudail & Mellar, 2008), which can disrupt task performance. The wide use of diverse ICTs also exposes employees to information insecurity risks. For example, a ransomware named "WannaCry" infected more than 200,000 machines all over the world recently, causing billions of dollars' loss to the economy and no doubt causing extensive hassles and impaired performance for individuals. Moreover, technology malfunction is another major type of ICT-related work hassle (Day et al., 2012), often caused by system errors, software malfunctioning, and the like (Bessière, Newhagen, Robinson, & Shneiderman, 2006; O'Driscoll et al., 2010).

Consistent with previous ICT studies on job demands, ICT hassle-induced demands can negatively affect users' emotions, well-being, and performance (Bessière et al., 2006; Day et al., 2012; Lazar, Jones, & Shneiderman, 2006; Zimmerman, Sambrook, & Gore, 2014). However, the presence and strength of these relationships vary across individuals and situations (Bessière et al., 2006). When faced with ICT hassle-induced demands,

some individuals use adaptive coping strategies which can help them transform ICT-induced stress into energy that helps them better manage ICT-induced demands. In contrast, others tend to rely on maladaptive coping strategies and react with aggression or withdrawal, which makes things worse (Bessière et al., 2006; Shorkey & Crocker, 1981). In addition, organizational support matters (Day et al., 2012). For example, Day et al. (2012) found that personalized technical assistance can attenuate the detrimental impacts of ICT hassles on individuals' strain and cynicism, although technology resources support did not work in the same way.

Besides the aforementioned demands raised in human-ICT interactions (i.e., using production and/or task functions of ICT for technical aspects of work), recent theoretical work has also paid attention to demands derived from ICT-mediated interpersonal communications such as ICT-related interruptions. Previous studies have shown that ICT-related interruptions (e.g., frequent instant messages) increase job demands (e.g., time pressure and workload) and harm performance and well-being (e.g., Addas & Pinsonneault, 2015, 2018a; Jett & George, 2003; Sonnentag, Reinecke, Mata, & Vorderer, 2018; Ter Hoeven, van Zoonen, & Fonner, 2016). For example, based on a diary study, Sonnentag et al. (2018) found that receiving ICT-related interruptions and intensively responding to online messages can enhance employees' daily negative affect through increased time pressure.

However, Addas and Pinsonneault (2015) proposed a bright side for workplace interruptions. Based on a cross-sectional study and a diary study, Addas and Pinsonneault (2018b) showed that the frequency and duration of email interruptions that contain useful information for the worker's primary tasks was positively associated with mindfulness

and performance, whereas the frequency and duration of receiving interruptions that did not provide relevant information had a negative indirect effect on performance through increased subjective workload.

***Summary of Changes in Job Demands***

In sum, a set of job demands affected by ICT use have been identified in the literature: information overload, learning expectation, and ICT-related hassles and/or interruptions. We found that ICT-induced demands not only emerge in human-ICT interactions (e.g., when employees learn knowledge to master a new technology) but also emerge in ICT-mediated communications (e.g., when they experience online interruptions by colleagues). The research further shows that, although ICT-induced demands commonly exist in the workplace (Tarafdar et al., 2007), employees may not necessarily respond to them similarly (Tarafdar, Cooper, & Stich, 2019). For example, individuals who prefer multiple activities at the same time would perceive less information overload when multitasking (Saunders et al., 2017), and those who can get technical support from the organization can better handle these demands (Day et al., 2012).

In fact, these results about ICT and demands are consistent with wider work design research. Job demands can be appraised either as hindrances or challenges (LePine, LePine, & Jackson, 2004; Lepine, Podsakoff, & Lepine, 2005; Podsakoff, Lepine, & Lepine, 2007). According to this perspective, only demands which are hindrances are destructive, while some "good" (challenging) demands (e.g., the attention required by the job, learning demands) are constructive such that moderate levels of such demands can lead to desirable employee outcomes (e.g., Ohly & Fritz, 2009). Consistent

with this reasoning, Humphrey, Nahrgang, and Morgeson's (2007) meta-analysis showed that information processing demands and job complexity are positively related to job satisfaction, suggesting these demands function as challenges. Therefore, although these three ICT-related stressors are labeled as demands in the current review, we recognize that they can, depending on the nature of the demand itself as well as other factors, also be appraised as challenging demands. Thus, they might not necessarily lead to detrimental outcomes. As we elaborate later, we advocate that future ICT evaluation studies include how demands are appraised.

Our review also suggests that certain ICT-induced demands, such as interruptions caused by ICT or demands to always be online for work (i.e., constant connectivity) may also influence another important work design element, job autonomy, which we expand on in the next section.

**ICT Use and Autonomy**

We identified 45 papers focusing on how ICT use relates to job autonomy, which comprised more than 50% of all reviewed articles. Job autonomy is defined as "the degree to which a job provides discretion over daily work decisions, such as when and how to do tasks" (Parker, 2014, p. 664), including work scheduling, decision-making, and work method autonomy (Morgeson & Humphrey, 2006). According to work design theory, work autonomy is a vehicle for desirable employee outcomes such as enhanced individual performance and work engagement (Hackman & Oldham, 1976). For instance, job autonomy can enhance job performance through increasing employees' role breadth (Morgeson, Delaney-Klinger, & Hemingway, 2005), through fostering intrinsic motivation (Gagne, Senecal, & Koestner, 1997) and prosocial motivation (Parker et al.,

2007), and through enabling individuals to address problems effectively at their source (Cordery, Morrison, Wright, & Wall, 2010).

Similarly to the impact of ICT on job demands, the existing research sheds light on the paradoxical effects of ICT use on employees' perceptions of their job autonomy (e.g., Bader & Kaiser, 2017; Mazmanian, Orlikowski, & Yates, 2013), both with respect to human-ICT interaction and ICT-mediated communication processes.

***Increased Autonomy***

Previous studies have shown that ICT use can directly increase *work scheduling autonomy*. As employees can obtain the necessary resources or information with portable ICT and engage in work digitally, they are able to work anytime and anywhere, such as working after hours, working in virtual teams, and teleworking (Raghuram, Hill, Gibbs, & Maruping, 2019). A recent meta-analysis (Wegman, Hoffman, Carter, Twenge, & Guenole, 2018) revealed that mean levels of job autonomy perceptions have increased substantively since 1975, for which the authors speculated that ICT use at work might be a major driver. Consistent with work design theory, empirical evidence has shown that ICT-facilitated autonomy can lead to desirable employee outcomes such as higher levels of work engagement (e.g., Fujimoto, Ferdous, Sekiguchi, & Sugianto, 2016; Ter Hoeven et al., 2016; van Zoonen & Rice, 2017) and performance (Gajendran, Harrison, & Delaney-Klinger, 2015).

Research in the field has emphasized the impact of ICT-facilitated autonomy on balancing demands across different roles or domains. In theory, smartphone use after work can reduce the negative impacts of competing expectations from different roles and help people handle different demands simultaneously. Employees are able to fulfil their

family obligations at home while responding to clients and colleagues. Such employees can also leverage ICT to attend to urgent personal or family demands while at the workplace (König & Caner de la Guardia, 2014).

Nevertheless, empirically, the results are less positive than this reasoning implies. Piszczek's (2017) time-lagged study and Xie et al.'s (2018) two cross-sectional studies revealed the moderating impact of preferences for personal and work role partitioning (or combination). It was found that the intensity of ICT use for meeting work demands at home was positively associated with perceived control (i.e., boundary control, work schedule control, and location control) only for those who preferred role integration, but it was associated with lower perceived control for those who preferred role segmentation. Likewise, drawing on cross-sectional data from three organizations in telecommunication and consulting sectors, van Zoonen and Rice (2017) found that employees' responsiveness to colleagues moderated to weaken the relation between the frequency of ICT use for work-related communication and perceived autonomy. Fulfilling the expectation of continuous responsiveness reduces individuals' abilities to detach from work, resulting in lower levels of autonomy in their personal lives.

