Computers in Human Behavior Reports 15 (2024) 100444

Contents lists available at ScienceDirect

Computers in Human Behavior Reports

journal homepage: www.sciencedirect.com/journal/computers-in-human-behavior-reports

Boundary-crossing ICT use – A scoping review of the current literature and a road map for future research

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ARTICLE INFO

Keywords:
Work-family interface
Boundary management
Boundary-crossing
Information communication technology (ICT)
Flexibility
Scoping review

ABSTRACT

Research on the use of digital devices to conduct tasks across work and non-work domains (i.e., boundary-crossing ICT use) grows rapidly. To gain an overview of this expanding field, we conducted a systematic search in 14 databases (e.g., WoS, PsycINFO) for studies examining the outcomes of performing 1) work-related tasks during non-work time and 2) non-work tasks during work time. After screening 17,388 abstracts, 398 were read in full text, and 159 publications were included. Most studies used cross-sectional interviews or self-report survey data of employees in high-income countries. The work-family interface, individual work and health outcomes were commonly studied, while family and organizational outcomes received little attention. Moreover, research with a multilevel perspective and studies examining objective outcomes (e.g., divorce, sick leave) were scarce and the performance of non-work tasks during work time was often ignored. Despite the burgeoning literature, there is an urgent need to arrive at a common conceptualization and operationalization of boundary-crossing ICT use to be able to compare findings across studies and disciplines. We suggest a new definition and future agenda to contribute to a deeper understanding of the field.

1. Introduction

Information communication technology (ICT) is ubiquitous, with employees being increasingly connected to their jobs and families beyond the boundaries of the traditional places and times of work, home, and leisure (Olson-Buchanan et al., 2016; Valcour & Hunter, 2005). The availability and improvement of digital devices, such as laptops, tablets, smartphones, and smartwatches have lowered the threshold for communication, making it easier to attend to duties and tasks across work and nonwork spheres; i.e., boundary-crossing Information Communication Technology (ICT) use (also called 'cross-domain ICT use') (Olson-Buchanan et al., 2016). This development has been further accelerated due to the rapid transition to teleworking for a large part of the labour force during and since the COVID-19 pandemic (Howe et al., 2021; ILO, 2020; Moens et al., 2022; OECD, 2020). Understanding how boundary-crossing behaviours affect us, our families and our workplaces is essential to facilitate healthy working habits and prevent adverse outcomes.

The permeability of boundaries between work and private domains has been of interest to researchers for several decades (Kanter, 1989; Staines, 1980; Young & Kleiner, 1992). *Boundary management theory* proposes a theoretical framework for understanding how boundary-crossing ICT use may have an impact on individuals (Allen et al., 2014; Bulger et al., 2007). This theory suggests that individual preferences about managing and maintaining boundaries between work and family vary across a spectrum, from strict *segmentation* to *integration* of these domains. *High role integration* means that there is no distinction between the 'work' or 'family' domains with employees moving between the two, sharing time, space, and attention. Conversely, *high role segmentation* means that the two domains are treated as separate spaces

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https://doi.org/10.1016/j.chbr.2024.100444
Received 16 April 2024; Accepted 22 June 2024
Available online 26 June 2024

with firm boundaries maintained. High role segmenters leave family issues "at the door" upon entering the work domain, and vice versa (Olson-Buchanan & Boswell, 2006, p. 433). Boundary management theory implies that boundary-crossing ICT use has an array of positive and negative consequences on employees' health and well-being. These outcomes are dependent, however, on whether the boundary-crossing aligns with employees' preferences for boundary management (i.e., their level of preferred integration/segmentation) and whether this preference is supported and feasible in their job, within their organization (Butts et al., 2015; Olson-Buchanan & Boswell, 2006).

The current expansion of boundary-crossing ICT use has unlocked new and comprehensive challenges as the temporal and spatial work-family borders are becoming increasingly permeable and flexible. A growing body of research aims to investigate the consequences of digital boundary-crossing strategies that employees develop when work permeates homes and families (e.g., sending work-related e-mails on a Friday evening), and when private matters permeate the world of work (e.g., when employees help elderly parents with digital bank services from their workplace). To know which directions future studies should focus on, there is a need to understand which consequences of boundary-crossing activities have been examined, how they have been investigated and, perhaps most importantly, which consequences have to date been overlooked.

Given this, we argue that to fully understand the potential outcomes of boundary-crossing ICT use, a holistic perspective is required to encompass the existing research which spans multiple disciplines and methodologies. To do so, we performed a scoping review of the boundary-crossing ICT literature. We followed a structured process where the results from a systematic search were reviewed, summarized, and analysed. The aim of this process was to identify knowledge gaps to provide for future research directions (as suggested by e.g., Arksey & O'Malley, 2005; Munn et al., 2018). This scoping review approach is appropriate given the current 'state of the evidence', consisting of an array of disciplines, methods, and concepts about everyday ICT use.

The consequences of boundary-crossing ICT use have been examined in several disciplines, such as psychology, sociology, organizational science, management science, and technology studies (Nordberg et al., 2024). So far, existing reviews focus on specific types of technology use and typically hone in on the "dark sides" of technology use, e.g., problematic smart-phone use (Busch & McCarthy, 2021), cyberslacking (e.g., employee's ICT use for personal or non-work purposes during work hours; Lim & Teo, 2022; Tandon et al., 2022) or technostress (i.e., experienced stress due to ICT use; Tarafdar et al., 2019). Moreover, existing reviews tend to focus on descriptive concepts and terms unique to specific disciplines, such as "technology-assisted supplementary work" (e.g., Kühner et al., 2023). We argue that there is a need for a wider interdisciplinary mapping of the boundary-crossing ICT phenomenon.

The work-family interface is most understood as a two-directional phenomenon, spanning both the family-to-work direction and the work-to-family direction (Carlson et al., 2000, 2006; Greenhaus & Beutell, 1985; Greenhaus & Powell, 2006). In line with this, we argue that it is essential to focus on *both* directions of boundary-crossing ICT use. Examining both directions simultaneously is vital for getting the whole picture of the potential positive or negative consequences of boundary-crossing ICT use. The current scoping review thus examines the use of digital devices (e.g., smartphones, tablets, or similar devices) which allow employees to conduct 1) work-related tasks during non-work time outside the workplace (e.g., at home, on vacation); and 2) home-related tasks at work or during work time (e.g., scheduling medical appointments, communicating with family members). In this review, we systematize the field to more clearly grasp how researchers define, measure, and examine boundary-crossing ICT use, to reveal knowledge gaps and suggest future directions for research.

The aim of the current study is to conduct an integrated and explorative scoping review of the empirical studies examining the outcomes of boundary-crossing ICT use. We address the following research questions: 1) Which samples and study designs are used to examine the outcomes of boundary-crossing ICT use? 2) How is boundary-crossing ICT use conceptualized and operationalized? 3) Which moderators/mediators/subgroups are examined? and 4) Which consequences (e.g. personal, health, family, work) are considered, and how are they operationalized?

2. Materials and methods

A scoping review was conducted following the framework described by Arksey and O'Malley (2005), which is a structured and systematic process where the results from a systematic search are reviewed, summarized, and analysed with the purpose of detecting knowledge gaps to suggest future research directions (Arksey & O'Malley, 2005; Munn et al., 2018).

2.1. Search strategy

A systematic search was conducted in January 2020 across 14 electronic databases including those for social sciences, health, and engineering sciences (i.e., Medline, PsycINFO, The Cochrane Library, SocINDEX, Arbline, Scopus, Article First, SSRN, Web of Science, Academic Search Ultimate, JSTOR, LabourDiscovery, Google Scholar and Engineering Village). The selection of databases was made to ensure the best possible coverage of the topic from as many different disciplines as possible. In January 2022, an updated search was conducted.

The authors, in collaboration with librarians with expertise in systematic search methodology, developed a broad and comprehensive search strategy. The search consisted of three main keyword clusters tailored for each of the databases: 1) Technology (e.g., "internet", "telecommunication", "ICT", "digital", "smartphone"); 2) Specific and general cross-domain-related terms (e.g., "technology assisted supplementary work", "cross-domain", "after-hours work", "spillover"), and 3) Work (e.g., "employment", "work", "job", "occupational"). See online supplement 1 for the final search strategy and search terms for each database. The search was restricted to abstracts in English but was not limited in terms of date or country of origin. The protocol was published online (Drange et al., 2020).

2.2. Study selection

Studies were included if they met the following inclusion criteria: 1) Participants: Employed or self-employed adults (ages 16–69); 2) Independent variable(s): Boundary-crossing ICT use, defined broadly as the use of digital devices (e.g., smartphones, tablets, or similar devices) to conduct work-related tasks outside of work hours and the workplace, and/or to conduct home-related tasks when at work or during work hours; 3) Dependent variable/Outcome(s): Unrestricted and 4) Study design(s): Empirical studies with a qualitative, quantitative, or mixed-method design published in peer-reviewed journals, reporting data that explored the association between boundary-crossing ICT use and its outcomes.

Each abstract was independently screened by at least two authors using the online screening tool Covidence (Veritas Health Innovation, 2021). Relevant full texts were retrieved and read by at least two authors who performed an independent assessment using the inclusion and exclusion criteria.

2.3. Data extraction and synthesis

The following data were extracted for each publication: (i) General details (author, year, title, and journal); (ii) Design and sample (study design, country, sample size, gender distribution, type of occupation, and parenthood status); (iii) Operationalization of the independent variables (origin, description, direction, and number of items); (iv) All

assessed dependent/outcome variables listed; (v) Factors that play a role in the link between the independent variable and dependent/outcome variable (i.e., moderators and mediators in the quantitative studies). Another author double-checked the data extraction. We synthesized the studies and summed up the main findings in four tables.

3. Results

Each of the 17,388 abstracts were screened by at least two reviewers. A total of 16990 records were excluded during abstract screening because they did not meet the inclusion criteria. 398 records were identified as potentially meeting the inclusion criteria and were retrieved in full text. A total of 159 peer-reviewed publications (with 165 studies) met the inclusion criteria and were included in final review sample (see list of all included studies in Appendix A. Supplementary data). See Fig. 1 for the PRISMA flowchart (Moher et al., 2015; Page et al., 2021).

3.1. Overview of sample and study designs

The publication dates ranged from 1992 to 2022, with most (93%) being published between 2010 and 2022 (93%) (Fig. 2). Table 1 and Table 2 provide an overview of the sample and study designs. In brief, the included publications were mostly from high-income countries (e.g., North American and European countries), generally investigating samples of employees from a white-collar working population. Most of the studies used a quantitative design (n = 115; 70%) and about a third used a qualitative design (n = 46; 28%), with only a few adopting multi-method designs (n = 4; 2%) (Table 2).

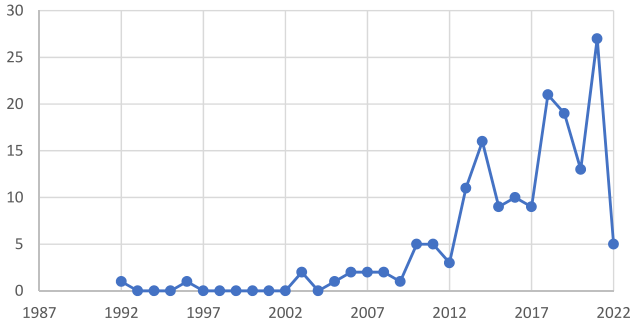

Fig. 2. Overview over number of publications each year between January 1992 to January 2022.

Most quantitative studies collected self-report single-source data using surveys, with a few exceptions which included data from e.g., significant others (e.g., Boswell & Olson-Buchanan, 2007) and managers (e.g., Becker et al., 2019). About a third of the quantitative studies had multiple measurement time points. Most of these were brief prospective studies, such as diary designs, where data are collected at one or several daily measurement points across several days, or longitudinal designs with 1-to-6-week time lags. The longitudinal studies were restricted to mostly two time points, with some exceptions (Bavafa & Terwiesch,