Recent work has also started to focus on the relationship between ICT use and decision-making autonomy. Given that ICTs have a range of functions (e.g., delivering information or interpersonal communications) and can influence work in different ways, studies (e.g., Bloom, Garicano, Sadun, & Van Reenen, 2014; Lai & Dobrajska, 2015) have distinguished information technology (IT) from communication technology (CT), finding that they exert different effects on decision-making autonomy. In fact, this thinking (Bloom et al., 2014; Lai & Dobrajska, 2015) is similar to our approach of

distinguishing human-ICT interactions (using the production and/or task function of ICT for technical aspects) and ICT-mediated communications (using the social function of ICT for social aspects). IT in their studies was mainly designed to help individuals accomplish information-related tasks, while CT was mainly designed to help individuals connect with others at work.

Bloom et al. (2014) argued that centralization requires the transmission of decisions from managers to workers, which comes at a communication cost, and managers therefore are more likely to delegate tasks to employees when the communication cost is higher than the information acquisition cost. Some IT (e.g., an enterprise resource planning system) can reduce employees' cost in acquiring organization- or production-related information. Therefore, using IT can increase decision-making autonomy. On the other hand, CT (e.g., email) can reduce the communication cost of transmitting information between managers and workers, which, in turn, enhances centralization and hence creates lower job autonomy (Lai & Dobrajska, 2015). However, ICT use in Bloom et al.'s (2014) study was measured at the firm level and Lai and Dobrajska (2015) measured ICT use with dummy variables (i.e., whether a particular ICT was used by employees).

According to our definition of ICT use, these measurements lack some important information, such as use intensity and the specific functions of ICT use. Besides, this classificatory approach is problematic because advanced ICTs have all the functions or features that both IT and CT have. For example, one can use a smartphone either to search for information or to communicate with colleagues. Thus, a more appropriate

approach is to understand ICT use by considering the use intensity and functions of use, as mentioned earlier, rather than distinguishing between types of ICTs.

To sum up, although a set of empirical studies supported the positive impact of ICT use on scheduling autonomy, we also observed that this varies in terms of individual differences. Recent theoretical work has started to distinguish IT and CT to disentangle their differential effects on decision-making autonomy (Lai & Dobrajska, 2015). However, due to limited information captured by the researchers' measurements of ICT use, we still need more empirical evidence with appropriately precise and conceptually defined measurement to examine their assumptions. This point is expanded in the last section of this paper.

***Reduced Autonomy***

ICT use in the workplace indeed offers the potential for greater autonomy, but on the other hand it also exposes employees to ubiquitous managerial control (e.g., electronic monitoring and standardized electronic systems). ICT use can also coerce employees to be "always online" in interpersonal collaborations and communications, which may actually reduce employees' scheduling, work methods, and decision-making autonomy (Bader & Kaiser, 2017).

***Managerial control-induced decreases in autonomy***. Bernstein's (2017) review on observation in management (i.e., "the act of careful watching and listening, or paying close attention to someone or something, in order to get information") found a shift from "people observing the technology" to "technology observing people", and another shift from observing organizational outcomes such as performance to observing specific individual activities (e.g., internet use behavior). In the industrial age, employees

(operators) were required to monitor automated systems to maintain the machines' reliability (Wall et al., 1990). However, electronic monitoring, as an important managerial control tool in the digital era, has been widely used to monitor employees' performance and other related behaviors at work.

More and more organizations are using electronic technologies to collect, store, analyze, and report the individual actions, group actions and/or performance (Nebeker & Tatum, 1993). Electronic monitoring can be used for the internet, telephone, and social media usage, visual observation, and detection of the person's physical location (e.g., via GPS; Alge & Hansen, 2014). A recent survey (Electronic Monitoring and Surveillance Survey, 2007) found that 66% of surveyed organizations used internet monitoring, 43% used email monitoring, 45% used telephone monitoring, and 48% used video surveillance.

Carayon (1993) first proposed a conceptual model linking electronic monitoring to worker stress through the work design perspective. She pointed out that exposure to monitoring reduces employees' autonomy to control work pace, work schedules, work methods, and decision-making. Consistent with this reasoning, using cross-sectional data from call centers, Sprigg and Jackson (2006) found that performance monitoring had negative indirect effects on job-related strain through reduced autonomy. However, this effect was not replicated in another study also conducted in call centers (Holman, Chissick, & Totterdell, 2002) – this study found job control did not mediate the relationship between monitoring and well-being but it weakened the detrimental impact of perceived monitoring intensity on well-being.

This mixed evidence indicates the importance of influencing conditions. Indeed, reviews suggest that electronic monitoring can be positive for managers and employees because it can provide valuable feedback (Alge & Hansen, 2014; Ball, 2010). In a qualitative study, Stanko and Beckman (2015) found that overuse of a monitoring system made people feel both disconnected to work and powerless, whereas underuse led to inefficiency. Only when monitoring is used astutely can people adjust their behaviors in time and keep focused at work. Previous reviews (Alge & Hansen, 2014; Ball, 2010; Stanton, 2000) found several crucial contextual factors for artful monitoring, such as feedback integration, clarity of monitoring criteria, quality of work design (e.g., social support and job security), monitoring frequency, target task, and so forth. For example, Stanton and Barnes-Farrell (1996) found that participants who can control electronic monitoring (i.e., where individuals can choose when to use electronic monitoring) reported higher levels of perceived job control.

The reactions to electronic monitoring also vary as a function of individual differences (Stanton, 2000). Early studies captured the moderating role of employees' task ability and skill (Aiello & Kolb, 1995; Schleifer, Galinsky, & Pan, 1995). Schleifer et al. (1995) specifically studied workers who had difficulty maintaining their data entry performance. They found that low performing workers experienced more stress when monitored. Aiello and Kolb (1995) compared low and highly skilled workers. Their results revealed that when highly skilled participants were monitored they demonstrated better data entry performance than when their highly skilled counterparts were not, whereas an opposite pattern was found among low skilled participants.

Individuals' attitudes towards surveillance, organizational commitment, and organizational identification also matter as potential moderators (Spitzmüller & Stanton, 2006; Stanton, 2000). When employees hold a positive attitude towards monitoring and have a higher organizational commitment or identification, they are more likely to accept monitoring. Besides attitudes, Watson et al. (2013) identified employees' goal orientation as playing an important role. They found that individuals with higher performance prove goal orientations, compared with individuals with higher performance avoidance goal orientations, showed greater evaluation apprehension, or "distress and unease due to concerns about negative appraisal of others in an evaluative situation" (Watson et al., 2013, p. 643), resulting in poorer performance.

Finally, concerns over other managerial controls being enhanced by ICT, such as standardized work procedures and routines, are increasing. In human-ICT interactions, both scholars and engineers focus on ICT's advanced features such as automation, whereas humans (users) are gradually "out of the loop" (i.e., less attention to individuals' autonomy in use; Grote, Weyer, & Stanton, 2014). Consequently, working with these standardized ICTs, employees perceive themselves to have less decision-making and work method autonomy. Eriksson-Zetterquist, Lindberg, and Styhre's (2009) qualitative study found that employees have to strictly obey the automated workflow, with limited decision-making and work method autonomy, when they use an e-business system for purchasing. In an extreme case, Charlie Chaplin's masterpiece *Modern Times*, humans become parts of a machine and they have no autonomy at all to decide how to accomplish their work.