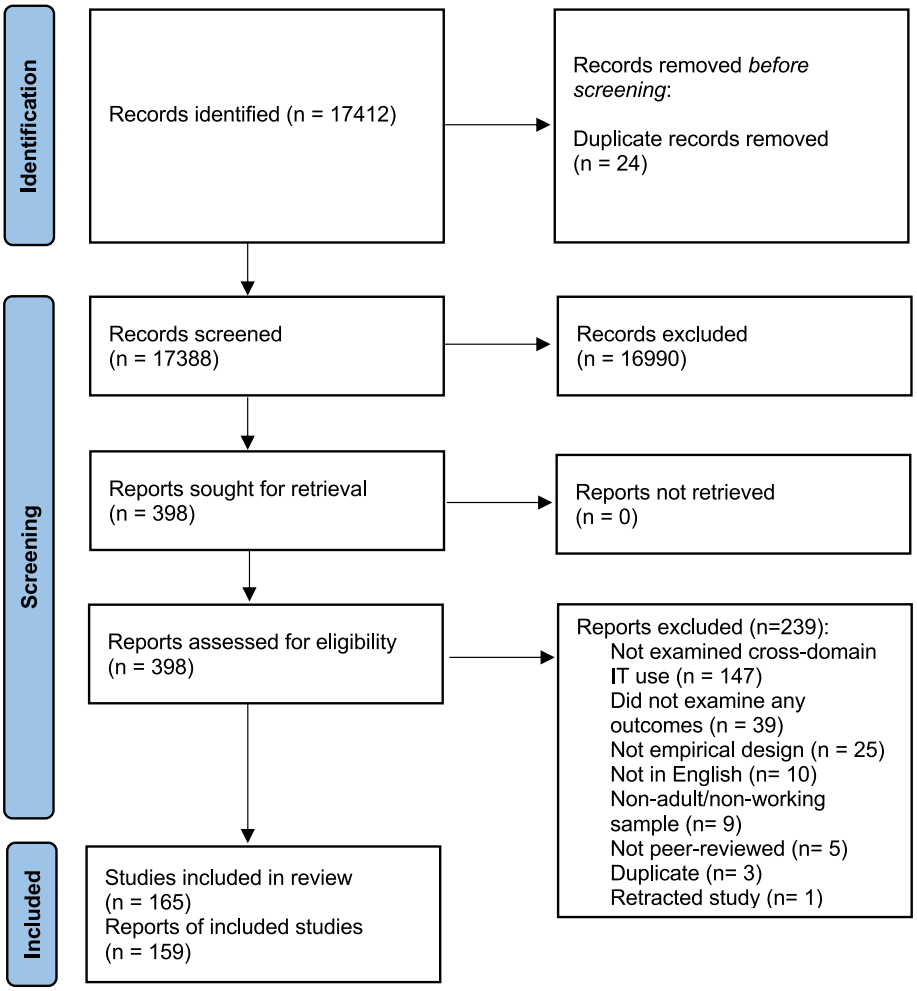

Fig. 1. PRISMA diagram of the flow in the search process.

Table 1
Sample characteristics of the included studies.

Sample characteristics	Frequency	%
Geographical origin		
North America	56	35 %
Europe	53	33 %
Asia	24	15 %
Oceania	8	5 %
Africa	5	3 %
South America	2	1 %
Multiple countries	5	3 %
Missing	6	4 %
Sample size (range)		
Qualitative studies	8–153	
Quantitative studies	51–34399	
Mixed-method studies	9–845	
Percentage of women		
0–15%	3	2 %
16–28%	11	7 %
28–42%	25	15 %
43–56%	68	41 %
57–70%	31	19 %
71–84%	5	3 %
85-100	6	4 %
Missing	16	10 %
Parenthood		
Parents 100%	9	5 %
Mixed	83	50 %
Missing	73	44 %

Table 2
Study design of the included studies.

	Total studies		Quantitative		Qualitative		Mixed method	
	n	%	*n*	%	*n*	%	*n*	%
Study design								
Cross-sectional	119	72 %	75	65 %	41	89 %	3	75 %
Longitudinal = 2 waves	14	8 %	11	10 %	3	7 %	0	0 %
Longitudinal>2 waves	3	2 %	3	3 %	0	0 %	0	0 %
Diary study**	29	18 %	26	23 %	2	4 %	1	25 %
Total	165	100 %	115	70 %	46	28 %	4	2 %

Data types (n = 188) [a]		
Questionnaire survey	122	65 %
Individual interviews	46	24 %
Focus group	6	3 %
Observations	4	2 %
Qualitative diary studies	4	2 %
Electronic device (App)	1	1 %
Registry data	1	1 %
Physiological data	1	1 %
Document analysis	1	1 %
Experimental vignette study	1	1 %
Social media/ online data	1	1 %
Informants		
One informant	150	91 %
Significant others	9	5 %
Managers	3	2 %
HR/Admin personnel	3	2 %

Time lags in longitudinal studies [a]		
	n	%
1–2 weeks	5	36 %
4–6 weeks	6	43 %
A year or more	2	14 %
Missing	1	7 %

Time lags in diary studies [a]		
	n	%
1–4 days	10	38 %
5 days	6	23 %
6–9 days	1	4 %
10 days	7	27 %
1 month or more	2	8 %

[a] Quantitative longitudinal and diary studies.

2019; Khalid et al., 2021a; Liu et al., 2021).

Most qualitative studies utilized cross-sectional single-source interview data of employees, with a few collecting data from significant others such as partners (Golden, 2013; Blair-Loy & Jacobs, 2003; Ciolfi & Lockley, 2018; Duxbury et al., 2014; Mazmanian et al., 2013) or human resource practitioners/organizational support staff (Aljabr et al., 2021; Mazmanian et al., 2013). A small percentage (11%) of the qualitative studies had multiple measurement points, including diary studies (Braukmann et al., 2018; Palm et al., 2020) and follow-up interviews across several months (Duxbury et al., 2014; Mazmanian et al., 2013) and years (Dery et al., 2014).

While most quantitative studies measured self-reported boundary-crossing ICT use, there were two innovative exceptions. An experimental vignette study by Lutz et al. (2020) examined the link between employees available time for others (manipulated to be either for a colleague outside work hours; versus a friend during work hours), and time pressure and emotional well-being. A second study examined primary-care physicians frequency and duration of conducting medical e-visits outside of ordinary work hours in a longitudinal study spanning over eight years (Bavafa & Terwiesch, 2019).

The mixed-method studies included three cross-sectional studies (Gardner et al., 2017; Ladner, 2008; Towers et al., 2006) and one diary study (Currie & Eveline, 2011), with all four combining a quantitative survey and qualitative interviews.

3.2. Conceptualization and operationalization of boundary-crossing ICT use

Boundary-crossing ICT use was often conceptualized in broad terms in most qualitative studies, such as bringing work into the home and family into the workplace in general (e.g., Field & Chan, 2018). Narrower indicators and measures were used in the quantitative studies, i.e., work-related intensive smartphone-use after work hours (Cambier et al., 2019). Often, boundary-crossing ICT use was captured in a single-direction only, with studies either examining the working during nonwork time, or performing nonwork tasks at work. Working out of hours or during nonwork time was the most frequently investigated topic, independently of methodology. More qualitative (24%) than quantitative studies (9%) examined both directions of boundary-crossing ICT use concurrently (Table 3).

The operationalization of boundary-crossing ICT use in quantitative studies was based on study-specific instruments in 43% of the studies, mostly consisting of adapted versions of validated instruments. A total of 26% studies used a single item only to measure boundary-crossing ICT use.

Commonly-used scales measuring the extent of working during nonwork time were the “Intensive Smartphone Use Scale” (Derks et al., 2016), a cross-domain ICT use measure (Boswell & Olson-Buchanan, 2007), the “Technology Assisted Job Demand Scale” (Ghislieri et al., 2017) and a work-connectivity after-hours measure (Richardson & Benbunan-Fich, 2011). The studies examining non-work ICT use at work rarely mentioned the use of a particular instrument, with few exceptions: i.e., the Cyberloafing scale (Lim, 2002), “Time Banditry Questionnaire” (Brock et al., 2013), and one study that adapted the “Intensive Smartphone Use Scale” (Derks et al., 2016) to measure daily private ICT use during work hours (Derks et al., 2021).

We found no validated instrument that measured both directions of boundary crossing activities concurrently. Of the ten quantitative studies examining both directions, most used short, study-specific instruments, making it difficult to compare the consequences of dual-

Table 3
Measurement of boundary crossing ICT-use in the included studies.