Although using such technologies could save cognitive resources and reduce uncertainty at work, Eriksson-Zetterquist et al. (2009) found that employees perceive less skill utilization and less autonomy, resulting in lower levels of professional identity after the adoption of e-business system. Bala and Venkatesh's (2013) longitudinal study also found similar negative effects after electronic system implementation. Their study revealed that the lower levels of reconfigurability and customization of adopted ICT can enhance perceived work process rigidity and radicalness, which, in turn, reduce employees' perceived job control.

***Constant connectivity-induced decreases in autonomy***. As mentioned above, the flexibility enabled with ICT use can increase scheduling autonomy (e.g., working without restrictions of time and space), but this is just part of the picture. ICT use can also create expectations of constant connectivity—individuals are expected to always keep online and respond to requests, imprisoning them in a "digital cage" (e.g., Cavazotte, Heloisa Lemos, & Villadsen, 2014; Mazmanian et al., 2013). Taking emails as an example, senders can direct emails to recipients anytime and anywhere without any concern about disturbing them. Recipients are then expected to handle emails in a timely manner, if not, they will violate social norms (Barley et al., 2011). The experience of email-mediated communications is different from face-to-face communications. Perceived obligations will disappear after face-to-face chatting, whereas the reminder of pending tasks will only disappear when the tasks are handled (Barley et al., 2011). Thus, individuals might perceive less autonomy in managing their work/life balance as a result of ICT use.

More specifically, due to the constant availability of ICT, work issues can gradually invade into staff's personal lives through ICT usage, blurring boundaries

between the work and non-work domains. Employees are expected to continue working outside regular working hours and therefore have limited autonomy in their personal lives (Fenner & Renn, 2004, 2010). In Mazmanian's (2013, p. 1242) case study, one participant from a legal team described his/her experience after two to three years' email use: "To me it's this passive/aggressive way that people get access to you... I think they will sometimes email you knowing that if you see it [the message], you'll feel obligated to do something about it."

In terms of quantitative evidence, Dettmers et al. (2016) traced 132 individual for four working days and found that perceived control (autonomy) in off-the-job activities mediated the relationship between after work ICT use and well-being. They found that the intensity of work-related ICT use after hours has indirect negative effects on start-of-the-day mood via reduced perceived control in off-the-job activities. A large body of research has shown the negative consequences of intensive work-related ICT use after hours such as work-family conflict, diminished well-being (e.g., emotional exhaustion and poor sleep quality) and reduced performance (e.g., Boswell & Olson-Buchanan, 2007; Butts, Becker, & Boswell, 2015; Chen & Karahanna, 2018; Ferguson et al., 2016; Piszczek, 2017).

As mentioned in the previous section, a preference for work/life segmentation (or the opposite) can mitigate the impacts of work-related ICT use after hours. Individuals who have a preference for integration of work and the family may regard ICT as a useful tool to increase autonomy in balancing different roles. In contrast, those who prefer segmentation are more likely to perceive after work ICT use as a stressor. In addition, employees with better time management skills (e.g., goal setting and periodization) may

be able to cope with constant connectivity better (Fenner & Renn, 2010; Huang & Lin, 2014).

Besides these individual factors, we also identified the moderating roles of the social context. According to Derks, van Mierlo, and Schmitz's (2014) 4-day diary study, intensive work-related smartphone use after work impairs psychological detachment more seriously when employees perceive strong workplace segmentation norms, because these behaviors are inconsistent with their common practice. At the national level, employees are prone to give work a higher priority than their personal life in eastern countries (Chandra, 2012; Chen & Karahanna, 2014). Thus, it might be possible that work-related ICT use after work would be more tolerable in eastern countries.

***Summary of Changes in Job Autonomy***

To sum up, our review identified some paradoxical effects of employees' ICT use on job autonomy. ICT use can enhance employees' autonomy, especially their scheduling autonomy, via supporting teleworking or online collaboration. However, such impacts on job autonomy can be negative for individuals with a work/home segmentation preference and/or poor time management skills. In addition, individuals can suffer from excessive managerial control due to electronic monitoring or the use of standardized electronic systems if ICTs are not designed or implemented artfully, resulting in lower levels of autonomy. Finally, raised expectations for constant connectivity in ICT-mediated communications not only increase job demands as discussed in the previous section, but can trap people into "always being online", which can be perceived as eroding job autonomy, especially when there are strong social norms for segmentation.

## ICT Use and Relational Aspects of Work

In the digital era, with the prevalence of social network services such as Facebook and WhatsApp, more and more interpersonal interactions are mediated through ICTs (i.e., ICT-mediated communication). Meanwhile, scholars have emphasized the crucial role of ICT use in shaping social and relational aspects in daily life (e.g., Domahidi, 2018; Turkle, 2012; Waytz & Gray, 2018). For example, a meta-analysis showed that levels of dispositional empathy among college students in the US decreased from 1979 to 2009 (Konrath, O'Brien, & Hsing, 2011). The authors speculated that ICT use might be one of the antecedents that has made the young less empathetic.

However, attention to the social consequences of ICT use is still inadequate in the management and organization literature. With the rise of the service and knowledge economies, jobs, roles, and tasks are becoming more and more socially embedded (Grant & Parker, 2009). As Grant and Parker (2009) articulated, interpersonal interactions and relationships are as important as task characteristics in the current workplace and are playing a crucial role in influencing employees' work effectiveness and well-being (Humphrey et al., 2007). Thus, in this section, we specifically focus on 23 papers that considered the impact of ICT use on relational work design.

### *Increased Instrumental Support*

One way of conceptualizing social relations is to consider two types of social ties: *instrumental* and *expressive* (Balkundi & Harrison, 2006; Lincoln & Miller, 1979). Instrumental social ties are closely related to the task or work roles, which usually emerge from formal work relations (e.g., leader-subordinate and agent-customer relationships). High quality instrumental ties are important to achieve task performance

because one can gain valuable information and knowledge from such ties (i.e., instrumental social support; Ibarra, 1993). Expressive social ties, in contrast, usually reflect friendships or informal social relations in the workplace. Individuals with strongly positive expressive social ties (e.g., friendship) are more likely to receive emotional support from peers or supervisors (e.g., care and empathy), whereas those with negatively expressive social ties (e.g., antipathy) are more likely to receive social undermining. Briefly, "expressive ties are normative and affect based, whereas instrumental ties are information and cognition based" (Umphress, Labianca, Brass, Kass, & Scholten, 2003, p. 742).

Compared with face-to-face interactions, most ICT-mediated communications convey a limited number of social cues (e.g., nonverbal cues such as body language). Thus, it is relatively hard for individuals to comprehend others' moods or emotions, which may inevitably hinder the formation of expressive ties. They, however, are more likely to rely on easily accessible task-related information to reduce uncertainty. As a result, ICT-mediated communications are more likely to foster the development of instrumental rather than expressive ties (Monzani, Ripoll, Peiró, & Van Dick, 2014).

In fact, previous studies have revealed the advantages of ICT-mediated communication in building instrumental ties, such as fewer temporal or spatial constraints, the possibility of parallel communication, and the high speed of retrieving or documenting information (Dennis, Fuller, & Valacich, 2008; Zhang & Venkatesh, 2013). Especially with the development of social media, ICT-mediated communications largely reduce the cost of acquiring or delivering information in interpersonal interactions, which helps to build and extend information-based social networks. Specifically, employees can

utilize ICT to learn more about others within or outside their work groups and build instrumental ties.

For example, Leonardi (2018) conducted a quasi-natural field experiment to examine the impacts of enterprise social media use on shared cognition. Leonardi found that ICT use can overcome temporal and spatial constraints and promote shared experience across groups. As a result, employees have a better understanding of their colleagues' knowledge and social network. In other words, social media use promoted information sharing and the formation of cognition-based instrumental ties. According to the literature on social networks, increased instrumental social ties positively relate to the amount and diversity of instrumental social support (e.g., advice, training, and professional development support; Robertson, O'Reilly, & Hannah, 2019), which means employees will own more resources (e.g., information and knowledge) to accomplish core tasks. Thus, they can achieve better performance (Ali-Hassan, Nevo, & Wade, 2015).

***Reduced Emotional Support and Increased Social Undermining***

On the other hand, ICT use can be detrimental to expressive social ties because of the limited number of social cues in ICT-mediated communications (Walther, 2011). For example, neither individuals' social contextual cues (e.g., body language; Daft & Lengel, 1986) nor communicators' background information (e.g., demographic information; Siegel, Dubrovsky, Kiesler, & McGuire, 1986) is presented in ICT-mediated communications. Video conference platforms such as Skype may make it possible to see more of others' vivid reactions, but they still cannot deliver as much information as face-to-face interactions (Lee, Leung, Lo, Xiong, & Wu, 2011). As one participant in Barnes's

(2012, p.128) study expressed: "Technology has speeded work processes up but taken away some personal elements and interactions [...] some personnel have felt isolated from their colleagues by the introduction of email etc." Such a limited amount of social cueing in ICT-mediated communication will lead to deindividuation (Reicher, Spears, & Postmes, 1995).

Hence, employees usually focus on task-related content rather than building informal social relations as they would normally do in face-to-face interactions (Zornoza, Ripoll, & Peiró, 2002). Siampou, Komis, and Tselios's (2014) laboratory study showed that compared with participants collaborating face-to-face, those in ICT-mediated communications demonstrated more task-focused actions, paid more attention to analysis and synthesis, yet engaged in fewer social interactions. Therefore, employees may benefit instrumentally from ICT use by achieving better task performance whereas it might be hard for them to establish expressive ties and get emotional support in ICT-mediated communications.

However, our review also found some evidence for the bright side of using ICT's effect on social ties. For instance, Ali-Hassan et al. (2015) found that using social media to build and maintain workplace social relations can enhance both instrumental and expressive ties. Hislop et al. (2015) and Lal and Dwivedi (2009) found that homeworkers can utilize ICT to meet their social needs or cope with social isolation by communicating with friends or colleagues. Thus, it is necessary to consider the potential influencing conditions in this process.

In their review, Waytz and Gray (2018) suggested the crucial roles of individuals' offline relationships and argued that ICT use could be beneficial when deep offline

relationships are difficult to attain. Homeworkers, for example cannot engage in offline work relations as deeply as employees in face-to-face work conditions. Consequently, they will rely on ICT to build and maintain relationships. Furthermore, ICT use will be positive when individuals use it to complement deep offline relationships, whereas it will be detrimental when used to supplant offline relationships (Waytz & Gray, 2018). Cummings et al.'s (2003) study showed that using the internet is associated with declines in loneliness for individuals who already had many social resources. Using a sample of adolescents, Lee (2009) also found the rich-get-richer effect—people who already had strong social relationships are more likely to build high quality friendships via ICT-mediated communications.

Moreover, individuals may indeed build expressive ties and receive emotional support in ICT-mediated communications, but the emotional support delivered through ICT may be less effective than the social support provided in person. Holtzman et al. (2017) conducted two randomized controlled experiments in which participants were asked to finish a stressful task. Results of both experiments showed that in person support was associated with a higher positive affect than ICT-mediated emotional support. Thus, under most circumstances, offline social interactions might be more effective in building expressive ties. ICT use might only be beneficial when it is used to maintain the already deep offline relationships or when offline interactions are not available.

In addition to decreased positive expressive social ties, we also found an increase in negative expressive social ties in ICT-mediated interpersonal communications, which, in turn, leads to more social undermining in the workplace. Limited social cues in ICT-mediated communication encourage new types of social undermining in organizations,

such as cyberbullying, cyber incivility, and cyberaggression (e.g., Farley, Coyne, Axtell, & Sprigg, 2016; Park, Fritz, & Jex, 2018).

This behavior has three main origins, according to the literature. First, individuals usually hold the view that social norms that apply to face-to-face communications may not equally apply to ICT-mediated communications, which is termed the online disinhibition effect (i.e., "people say and do things in cyberspace that they wouldn't ordinarily say and do in the face-to-face world"; Suler, 2004, p. 321). Thus, they may perceive less guilt if they hurt others in ICT-mediated communications and exert fewer resources to control their behavior in cyberspace (Bauman & Yoon, 2014). Second, the poor quality of communication caused by limited nonverbal information will lead to more misunderstandings and misinformation in ICT-mediated communications, thereby leading to interpersonal conflicts (Friedman & Currall, 2003). Driven by these conflicts, people are more likely to show aggressive behaviors towards others (Camacho, Hassanein, & Head, 2018). Third, as people usually cannot see victims' reactions in time, it is hard for perpetrators to realize the harm of their behaviors to victims. Besides, anonymity in the ICT-mediated environment also inhibits perpetrators' motivation to be mindful of their behaviors.

Consistent with studies on offline social undermining, ICT-mediated social undermining has been found to be associated with a series of negative outcomes, such as emotional exhaustion, distress, reduced job satisfaction, and workplace deviance (e.g., Farley et al., 2016; Giumetti et al., 2013; Lim & Teo, 2009; Park et al., 2018). ICT-mediated social undermining can even exert stronger negative impacts than offline social undermining because ICT can break the restrictions of time and space, reach a large

audience, and make messages accessible for a long term or permanently (Camacho et al., 2018; Farley et al., 2016).

Decreased emotional support and increased social undermining due to ICT-mediated communications likely hinders employees' fulfilment of their social needs at work, which, in turn, may lead to loneliness. For instance, in Sacco and Ismail's (2014) laboratory study, participants in a face-to-face interaction condition showed higher levels of social needs satisfaction and positive mood compared to participants in an ICT-mediated interaction condition and participants in a no-interaction condition. In the work context, worries about workplace loneliness have surfaced with the widespread usage of ICT in virtual teams or in teleworking contexts.

Various scholars have realized that collaborating via "screens" (i.e., ICT-mediated communications) and having less or no face-to-face interactions may contribute to workplace loneliness (Cooper & Kurland, 2002; Golden, Veiga, & Dino, 2008; Hislop et al., 2015), which is defined as "employees' subjective affective evaluations of, and feelings about, whether their affiliation needs are being met by the people they work with and the organizations they work for" (Ozcelik & Barsade, 2018, p. 2345). According to Ozcelik and Barsade's study, workplace loneliness is negatively associated with employees' approachability and affective organizational commitment, which, in turn, will impede job performance. Besides, loneliness also exerts a series of negative impacts on employees' well-being such as an increased risk of mortality (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015).

### *Summary of Changes in Relational Aspects of Work*

To recap, ICT use is gradually changing the social and relational aspects of today's work. We found that ICT use is conducive for building instrumental social ties that can help employees gain instrumental social support. Nevertheless, ICT use reduces positive expressive social ties and increases negative expressive social ties, which, in turn, reduces emotional support and increases social undermining at work.