	Quantitative (n = 115)		Qualitative (n = 46)		Mixed method (n = 4)		Total (n = 165)	
	n	%	*n*	%	*n*	%	*n*	%
Directions[a]								
Working during private times	94	82 %	30	65 %	4	100 %	128	78 %
Private tasks during work hours	11	10 %	5	11 %	0	0 %	16	10 %
Both directions	10	9 %	11	24 %	0	0 %	21	13 %
Measurement in quantitative studies								
Based on previous instruments[b]	70	61 %						
Study-specific/ Missing[c]	50	43 %						
Short instrument (1 item)	30	26 %						

[a] The number for 1) working outside work and 2) doing non-work tasks at work are for studies measuring that direction only; and "both directions" measures studies examining both directions concurrently.
[b] Authors state that they use or base themselves on previous instrument/ items.
[c] Authors state that the instrument study-specific, i.e., designed for the specific study, or information is missing.

direction ICT use between studies.

In summary, the quantitative measures of boundary-crossing ICT use varied in terms of: i) *Incidence* of cross-domain behaviour (i.e., dichotomous responses [yes/no]), ii) *Frequency* (e.g. number of episodes over the past day, week, month; or unspecified frequency, such as "never" to "very frequently") and, iii) *Duration* (with responses focusing on the specific amount of time spent on ICT use).

The operationalisations in the quantitative literature can be divided into *negative* (e.g., "Today, I experienced overload due to my ICT use for work after hours"; Reinke & Ohly, 2021); *positive* (e.g., "Today, I was able to make progress toward my professional goal due to my ICT use for work after hours"; Reinke & Ohly, 2021), and *neutral* questions or statements (e.g., "Please rate the frequency with which you use different kind of technology for work purpose at home"; Khalid et al., 2021a). In addition, some studies combined boundary-crossing ICT use, its predictors (e.g., organizational expectations) and/or its outcomes (e.g., professional progress/overload) in the same sentence or scale, thus making it more challenging to interpret the specific driver of a potential negative or positive effect.

Notable limititations to the literature were as follows: Many studies focused on one specific type of communication only e.g. smartphone use or email rather than multiple types concurrently. Measures relied on negatively stated items or use a non-validated study-specific indicator, with only 1–2 items, to assess duration or frequency, and only considered one direction of boundary-crossing ICT use. Many study only focused on after-work hours communication and did not concurrently assess other time points of which boundary-crossing ICT use occurs (e.g., before work, in weekend).

3.3. Investigated outcomes of boundary-crossing ICT use

The outcome most reported and assessed in the reviewed studies was the work-family interface (55%) (e.g., work-family conflict and boundary management), followed by employees' work factors (39%) (e.g., job satisfaction and performance) and employee health and well-being (e.g., burnout/engagement, detachment, life satisfaction) (39%) (see Table 4).

In general, the least examined outcomes were family (e.g., relationship satisfaction, family discord) and nonwork factors (such as rumination and feelings of guilt). Moreover, health-related outcomes were seldom examined in qualitative studies. Notably, while most studies focus on the work-family interface or work outcomes, these outcomes were often measured at the individual level. For instance, organizational outcomes (e.g., team productivity) or family outcomes (e.g., divorce, parenting, parent-child relationships) were seldom examined.

Table 4
Types, frequency and percentage of outcomes, moderators and mediators examined in the included studies.

	Total (n = 165)		Quantitative (n = 115)		Qualitative (n = 46)		Mixed method (n = 4)	
	n	%	*n*	%	*n*	%	*n*	%
Outcomes*								
1 *Work-Family interface*	90	55 %	50	43 %	37	80 %	3	75 %
2 *Health and well-being*	65	39 %	58	50 %	6	13 %	1	25 %
3 *Work*	64	39 %	41	36 %	20	43 %	3	75 %
4 *Family and nonwork*	19	12 %	17	15 %	1	2 %	1	25 %
5 *Cognitive/ Emotional*	18	11 %	14	12 %	4	9 %	0	0 %
6 *Technology*	17	10 %	12	10 %	5	11 %	0	0 %
7 *Time and flexibility*	4	2 %	2	2 %	2	4 %	0	0 %

Mediators and moderators* examined in the quantitative studies					
Moderators (n = 69; 60%)	*n*	%	Mediators (n = 42)	*n*	%
1 *Work*	25	36 %	1 *Health and well-being*	16	38 %
2 *Work-family interface*	16	23 %	2 *Work-family interface*	15	36 %
3 *Technology*	13	19 %	3 *Work*	10	24 %
4 *Gender*	13	19 %	4 .*Cognitive/ Emotional*	6	14 %
5 *Cognitive and emotional factors*	8	12 %	5 *Technology*	5	12 %
6 *Family and nonwork*	6	9 %	6 *Family/Nonwork*	4	10 %
7 *Age*	5	7 %			
7 *Health and well-being*	4	6 %			
8 .*Country*	1	1 %			

* Percentages of number of studies. Since some studies examine more than one consequence, they are overlapping.
*Percentages of number of studies examining moderators and mediators, respectively. Since some studies examine more than one moderator/mediator, they are overlapping.

3.4. Moderators and mediators of boundary-crossing ICT use

We reviewed moderators and mediators in the quantitative studies and central factors of the qualitative findings (e.g., gender, parenthood, organizational factors).

A total of 60% (n = 69) of the quantitative studies conducted analyses of moderator or subgroups (i.e., stratified analyses) (see Table 3). The moderators that were most investigated were work factors (e.g., job characteristics, psychosocial factors) (36%), the work-family interface (e.g., segmentation preferences/boundary control) (23%), technology factors (i.e., characteristics of the technology) (19%) and gender (19%).

Few studies examined family and nonwork-related factors as

potential moderators. The exceptions were three studies examining parental status, marital status and partner's employment status (Duxbury et al., 1992, 1996; Kotecha et al., 2014) and three studies examining relationship quality and home support (Kim & Hollensbe, 2018; Wan et al., 2019; Wang et al., 2017). For instance, family support (Wang et al., 2017) and parental status (Kotecha et al., 2014) were examined as moderator of the link between working at home during off-job time on employees work-family conflict. Only four studies examined whether health and well-being could act as moderators. For instance, one diary study examined if sleep quality could impact the link between work-related smartphone use during non-work time and next-day self-control processes (Gombert et al., 2018). A second, cross-sectional study examined if workaholism was a moderator of the link between technology-assisted working during non-work time and mental health outcomes (Magnavita et al., 2021).

More than a third (n = 42; 37%) of the quantitative studies examined mediators. The most common mediators examined were health and well-being (38%): the work-family interface (36 %), and aspects of employee work experience (e.g., organizational commitment; supervisor communication) (24%). Of note, half of the studies examining mediators were longitudinal (n = 21). The increases in mediator analyses during the past five years (2018–2022: 17 studies) can be seen as evidence of the growing complexity in this field.