Research into the social consequences of ICT use at work is relatively scarce. Most existing studies were conducted in laboratory settings and simply compared the differences between ICT-mediated communications and face-to-face communications. In fact, social interactions in the workplace usually involve both face-to-face and ICT-mediated communications. Thus, offline relations and/or interactions and online relations and/or interactions are likely to influence social outcomes in a joint manner. Waytz and Gray (2018) proposed the moderating role of offline relationships on the effects of ICT-mediated communications—ICT-mediated communications are only beneficial for those who cannot attain enough offline relations or those who just employ ICT to complement their offline relations. However, less is known about this proposition in the work context.

## INSIGHTS AND INTEGRATION

This research presents a state-of-the-art summary and a holistic critique of existing knowledge about individual ICT use and its effects on work. By employing the work design perspective as our lens, we have identified solid evidence for fundamental changes in work characteristics that can transmit the effects of ICT to employees. We also identified some powerful moderating roles of individual and social factors in this process. In what follows, we outline the key insights arising from our review.

***Beyond Technocentric vs Humancentric Approaches to Technology Use in Practice***

At the broadest level, our review moves beyond previous reviews on workplace technology by focusing on individuals' ICT use in practice, thereby showing the intertwined relationships among humans, technology, and work (or social systems).

Orlikowski and Scott (2008) observed that previous reviews either treat technology as having a deterministic role in predicting changes in organizations (i.e., technocentric perspective; Dewett & Jones, 2001; Huber, 1990) or regard technology use and its effects to be a product of social construction (i.e., humancentric perspective; Barley, 1988; Zammuto et al., 2007). However, these one-sided approaches may restrict our understanding of the whole picture (Orlikowski & Scott, 2008). Technocentric perspectives widely exist in management literature (Rice & Leonardi, 2013) and indeed can help us understand the significance of technology in organizational life; however, they ignore the influences of contextual factors and human agency in shaping ICT use (Orlikowski, 2007). Humancentric perspectives, on the other hand, tend to minimize the role of technology in shaping our work, because they assume that the properties of a technology depend on individuals' interpretations and agency (Leonardi, 2012). Instead, what is needed, and what we sought to do in this review, is the consideration of technology use in practice, including human agency in the process, to go beyond the technological deterministic approach (e.g., Dewett & Jones, 2001), but at the same time, recognizing it is not all about human agency but also about influencing the work.

To achieve this goal, we captured how ICT is used in practice by focusing on individual level ICT use and defining it by "ICT use intensity" (indicating the relationship between the human and technology) and "functions of ICT use" (indicating

the relationship between technology and work). Our approach was not to prioritize either technology or human aspects, but to emphasize how ICT is enacted in practice and how ICT use is embedded in the social context, with often profound implications for work. Thus, we showed how ICT use, individual differences, and contextual factors interact together in complex ways to affect work design and employee outcomes.

***Key Role of Work Design for Understanding the Effects of ICT Use on Individuals***

Positing work design as a central mechanism for interpreting the impact of ICT use on individuals provides an important theoretical perspective to guide future studies. Although scholars have acknowledged the role ICT plays in shaping our work, as is the case for technologies in previous industrial revolutions (e.g., Cascio & Montealegre, 2016; Forman et al., 2014; Zammuto et al., 2007), there has been limited scholarly attention devoted to synthesizing - across multiple disciplinary perspectives - what aspects of work are changed by the adoption of ICTs at work, and how these work changes explain the effects of ICT use on employees' work effectiveness and well-being.

Specifically, most previous research on ICT use has adopted an affordance perspective (Gaver, 1991; Leonardi & Vaast, 2017) to explain newly emerging actions in the workplace afforded by ICTs (e.g., new forms of knowledge creation and sharing in the digital context), or it has employed a 'user experience' approach to understand the direct psychological effects of ICT use (e.g., psychological gratifications; Cascio & Montealegre, 2016; Coovert & Thompson, 2014; Peters, Calvo, & Ryan, 2018; Zhang, 2008). These two approaches can only partially interpret the impacts of ICT use on employees due to an omission of the work context.

As our review showed, for instance, previous studies reported mixed effects of ICT use on work-family conflict (e.g., Derks, Bakker, et al., 2015; Ferguson et al., 2016). Without deep insight into the changes in the nature of work, we cannot comprehensively understand such mixed results. Here, in contrast, we have focused on and captured the role ICT plays in transforming the nature of work (Bandura, 2001). The work design perspective reveals that such mixed effects are caused by the paradoxical impact of ICT use on job autonomy, as we discussed above.

Thus, our review contributes to understanding ICT usage and its consequences by providing a unique explanation from the lens of work design, which also helps to reconcile previous mixed empirical findings and integrate interdisciplinary knowledge into a single framework.

***Three Key Work Design Effects Identified Across Multiple Literatures***

By bringing together research from different disciplines, our review has identified the key work design aspects affected by ICT use. Traditionally, researchers in the management information system field have studied stressors (job demands) affected by ICT use, such as ICT-related hassles and information overload (e.g., Ragu-Nathan et al., 2008). Scholars in organizational behavior have paid considerable attention to the role of ICT use in blurring work and non-work boundaries and studied issues such as ICT use and work-family conflict (e.g., Mazmanian, 2013). Researchers in computer-mediated communication have examined the differences between ICT-mediated communications and face-to-face interactions (e.g., Dennis et al., 2008). However, because of disciplinary barriers and a lack of knowledge integration, many of these findings have been disparate

and disconnected, which inevitably hinders researchers' systematic and complete understanding of ICT's influences on work and individual outcomes.

Building upon the work design perspective, we have synthesized these diverse findings from different disciplines by categorizing them into ICT-induced changes in *job demands*, *job autonomy,* and *relational aspects of work*. As McGuire (1983, p. 33) articulated, reducing complex realities to a set of dimensions based on their characteristics is particularly important for phenomenon oriented studies, because scholars can treat sub-dimensions as a checklist to decide which dimension needs a narrower and deeper look or which aspect still needs further exploration.

More importantly, this categorization helps to build a bridge between ICT-related studies and the well-established work design framework. That is, our review covers the three key work design elements: demand, control and resources. Scholars have developed powerful theories to interpret the multiple outcomes of work design (e.g., the job characteristics model, role theory, job demand-control model, and relational work design). Once we know which work design elements are being shaped by ICT use, we can link changes in work characteristics to employee outcomes. Therefore we are better able to understand and predict the effects of newly emerged phenomena in the workplace. Ultimately, we can hopefully use this knowledge, combined with our growing understanding of moderators, to proactively create more positive effects of ICT use on fundamental aspects of work.

***The Three Work Design Effects Are Contingent***

A crucial conclusion from our review is that there are non-deterministic effects of ICT use on work design and hence outcomes, with factors that moderate the link between

ICT use and work design. Specifically, our review has showed that different boundary conditions can be observed according to the discipline of the study and the key work design variable being considered.

Building upon the well-established technology acceptance model, scholars who focused on ICT-related demands have argued that the antecedents of technology acceptance (e.g., demographic factors and ICT experience) also influence the relationships between ICT use and individual outcomes (Valkenburg & Peter, 2013). Thus, most moderators in these studies were derived from the technology acceptance model, which sometimes hindered further explorations. In contrast, work design theory posits that the outcomes of job demands are dependent upon employees' appraisal of the job demands (i.e., employees may appraise job demands either as challenge or hindrance demands; Ohly & Fritz, 2009), a point which has been neglected in the reviewed literature (Tarafdar et al., 2019).

Studies on changes in autonomy entailed by ICT use are influenced by industrial and organizational psychology traditions. Scholars in these disciplines have recognized the essential impact of context on organizational behaviors (e.g., Johns, 2006). Therefore, these researchers not only captured individual differences (e.g., attitudes, time management skill, and segmentation preference), but also paid most attention to contextual factors such as organizational policy and social norms. However, with respect to relational aspects of work design, due to the lack of research on the relationships between ICT use and social consequences, little is known about the boundary conditions. Although recent theoretical work proposed the role of offline relationships as a possible factor (Waytz & Gray, 2018), empirical evidence is still inadequate.

In sum, our review shows that the influence of ICT use on work and individuals can be mitigated by various individual and contextual factors. In fact, task-technology fit is the dominant paradigm used to explain boundary conditions in the relationship between ICT usage and its outcomes (Maruping & Agarwal, 2004). However, the task-technology fit perspective has been criticized due to its limited attention to individual differences (e.g., employees' knowledge, abilities, and skills) and other contextual factors (e.g., social norms) (Devaraj, Easley, & Michael Crant, 2008; Kock, 2009). For example, the task-technology fit perspective cannot explain why consequences of ICT usage vary with employees operating within the same work context. Results from our review therefore shift the locus of understanding boundary conditions from merely considering technical aspects to considering the work characteristics of *job demands*, *job autonomy,* and *relational aspects of work*, which helps to sketch a holistic picture as to how and when ICT matters in the current digital era.

***An Integrative Model***

To summarize the above points, and to guide support both theoretical development and practice, we propose a comprehensive framework to help understand the work design mechanisms linking ICT use and employee outcomes (see **Figure 1**).

First, the framework shows that ICT use affects employee work effectiveness and well-being via the three work characteristics of mentioned above (note the model also depicts additional work design variables and outcomes which we discuss in the section on future directions).

Second, we depict in the framework that ICT use should be considered as an interaction between intensity and function. More specifically, with regard to function, we

illustrate that ICT use is more likely to influence job demands and decision-making or work method autonomy when it is applied to the technical or task aspects of work (i.e., in the human-ICT interaction process), but influences relational work design and scheduling autonomy when applied to the social aspects of work (i.e., in the ICT-mediated communication process). As Lai and Dobrajska (2015) pointed out, ICT's different functions (e.g., social and production and/or task functions) can affect work and employees in various ways. The differentiation of ICT use functions helps to disentangle ICT's discrete impacts on work.

Third, to reconcile the previous mixed effects of ICT use, the framework shows boundary conditions of the key relationships based on a *fit* perspective. As Trist explained, "economic performance and job satisfaction were outcomes, the level of which depended on the goodness of fit between the substantive factors" (Trist, 1981, p. 10). We categorize the influencing conditions identified in the review into *user-technology fit conditions* (i.e., individual level factors) and *social-technology fit conditions* (i.e., organizational/team level factors). That is, we propose that using ICT will likely be associated with desirable outcomes when the ICT being used fits with the user's characteristics (e.g., demographic factors, personality, and previous experience) or the social context (e.g., task requirement, social norms, and culture).

Theoretically, this framework, and the review on which it is based, will help to foster a theoretical conversation between different disciplines, thereby creating more opportunities for understanding. Due to the consistent lack of a well-established integrative framework, there has been little cross-fertilization of ICT-related knowledge in the existing literature (Rice & Leonardi, 2013). A complete comprehension of

workplace ICT use will be enhanced with greater interdisciplinary integration. For example, research into management information systems and computer-mediated communication both emphasize the technical characteristics of ICT (e.g., limited social cues in ICT-mediated communications exert negative impacts on social outcomes; Dennis et al., 2008), which, however, have been largely neglected in the organizational behavior literature. Though some conceptual work has recognized the importance of technical characteristics in organizational behavior (e.g., Maruping & Agarwal, 2004; McFarland & Ployhart, 2015), empirical studies addressing these are lacking.

Practically, the framework also has value. It provides guidance for managers who currently tend to focus on organizational-level ICT use from a strategic perspective, yet overlook ICT's impacts on employees. For example, managers should be aware that although mobile ICTs apparently increase workers' autonomy, such ICT use might actually reduce employees' perceived autonomy under certain circumstances (Mazmanian et al., 2013). Consequently, managers should attend closely to how ICTs affect employees' work and employee outcomes. Learning from such evaluations, they can redesign or update ICTs. Alternatively they may introduce managerial interventions such as providing extra technical training (Day et al., 2012) to alleviate detrimental outcomes. For example, given that the limited social cues in ICT-mediated communications can hinder social satisfaction, managers can add more social elements in communication technologies (e.g., chatting channels unrelated to work) and encourage face-to-face interactions (Zhang, 2008). Thus, managers are not only responsible for utilizing technology to promote work effectiveness, they also play a crucial role in helping organizations and employees to benefit from this technology (Major et al., 2007).

Our review also suggests the importance of designing and developing ICTs to achieve high quality work in the current digital era. Our framework has shown that technology per se is neither good nor bad; whether it is helpful or harmful depends on how it is designed and implemented, as well as the fit between technology and individuals or the social context. On one hand, more attention should be given to designing technology in a way that will improve the quality of work. For example, Parker and Grote (in press) recommend that human-centered design would be useful to achieve high quality work. On the other hand, more effort needs to be given to designing the supporting organizational context, or the fit. For example, managers can provide end user training systems and technical support to mitigate the potential demands induced by ICT use (Ragu-Nathan et al., 2008).

Finally, employees can draw on findings from our review to improve how they cope with ICT-related stressors, such as via job crafting. Previous studies have shown that individuals often overlook the dark side of ICT (or they are not aware of it), and therefore they are less likely to control their use behaviors (Singer & Alexander, 2017a). To better adapt to the digital era, employees will need to exert more self-regulation to cope with the challenges or difficulties entailed by ICT.

Altogether, therefore, a work design framework helps to highlight the potential proactive role of employers and managers in seeking to design technology and organizations so as to preserve and enhance work quality in the face of growing ICT use (Grant & Parker, 2009; Parker et al., 2017).

## FUTURE DIRECTIONS

Building upon our framework, and our analysis of the existing literature, we have identified four promising theoretical directions for future exploration (see the points with asterisks in **Figure 1**) and also propose two suggestions to improve research quality.

***What additional work characteristics might be changed by ICT use?***

We recommend more attention to theorizing and testing the work design mechanisms (i.e., changes in work characteristics) between ICT usage and employee outcomes, which are often not modeled explicitly. For example, besides job demands, job autonomy, and relational work design, we argue for more attention to task significance. Task significance reflects "the degree to which a job influences the lives or work of others, whether inside or outside the organization" (Morgeson & Humphrey, 2006, p. 1323). As Baumeister and Wilson (1996) suggested, purpose, efficacy, value and positive self-worth are tied to meaningfulness. However, advanced technologies such as AI or automation are gradually leading to a shift from "machines assisting human" to "human assisting machines", which might diminish the value and worth of human beings, and hence impair task significance.

It might be possible in the future that technology determines business success, while employees might move to a more marginal position in the value chain (Nelson & Irwin, 2014). For example, purchasers perceived that their practice of "being with suppliers, the internal construction process, or interactions and relationships with other groups" was less valuable after the introduction of an e-business system (Eriksson-Zetterquist et al., 2009, p. 1163). Especially with the rapid growth of AI, most employees will be required to train algorithms or to ensure the AI system is functioning properly and

safely (Wilson & Daugherty, 2018). To some extent, they become assistants for machines rather than the reverse. Therefore, how ICT will influence work's significance or meaningfulness in the future will be an important research question.