Few studies examined family and nonwork factors as a potential mediator of the link between boundary-crossing ICT use and its consequences, with four exceptions (Ferguson et al., 2016; Patterer et al., 2021; van Zoonen et al., 2020; Zhang et al., 2021). One of these, a cross-sectional study examined if the link between working during family-time and turnover intentions could be mediated by work-family conflict, burnout, organizational commitment, and spousal resentment in 344 employee-partner dyads (Fergusson et al., 2016).

Although moderators and mediators do not apply to qualitative studies, some patterns did emerge with regards to central factors. In line with the quantitative studies, the qualitative studies also seldom examined country-specific aspects, such as working hour regulations, family policies, norms for work-family reconciliation practices or working norms and cultures. .

Table 5 provides an overview of the study design and sample in the longitudinal studies included in this review. An overview of the cross-sectional studies is provided in Table 1 in the supplementary files.

4. Discussion

We conducted an interdisciplinary scoping review of the boundary-crossing ICT use literature to provide a critical mapping of the field and identify key limitations and knowledge gaps. Most of the included studies were single-method and single-level, collecting self-reported experiences from employees in high-income countries at a single time-point. We found that the inconsistent conceptualization and measurement of boundary-crossing ICT use hinder the advancement of the field. Both qualitative and quantitative studies lacked a focus on the familial context, with few examining factors such as parenthood, children's ages, or other family aspects. Furthermore, the field lacks an in-depth understanding of the organizational, institutional, and national contexts in which boundary-crossing ICT use occurs. We propose a prioritized agenda for future research to address these and other knowledge gaps identified in this scoping review.

4.1. A new conceptualization of boundary-crossing ICT use

Our findings highlight the need for clarity in the terminology related to boundary-crossing ICT use, as there seems to be no common conceptualization for describing or examining such use. We argue that it is crucial for future studies to investigate boundary-crossing ICT use as a bi-directional concept. The current one-sided focus, which predominantly examines the outcomes of conducting work tasks outside office hours, contrasts starkly with both the actual everyday use of boundary-crossing ICT and the well-established differentiation between work-to-family and family-to-work directions in the work-family literature (Carlson et al., 2000, 2006; Greenhaus & Beutell, 1985; Greenhaus & Powell, 2006). As technological advancements and work flexibility increase, employees are regularly available to their workplaces outside work hours, and to their family and friends within work hours. Former findings show that employees in general spend more time on their smartphone device for private tasks during work hours, than for work tasks outside office hours (Dora et al., 2019), which indicates that this phenomenon is worth investigating further. In light of the lack of studies examining this direction of boundary-crossing ICT use, we echo previous calls for more research to examine the consequences of private ICT use at work (Dora et al., 2019; Holland & Bardoel, 2016).

Boundary-crossing ICT use might function as a boundary integration strategy (Allen et al., 2014; Ashforth et al., 2000), serving as evidence of organizational flexibility and a supportive workplace culture when family demands are high. It should thus be examined bi-directionally. Employees might, for instance, be available to support family members at work, and compensate for this time later in the day (Dora et al., 2019). We therefore suggest that the conceptualization of boundary-crossing ICT use should include both work-to-nonwork and nonwork-to-work directions. Using cross-sectional data, Dora et al. (2019) reported four types of bi-directional patterns of boundary-crossing ICT use ranging from those who frequently worked outside work and did private tasks at work, to those who seldom crossed these boundaries. Most often, employees level of working outside regular work hours mirrored that of doing private tasks at work. For instance, employees who do work tasks and check work e-mails outside regular work hours also often do private tasks and check private e-mails within work hours. The consequences of differing patterns of boundary-crossing ICT use, however, remains to be examined. A novel research contribution would thus be to use person-oriented methods to examine different profiles of boundary-crossing ICT use with a longitudinal design and examine the consequences of these profiles for the individual, their families, and their careers.

4.2. A need for common assessments and measurement

Future quantitative studies would benefit from a common operationalization of boundary-crossing ICT use to be able to compare and synthesize findings across studies. The current quantitative knowledge base is characterized by single-item scales, study-specific instruments, often negatively phrased items, and/or scales that blend boundary-crossing ICT use (as the independent variable) with its consequences or predictors. While these scales might have been created to respond to specific research questions or hypotheses, they are likely to obscure the relationships with key outcomes of boundary-crossing ICT use.

The field would benefit from consistent, validated published assessments of boundary-crossing ICT use, which include a bi-directional focus. We suggest that future studies include neutrally-phrased items in assessments, without positive or negative valence, and instead examine how valence, as a moderator, may affect the link between boundary-crossing ICT use and its outcomes (e.g., Derks et al., 2021). As such, efforts using both qualitative and quantitative methods should be made to create an neutral instrument, incorporating both aspects of working outside work, and performing non-work tasks at work. This might be the key to disentangling the mixed findings or the so-called "double-edged sword" of digitalization often reported to date (Kühner et al., 2023).

4.3. A need to enhance the study designs in the boundary-crossing ICT use literature

Of the 165 included studies, only one had an experimental design, and few were longitudinal. Therefore, we propose several suggestions to

Table 5
Longitudinal studies examining boundary-crossing ICT use, organized by directions.