***Does ICT usage influence other individual outcomes beyond work effectiveness and well-being?***

Scholars should pay more attention to the other individual consequences of workplace ICT use. Considering social outcomes, for example, the increased frequency of engaging in ICT-mediated communication may shape users' fear of missing out (FoMO) (Buglass, Binder, Betts, & Underwood, 2017). FoMO is defined as "a pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski, Murayama, Dehaan, & Gladwell, 2013, p. 1841). Individuals high in FoMO have a strong desire to stay informed on what others are doing. In organizational studies, research into FoMO related phenomena is still inadequate. One pertinent research question is whether constant connectivity will lead to FoMO and how FoMO influences employees' performance and well-being.

Other social consequences of workplace ICT use should also be examined. Previous studies have usually been concerned with the differences between face-to-face interactions and ICT-mediated communications and have focused on the risks of ICT use for interpersonal interactions, which has resulting in incomplete understandings. In fact, impersonal interactions in ICT can reach a large audience (e.g., helping colleagues in an internal online knowledge community), which can magnify the social impacts of individuals' online behavior. Thus, there is a strong motivation for employees to show prosocial behavior in the virtual world. For example, individuals will create user-

generated content (e.g., sharing knowledge) on social media because such behaviors can make them feel important, confident, and valued (Ansari & Munir, 2010; Daugherty, Eastin, & Bright, 2008). In addition to the intrinsic motivation, prosocial behaviors in ICT-mediated communications could also be driven by external motivations such as image management (Ollier-Malaterre, Rothbard, & Berg, 2013). Accordingly, exploring the bright aspects of ICT-mediated communication for prosocial interaction will provide a more holistic understanding of workplace ICT use and help managers to leverage its benefits.

***How might the impact of ICT use on work and individuals change over time?***

We recommend more attention to the moderating role of temporal factors. Scholars have argued that the impacts of ICT use will likely change over time (Carlson & Zmud, 1999; Dennis et al., 2008; Kock, 2004, 2009; Walther, 1992). Specifically, Walther (1992) suggested that, although ICT-mediated communication may initially lead to negative relational effects (e.g., less expressive ties), individuals can adjust their behaviors to adapt to changes over time. Kock (2004, 2009) and Dennis et al., (2008) further explained that the negative effects of ICT use would disappear with an increased familiarity that individuals have with each other, with the task, and with the ICT they use.

However, our review found that not all negative impacts which ICT use entailed can disappear over time. For task-related outcomes such as task performance and efficiency, familiarity with an ICT-supported environment will help employees achieve the baseline level of performance or even better outcomes (e.g., Carlson & Zmud, 1999; Dennis et al., 2008; Kock, 2004, 2009; Walther, 1992). Even so, detrimental impacts on social outcomes may not necessarily change over time. For example, Cummings, Butler, and

Kraut's (2002) empirical results suggested that ICT-mediated communication is less valuable for building and developing close relationships than face-to-face interaction.

Thus, individuals may not adapt to the limited social cues in ICT-mediated communications and will still feel lonely in the long run. Future research should systematically examine the role of temporal factors and differentiate their impacts in the relationships between ICT use and task-related outcomes from their impacts in relationships between ICT use and social outcomes.

***How does leaders' ICT usage (or ICT experience) influence work design?***

Our review shows that most studies focused on employees' ICT usage. Although previous reviews have also emphasized the importance of incorporating technology into leadership research (Banks, Dionne, Sayama, & Mast, 2019; Gardner, Lowe, Moss, Mahoney, & Cogliser, 2010; Potosky & Lomax, 2014), empirical studies for this stream are absent. However, our framework allows scholars to gain theoretical insights on how and why leaders' ICT usage matters differently.

Given that leadership behaviors and managerial practices are also usually mediated by ICTs (Leonardi, Neeley, & Gerber, 2012; Rosen et al., 2019), we recommend regarding a leader as a special kind of end user and call for more attention to leaders' ICT usage. Specifically, according to Parker et al.'s (2017) model of the antecedents of work design, ICT-related experience influences leaders' knowledge, ability, skills, motivations and perceived opportunities. Thus, apart from the outcomes that were identified in our framework, leaders' ICT use might also motivate them to adapt work design to the new digital environment, and/or to adapt ICTs to current work systems. In addition to the potential influence of leaders' usage on formal decision make of work design, ICT also

mediates leader-member communications (Potosky & Lomax, 2014; Rosen et al., 2019), which may further influence followers' ICT use, work effectiveness, and well-being in a "top-down" manner. Such processes warrant further investigation.

***How can ICT use be measured appropriately?***

As mentioned above, "ICT use" should capture the intertwined relationship between human, technology, and work (Burton-Jones & Straub, 2006). To precisely operationalize this variable in quantitative research, scholars therefore should capture both *ICT use intensity* (i.e., the relationship between humans and technology) and *functions of ICT use* (i.e., the relationship between technology and work).

Our review identified the functions or purpose of ICT use were sometimes missing in measurements (e.g., Derks, Bakker, et al., 2015; Dettmers et al., 2016; Rosen et al., 2019; Yu et al., 2018). As an example, although Yu et al., (2018) defined excessive social media use at work as "the degree to which an individual feels that she or he spends too much time and energy on social media for information seeking, communicating, and socializing in the workplace", they measured social media use simply with use intensity (i.e., the amount of time spent on social media). However, as ICT mediates most activities in the workplace, individuals can use it for various purposes, both work-related and personal. Thus, the omission of the functions of ICT use could be theoretically problematic, and we recommend in future studies the clear measurement or capturing of "the intensity of ICT use (e.g., use frequency and depth) for a particular purpose (e.g., accomplishing information-related tasks, building social connections, or even searching for hedonic experiences)".

***How can the quality of evidence be improved*?**

We found that most studies simply asked individuals to recall the changes of various kinds after using specific ICT. Such retrospective cross-sectional designs (38 of the 79 articles reviewed) muddy the waters as to the real impact of ICT use. We also found nine studies on ICT-mediated communications conducted in laboratory settings. Although experimental designs have high internal validity and help establish causality, the lack of ecological validity may make it hard to generalize their findings to real world settings.

Overall, a particular lack of rigorous field studies was noted, albeit with some exceptional studies that provide examples of good practice, three of which we mention here. One such example is a longitudinal research design, measuring variables repeatedly over a long time frame, used to examine the changes entailed in ICT use (Bala & Venkatesh, 2013). As a further example, Leonardi (2018) conducted a quasi-natural field experiment to examine the changes after using social media, which is a design with good internal and external validity. A diary study, as another type of longitudinal design, has occasionally been used to examine within individual daily ICT use (e.g., Derks et al., 2014), which we believe offers unique theoretical contributions because it assesses when individuals behave differently from their usual states (Dimotakis, Ilies, & Judge, 2013). In sum, although the topic as a whole is hampered by methodological challenges, there are pockets of good practice that can be built upon to provide more solid evidence and novel insights.

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**Table 1 Descriptive Information of Reviewed Articles**

| | Job demands | Autonomy | Relational aspects of work | Total |
|---|---|---|---|---|
| Management areas | 6 | 35 | 10 | 41 |
| Information management areas | 13 | 6 | 9 | 28 |
| Total (four articles addressed all three aspects and they were not included in this table) | 19 | 41 | 19 | 79 |

*Notes*: Those marked with an asterisk (†) were not rated as 4 or 4* in 2018 UK Association of Business Schools Academic Journal Guide but publish studies on individual level ICT use.