Author/s (year)	Title	Journal	Sample	Study design	Direction
Hubers et al. (2018)	The fragmented worker? ICTs, coping strategies and gender differences in the temporal and spatial fragmentation of paid labour	Time & Society	557 employees from various professions in the Netherlands	Quantitative; Diary study for 2 days	Both
Palm et al. (2020)	Towards More Proactive Sustainable Human Resource Management Practices? A Study on Stress Due to the ICT-Mediated Integration of Work and Private Life	Sustainability	24 employees from various professions in Sweden	Qualitative; Diary study for 7 days	Both
Wajcman et al. (2010); data 1	Enacting virtual connections between work and home	Journal of Sociology	653 employees from various professions, in Australia	Quantitative; Diary study for 24 h	Both
Wan et al. (2019); data 2	The knife cuts on both sides: Examining the relationship between cross-domain communication and work-family interface	Journal of Occupational and Organizational Psychology	111 employees from various professions, in the USA	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 month	Both
Yeh, Ma, Pan, Chuang, & Jhuang, 2019	Assessing potential effects of daily cross-domain usage of information and communication technologies	The Journal of Social Psychology	39 employees from various professions, in Taiwan	Quantitative; Diary study for 10 workdays	Both
Derks et al. (2021)	Private smartphone uses during worktime: A diary study on the unexplored costs of integrating the work and family domains	Computers in Human Behaviour	67 employees in various professions in the Netherlands	Quantitative; Diary Study for 4 workdays	Private use during work hours
Liu et al. (2021)	The Cost of Excessive Smartphone Use: Guilt Cross the Work-Family Domains	Frontiers in Psychology	105 employees from various professions, living with a family member, in China	Quantitative; Diary study for 10 workdays	Private use during work hours
Patterer et al. (2021)	Staying in touch, yet expected to be? A diary study on the relationship between personal smartphone use at work and work-nonwork interaction	Journal of Occupational and Organizational Psychology	127 employees from various professions, in Austria	Quantitative; Diary study for 10 workdays	Private use during work hours
Syrek et al. (2018)	Share, like, twitter, and connect: Ecological momentary assessment to examine the relationship between non-work social media use at work and work engagement	Work & Stress	334 white collar employees from various professions, unknown country	Quantitative; Diary study for 1 h	Private use during work hours
Alexander et al. (2010)	Working from 9 to 6? An analysis of in-home and out-of-home working schedules	Transportation	542 employees from various professions, in The Netherlands	Quantitative; Diary study for 2 days	Working outside work hours
Bavafa and Terwiesch (2019)	Work after work: The impact of new service delivery models on work hours	Journal of Operations Management	368 physicians, in the USA	Quantitative; Registry data; Longitudinal>2 waves with continuous data for 8 years (2008–2016)	Working outside work hours
Becker et al. (2019); sample 1	Killing Me Softly: Organizational E-mail Monitoring Expectations' Impact on Employee and Significant Other Well-Being	Journal of Management	108 employees from various professions, in the USA	Quantitative; Diary study for 4 days	Working outside work hours
Becker et al. (2019); sample 3	Killing Me Softly: Organizational E-mail Monitoring Expectations' Impact on Employee and Significant Other Well-Being	Journal of Management	162 employees from various professions, in the USA	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 week	Working outside work hours
Braukmann et al. (2018); data 1	Identifying ICT-related affective events across life domains and examining their unique relationships with employee recovery	Journal of Business and Psychology	153 knowledge workers in Germany	Qualitative; Diary study for 8 days	Working outside work hours
Braukmann et al. (2018); data 2	Identifying ICT-related affective events across life domains and examining their unique relationships with employee recovery	Journal of Business and Psychology	154 knowledge workers in Germany	Quantitative; Diary study for 8 days	Working outside work hours
Butts et al. (2015)	Hot buttons and time sinks: The effects of electronic communication during nonwork time on emotions and work-nonwork conflict	Academy of Management Journal	341 employees from various professions, in the USA	Quantitative; Diary study for 4 days	Working outside work hours
Cambier et al. (2019)	Detachment from work: A diary study on telepressure, smartphone use and empathy	Psychologica Belgica	80 employees from various professions, in The Netherlands	Quantitative; Diary study for 5 workdays	Working outside work hours
Chadee et al. (2021)	Is digital technology the magic bullet for performing work at home? Lessons learned for post COVID-19 recovery in hospitality management	International Journal of Hospitality Management	467 employee-supervisors' dyads within hospitality in China	Quantitative; Questionnaire survey; Longitudinal = 2 waves	Working outside work hours
Cho et al. (2020)	Daily effects of continuous ICT demand on work-family-conflict: Negative spillover and role conflict	Stress and Health	98 employees in various professions, in unknown country	Quantitative; Diary study for 10 workdays	Working outside work hours
Currie and Eveline (2011)	E-technology and work/life balance for academics with young children	Higher education	44 academics in Australia	Mixed-Method; Diary study for 1 week	Working outside work hours

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Table 5 (*continued*)

Author/s (year)	Title	Journal	Sample	Study design	Direction
Derks et al. (2015)	Smartphone use and work-home interference: The moderating role of social norms and employee work engagement	Journal of Occupational and Organizational Psychology	100 employees from various professions in the Netherlands	Quantitative; Diary study for 4 days	Working outside work hours
Derks et al. (2016)	Work-related smartphone use, work-family conflict, and family role performance: The role of segmentation preference	Human Relations	71 employees from various professions in the Netherlands	Quantitative; Diary study for 4 days	Working outside work hours
Derks et al. (2014)	A diary study on work-related smartphone use, psychological detachment, and exhaustion: Examining the role of the perceived segmentation norm	Journal of Occupational Health Psychology	70 workers from a consulting firm, a strategic management consultancy, and an energy company in Germany	Quantitative; Diary study for 4 days	Working outside work hours
Dery et al. (2014)	Working with connective flow: how smartphone use is evolving in practice	European Journal of Information Systems	10 employees and managers from a global financial services firm	Qualitative; Individual interviews; Longitudinal = 2 waves across 5 years	Working outside work hours
Duxbury et al. (2014)	Mobile Technology and Boundary Permeability	British Journal of Management	25 knowledge workers and 9 partners in Canada	Qualitative; Questionnaire survey; Individual interviews; Longitudinal = 2 waves across 6 months	Working outside work hours
Eichberger, Derks & Zacher (2021)	Technology-assisted supplemental work, psychological detachment, and employee well-being: A daily diary study	German Journal of Human Resource Management-Zeitschrift Fur Personalforschung	100 employees in various professions in German-speaking countries	Quantitative; Diary Study for 1 workweek	Working outside work hours
Eichberger, Derks & Zacher (2021) Same data as above	A Daily Diary Study on Technology-Assisted Supplemental Work, Unfinished Tasks, and Sleep: The Role of Problem-Solving Pondering	International Journal of Stress Management	100 employees in various professions in German-speaking countries	Quantitative; Diary Study for 1 workweek	Working outside work hours
Gombert et al. (2018)	Protect your sleep when work is calling: How work-related smartphone use during non-work time and sleep quality impact next-day self-control processes at work	International Journal of environmental research and public health	63 service sector employees in Germany	Quantitative; Diary study for 10 workdays	Working outside work hours
Khalid et al. (2021b) (same data as Khalid 2021a)	After-hours work-related technology use and individuals' deviance: the role of interruption overload, psychological transition, and task closure	Kybernetes	318 employees from various professions, in China	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 6 weeks	Working outside work hours
Khalid et al. (2021a) (same data as Khalid 2021b)	After-hours work-related technology use and individuals' deviance: the role of other-initiated versus self-initiated interruptions	Information Technology & People	318 employees from various professions, in China	Quantitative; Questionnaire survey; Longitudinal>2 waves across 6 weeks	Working outside work hours
Kim and Hollensbe (2018)	When work comes home: Technology-related pressure and home support	Human Resource Development International	267 employees from an information technology company in the USA	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 2 weeks	Working outside work hours
Kubo et al. (2021)	Work e-mail after hours and off-job duration and their association with psychological detachment, actigraphy sleep, and saliva cortisol: A 1-month observational study for information technology employees	Journal of Occupational Health	58 employees in technology company, in Japan	Quantitative; Diary study daily for a month; Electronic device (App); Physiological data	Working outside work hours
Lanaj et al. (2014); data 1	Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep	Organizational Behavior and Human Decision Processes	82 managers, in the USA	Quantitative; Diary study for 10 workdays	Working outside work hours
Lanaj et al. (2014); data 2	Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep	Organizational Behavior and Human Decision Processes	136 employees of various professions, in the USA	Quantitative; Diary study for 10 workdays	Working outside work hours
Li and Yuan (2018)	Smartphone Intrusion: Has Social Interaction Online Blurred the Work–Life Boundary of Employees?	Cornell Hospitality Quarterly	310 hotel employees, in China	Quantitative; Questionnaire survey; Longitudinal>2 waves across 1 week	Working outside work hours
Mazmanian et al. (2013)	The Autonomy Paradox: The Implications of Mobile Email Devices for Knowledge Professionals	Organization Science	48 knowledge workers and their administrative support (11) and spouses (8)	Qualitative; Individual interviews; Longitudinal = 2 waves across 2 months	Working outside work hours
Minnen et al. (2021)	The incessant inbox: Evaluating the relevance of after-hours e-mail characteristics for work-related rumination and well-being	Stress and Health	59 employees from various professions, in the USA	Quantitative; Diary study for 5 workdays	Working outside work hours
Park, Liu, and Headrick (2020)	When work is wanted after hours: Testing weekly stress of information communication technology demands using boundary theory	Journal of Organizational Behavior	546 teachers, in the USA	Quantitative; Diary study for weekly for 5 weeks	Working outside work hours
Piszczek (2017)	Boundary control and controlled boundaries: Organizational expectations for technology use at the work-family interface	Journal of Organizational Behavior	163 human resource managers, in the USA	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 month	Working outside work hours

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Table 5 (*continued*)

Author/s (year)	Title	Journal	Sample	Study design	Direction
Ragsdale and Hoover (2016)	Cell phones during nonwork time: A source of job demands and resources	Computers in Human Behaviour	313 employees from various professions, in the USA	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 week	Working outside work hours
Reinke and Ohly (2021)	Double-edged effects of work-related technology use after hours on employee well-being and recovery: The role of appraisal and its determinants	German Journal of Human Resource Management	51 knowledge workers, in Germany	Quantitative; Diary study for 5 workdays	Working outside work hours
Tang et al. (2019)	The dark side of social media connectivity: Influence on turnover intentions of supply chain professionals	International Journal of Operations & Production Management	325 supply chain managers, in China	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 2 weeks	Working outside work hours
Van Laethem et al. (2018)	Daily fluctuations in smartphone use, psychological detachment, and work engagement: The role of workplace telepressure	Frontiers in Psychology	116 employees from various professions, in The Netherlands	Quantitative; Diary study for 5 days	Working outside work hours
van Zoonen et al. (2020)	Boundary communication: how smartphone use after hours is associated with work-life conflict and organizational identification	Journal of Applied Communication Research	367 employees in telecommunication, in Scandinavia	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 year	Working outside work hours
Wang et al. (2017)	Communication technology use for work at home during off-job time and work-family conflict: The roles of family support and psychological detachment	Anales de psicologia	423 employees from various professions, in China	Quantitative; Questionnaire survey; Longitudinal = 2 waves across 1 month	Working outside work hours

enhance the methodological rigor of future studies.

First, we recommend that future researchers in the field conduct designs with multiple measurement points. Most of the previous studies relied on cross-sectional observational data, thus limiting the potential to draw causal conclusions. The diary study might be a fruitful avenue for future studies to continue to follow. Diary studies allow the investigation of daily fluctuations in thoughts and behaviours in everyday life and are appropriate for measuring immediate responses over a time period (Ohly et al., 2010). This design is thus suitable to examine to what extent and why boundary-crossing ICT use elicts affective responses or feelings of fatigue on daily basis, for instance. While the diary study methodology was the most prominent of the quantitative designs with repeated measurements, only two studies conducted qualitative diary studies (Braukmann et al., 2018; Currie & Eveline, 2011; Palm et al., 2020). For instance, Braukmann et al. (2018) examined which enriching and/or detrimental ICT-related affective events knowledge workers experience during and after work, using a diary design.

In addition, we also echo former recommendations, and call for more studies examining weekly or montly time periods, rather than the prevailing trends of either daily or yearly measurements (Allen et al., 2019). For instance, with weekly intervals, accumulated or chronic boundary-crossing ICT use over a week-long period, could be compared with one-time or occasional use. These 'chronic' patterns of use are likely more detrimental to long-term health issues (e.g., sickness absence) and family functioning compared with one-time or occasional use.

Second, future studies should move beyond the single-source approach and aim to include additional sources, such as responses from partner, supervisor, or colleagues and/or objective outcomes (e.g., divorce, productivity outcomes). While some existing studies examine the potential impact of colleague and supervisor expectations, the available literature is concentrated around self-report surveys or interviews in cross-sectional designs, thus making the findings prone to common method bias. Novel research avenues could expand the perspectives around family relationships, couple functioning, parenting, or time use for example, and further, include children's perspectives to examine how boundary-crossing ICT use can affect familial relationships, either positively or negatively. This could for instance build on recent findings, which suggest that 'phubbing' (i.e., ignoring others due to paying attention to one's digital device) has negative consequences for social interactions with others at work (i.e., colleagues) and at home (i.e., work-to-family spillover) (McDaniel et al., 2021). However, it remains to be examined how boundary-crossing phubbing activities are experienced by others (in qualitative or quantitative studies), or what the long-term outcomes of such digital interruptions might be (using longitudinal quantitative designs).

Third, we strongly encourage more rigorously conducted mixed-method studies. Based on our summary of the research gaps to date, we suggest that immediate innovations would be to conduct (i) a mixed-method longitudinal study; or (ii) a mixed-method vignette study. For instance, examining which reactions employees meet when responding (or not responding) to emails outside work hours would be a novel contribution to the field. . Are employees perceived as good and productive colleagues (or managers) when they do (or do not) work outside ordinary work hours? Disentangling these types of nuances, around perceptions, norms, and expectations in the workplace, would only be appropriately managed with integrated mixed-method designs.

Finally, examining the effect of boundary-crossing ICT use in an experimental design would yield the methodological rigor necessary to ascertain whether this way of working should be restricted by workplaces or public policies. Worries over the adverse effects of work-related connectivity have recently fuelled calls for new protective legislation, such as "the right to disconnect", giving workers the fundamental right to not engage in work-related communication outside work hours (Eurofound, 2021; Von Bergen et al., 2019). Despite this right having been passed in several European countries the past years, no experimental studies have examined how regulating this type of boundary-crossing ICT use can affect employees. We suggest that it is the right time for the evidence base to be developed and inform this policy and legislation more precisely as practice continues to evolve.

4.4. A need to investigate objective consequences and multilevel perspectives

Future quantitative studies should aim to investigate the objective and practical consequences of boundary-crossing ICT use. While some studies investigate the link between boundary-crossing ICT use and self-reported work productivity, there is still a lack of knowledge about its implications for objective, higher-order indicators such as customer/client satisfaction, organizational profit, employee turnover, and absenteeism. In addition, future studies could examine processes, for example career development, over time. Can employees use boundary-crossing ICT to further one's career or is it ultimately a risk? Likewise, to fully understand the implications of boundary-crossing ICT use for work-family conflict, a frequently examined outcome, future studies should examine what underlies the perceived work-family tension and

what the long-term consequences are (e.g., poorer partner relationship, divorce, poorer parent-child relationship, low quality family-time or work-time).