Management: *Academy of Management Annals, Academy of Management Journal, Academy of Management Review, British Journal of Management, British Journal of Industrial Relations, Business Ethics Quarterly, Human Relations, Human Resource Management, Human Resource Management Journal, Human Resource Management Review, Journal of Applied Psychology, Journal of Management, Journal of Managerial Psychology, Journal of Management Studies, Journal of Occupational and Organizational Psychology, Journal of Occupational Health Psychology, Journal of Organizational Behavior, Journal of Vocational Behavior, Leadership Quarterly, New Technology, Work and Employment†, Organization Science, Organization Studies, Organizational Behavior and Human Decision Processes, Personnel Psychology, and Work, Employment and Society.*

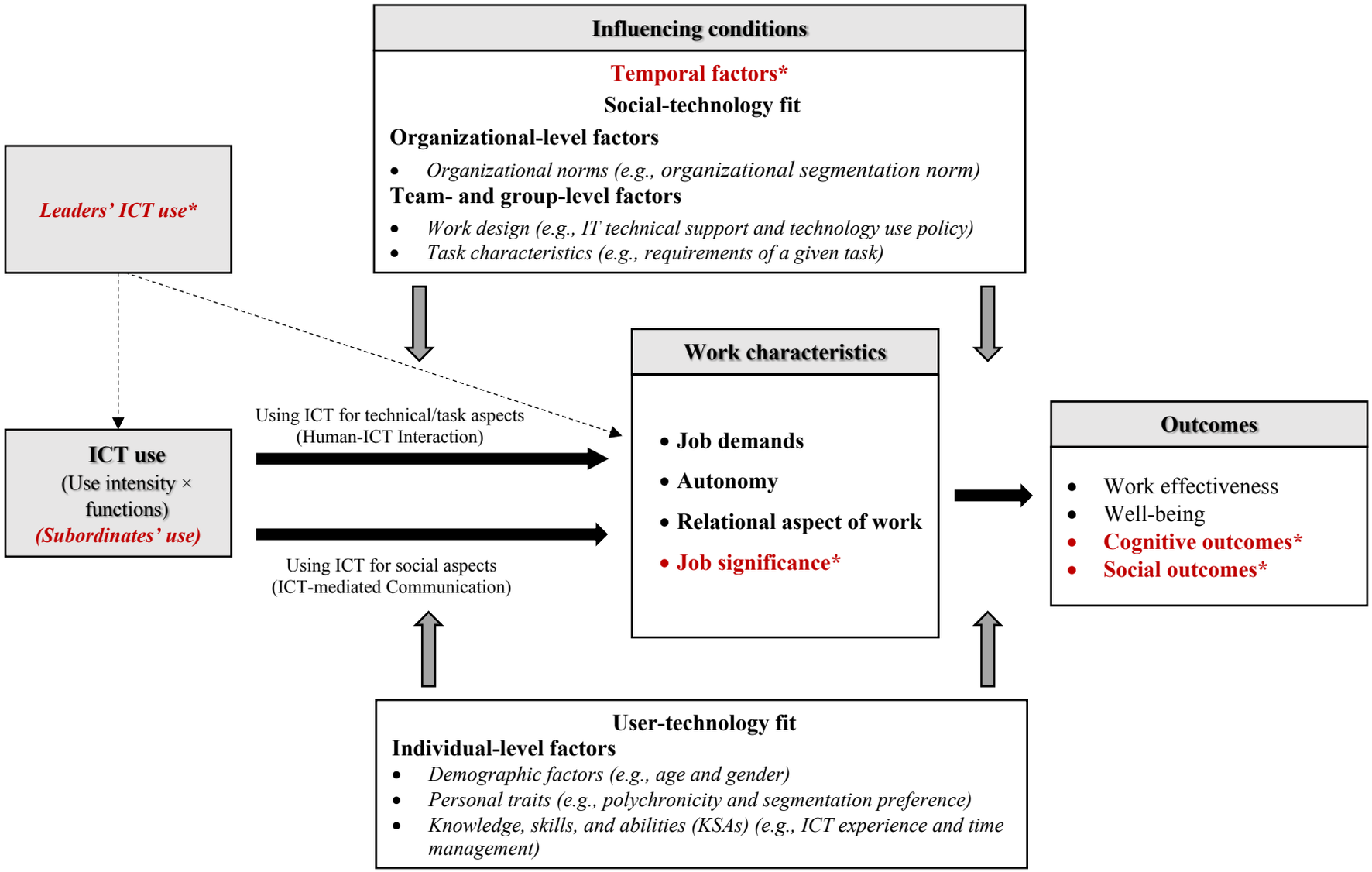
Information management: *Communication Research†, Computers in Human Behavior†, Information Systems Journal, Information Systems Research, MIS Quarterly, Journal of the Association of Information Systems, Journal of Computer-Mediated Communication†, Journal of Management Information Systems.*

**Table 2 Work Characteristics Affected by ICT Use with Examples and Boundary Conditions**

| Changes in Work Characteristics | Typical examples | Boundary conditions [we listed all boundary variables from reviewed papers] |
|---|---|---|
| **Job Demands** | | |
| ***Decreasing job demands*** | Nurses who frequently used smartphone for work purposes perceived more productivity and higher quality of care (Bautista et al., 2018). | **Individual factors:** Age, polychronicity, ICT experience, knowledge, coping orientation, technology self-efficacy. **Contextual factors:** Organizational IT technical support |
| ***Increasing job demands*** | | |
| 1) Information overload - induced demands | Excessive social media at work increased exhaustion via inducing information overload (Yu et al., 2018). | |
| 2) Learning-induced demands | Employees in clerical jobs, experienced a significant increase in work complexity and need for analytical skills after implementing an enterprise resource planning system, whereas those in technical and managerial service jobs did not (Marler & Liang, 2012). | |
| 3) ICT hassles-induced demands | ICT hassles were positively related to burnout, and personal technical assistance weakened the negative impacts of ICT hassles on employees (Day et al., 2012). | |
| **Autonomy** | | |
| ***Increasing autonomy*** | The intensity of ICT use for work after hours was associated with higher boundary control for those who prefer role integration and lower boundary control for those who prefer role segmentation (Piszczek, 2017). | **Individual factors:** Segmentation preference, employee's responsiveness, time management, task skill, attitudes (e.g., surveillance attitude and organizational commit), performance goal orientation. **Contextual factors:** Organizational monitoring policy (e.g., monitoring frequency and range), |
| ***Decreasing autonomy*** | | |
| 1) Managerial control-induced decreases in | Exposure to electronic monitoring had negative indirect effects on well-being through changes in work design (e.g., | |

| | | |
|---|---|---|
| autonomy | job control, workload, meaningfulness, etc.) (Smith, Carayon, Sanders, Lim, & LeGrande, 1992).<br><br>Using e-business system for purchasing limited employees' own autonomy to decide how to finish their work. As a result, they perceived deskilling and showed lower levels of professional identity (Eriksson-Zetterquist et al., 2009). | organizational monitoring context (e.g., social support and feedback integration), organizational segmentation norm |
| 2) Constant connectivity-induced decreases in autonomy | The intensity of ICT use after hours for work was negatively associated with perceived control over off-job activities, which, in turn, hurt employees' daily well-being (Dettmers et al., 2016). | |
| **Relational Aspects of Work** | | |
| ***Increasing instrumental social support*** | Using social media for acquiring information and building social connections had a positive indirect effect on job performance through increasing social capital (Ali-Hassan et al., 2015). | **Individual factors:**<br><br>Offline interpersonal relationships (this variable has not been empirically examined in the work context) |
| ***Reducing emotional support and increasing social undermining*** | Compared with participants collaborating face-to-face, participants in ICT-mediated communication demonstrated more task-focused actions, paid more attention to analysis and synthesis, yet engaged in fewer social interactions (Siampou et al., 2014). | |

**Figure 1 Integrative Framework of Workplace ICT Use and its Influences through the Lens of Work Design**




*Notes*: Those variables marked with an asterisk (*) and dotted arrows represent issues to be investigated by future research.