Similarly, qualitative research questions should aim at exploring in-depth the complexity of boundary-crossing ICT use phenomenon. While some qualitative studies offer descriptions of individuals experiences and practices, these findings often form part of general explorations of benefits and drawbacks of boundary-crossing ICT use, as is common early in a field. With the steadily increasing rate of publications, it is time to conduct in-depth examinations of specific topics and research questions, including those we suggest above.

Future studies also should strongly consider analysing organizational and national policies. For instance, comparing regulated versus unregulated contexts might bring insights into which policies and practices might be healthy for employees when conducting tasks via ICT use across workplace and home. It is essential to expand the perspective from the idiosyncratic individual level to the systemic level. This may include for instance the presence or absence of working hour regulations, or employees' right to parental or family medical leave. Such perspectives are important to increase our understanding of boundary-crossing behaviours as not only the responsibility of the individual, but also of the organization. Contextual information is essential to facilitate and identify how positive changes for employees can be made at a systemic level. In line with this, we encourage more multilevel research designs. Here, we want to emphasize the work of Choroszewicz and Kay (2019) who examined how differences in individual experiences are related to policies, through examining boundary preferences, family policies and gendered parenting.

4.5. Generalizing to a wider population

We strongly encourage future studies to include more diverse populations. Current evidence about boundary-crossing ICT use mostly originates from studies of white-collar professions/knowledge workers in high-income countries. The field should expand to include low-income countries, where employees are subject to weaker workers' protective regulations, limited child-care options, and often higher expectations about constant availability.

Moreover, researchers should strongly consider expanding their scope when examining boundary-crossing ICT use to also involve professions other than the white-collar worker. Technology advancements have been fast-tracked by the COVID-19 pandemic, and professions formerly seen as non-digital have experienced a fast and sudden digitalization surge. For example, professions such as social workers (Nordesjö et al., 2022) and teachers (e.g., Bauwens et al., 2020), are currently working more across work and nonwork domains. As digitalization is likely to continue spreading to new sectors of the workforce, future studies should expand their scope to study employees who have been largely overlooked in the field, such as blue-collar workers, health-personnel, social workers, or non-salaried wage earners (Bergman & Gaskins, 2015; Tarafar & Saunders, 2022) and employees in the informal economy (Gloss et al., 2017).

Sub-populations that might be vulnerable to adverse outcomes remain under-investigated in the field. For instance, parents have been shown to conduct more boundary-crossing ICT use and experience higher work-family conflict than non-parents (Byron, 2005; Huffman et al., 2013; Innstrand et al., 2010; Michel et al., 2011). Still, 44% of our included studies provided no information about parental status. A novel research question would be if boundary-crossing ICT use might have different consequences for the career trajectory of men and women with and without children across time. Future studies should also examine employees with added health or caretaker demands, such as single parents, or employees with caring responsibilities for elderly parents. There is some evidence suggesting that flexible work arrangements, such as working outside regular work hours and locations can reduce sickness absence and somatic symptoms (Shifrin & Michel, 2022): Studies should examine to which extent boundary-crossing ICT use is used together with other flexible work arrangements. For instance, when employees are working part-time or remotely, do they compensate with engaging in substantial boundary-crossing ICT behaviours, because they feel a higher expectation for digital presenteeism?

4.6. Strengths and limitations

In this scoping review, we rigorously mapped the interdisciplinary, burgeoning literature on boundary-crossing ICT use, summarizing the evidence and pointing out future research directions. We adopted a transparent and comprehensive systematic approach of searching and screening studies examining the outcomes of boundary-crossing ICT use. Notwithstanding these strengths, there are limitations.

We deliberately chose broad search terms and wide inclusion criteria to map all potential studies across diverse disciplines examining boundary-crossing ICT use. This broad search yielded more than 17,000 abstracts for screening. Studies were only included if they had a boundary-crossing element, i.e., that the technology-assisted task was conducted across the work and family/home divide. We thus chose not to include studies examining general use of digital devices or software (e.g., general social media use). This is however covered in former systematic reviews.

In line with the aim of a scoping review, which is to explore and map the evidence base, including samples, methods, focus, and operationalizations (Arksey & O'Malley, 2005; Munn et al., 2018), we did not provide a quality assessment or report specific findings of the included 159 publications. The current review complements other reviews of related and sub-topics of boundary-crossing ICT use (e.g., technology-assisted supplementary work; Kühner et al. (2023) by taking stock of the existing literature and providing a wider critical scoping review of the state of the field, with a focus on the methods used.

4.7. Conclusion

The findings underscore the need for a research agenda that transcends single-time, single-method, and single-source approaches to better understand boundary-crossing ICT use. Like all employee phenomena, boundary-crossing ICT use is complex. It occurs in the context of both work and home, evolves and changes over time; and is experienced by individuals but also perceived by individuals near them (e.g., family, colleagues). Future research must therefore engage with these complexities. We strongly emphasize the importance of measurements to be both value-neutral and bi-directional to provide a clearer picture of the potential advantages and disadvantages of boundary-crossing ICT use. Additionally, we propose an agenda and directions for future research that consider (i) sub-populations currently missing in the literature ('who' is most affected or at risk?); and (ii) factors which might affect the relationship between boundary-crossing ICT use and crucial employee, family, and organizational outcomes.

CRediT authorship contribution statement

Wendy Nilsen: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Writing – original draft, Writing – review & editing. **Tanja Nordberg:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Validation, Writing – original draft, Writing – review & editing. **Ida Drange:** Conceptualization, Data curation, Formal analysis, Investigation, Validation, Visualization, Writing – review & editing. **Nina Mareen Junker:** Investigation, Validation, Writing – review & editing. **Siri Yde Aksnes:** Investigation, Validation, Writing – review & editing. **Amanda Cooklin:** Investigation, Validation, Writing – review & editing. **Eunae Cho:** Investigation, Validation, Writing – review & editing. **Laurence Marie Anna Habib:** Conceptualization, Investigation,

Validation, Writing – review & editing. **Stacey Hokke:** Conceptualization, Investigation, Validation, Writing – review & editing. **Julie B. Olson-Buchanan:** Investigation, Validation, Writing – review & editing. **Vilde Hoff Bernstrøm:** Conceptualization, Data curation, Formal analysis, Investigation, Validation, Writing – review & editing.

Declaration of competing interest

The authors have no competing interests to declare.

Data availability

Data will be made available on request.

Acknowledgement

The present study is a part of the research project: "Flex-IT – A mixed-method study of cross-domain information technology use in everyday life", which is supported by the Research Council of Norway (RCN; project 296770). WN, TN, VHB and SYA was funded by this funding source. The funders had no role or influence on the research process or outcomes. The funders played no role in the study design, data collection and interpretation of the findings, decision to publish or preparation of the manuscript. We also strongly acknowledge the support and are very thankful for the assistance with the systematic search strategy and execution of the search, from the research librarians at OsloMet – Oslo Metropolitan University.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chbr.2024.100444.

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