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Success factors of global virtual teamwork: A social capital perspective

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ABSTRACT

Global virtual teamwork has emerged as a cornerstone of collaborative teamwork in today's work landscape, characterized by cross-border collaboration using digital technologies. Although research has started to investigate the mechanisms underlying effective teamwork through information and communication technologies (ICTs), an often-neglected dimension is the pivotal social context within which this collaboration unfolds. To address this research gap, this study adopts a social capital lens on teamwork in proposing social capital as a multidimensional mediator between the usage of ICTs and team effectiveness. The research model was tested using questionnaire data from 271 technologically sensitive and aware companies in the DACH region (Germany, Austria, Switzerland). The findings reveal that using multiple ICTs alone does not suffice for effective global virtual teamwork. Therefore, this study highlights the significance of social capital for the effectiveness of global virtual teamwork, which holds significant implications for theory and practice.

1. Introduction

Advances in information and communication technologies (ICTs), coupled with the increasing prevalence of globalization, have driven organizations to rely on digital technologies for globally distributed collaboration—so-called global virtual teamwork (Tavoletti & Taras, 2023). Due to several benefits, such as time and cost savings, talent pooling, and increased team diversity, global virtual teams were already well established in today's workplace before the COVID-19 pandemic (Jimenez, Boehe, Taras, & Caprar, 2017; Kozlowski & Ilgen, 2006; Tavoletti & Taras, 2023). However, global virtual teamwork also presents significant challenges that can threaten team effectiveness. Reliance on ICTs reduces media richness and delays feedback, including an increased risk of miscommunication and misunderstanding (Bilotta et al., 2021; Klitmøller & Lauring, 2013; Mangla, 2021).

Based on the premise that a single medium cannot support the two fundamental communication processes of conveyance (i.e., sharing new information) and convergence (i.e., reaching a common understanding), we introduce the concept of *ICT usage*, which refers to the frequent and strategic use of multiple ICTs (Dennis, Fuller, & Valacich, 2008; Niinimäki, Piri, Lassenius, & Paasivaara, 2012). We propose that high levels of ICT usage will increase team effectiveness, which consists of performance, longevity, and satisfaction (Dennis et al., 2008; Hackman, 1987).

Nevertheless, rather than focusing solely on the characteristics of ICT, it is essential to consider the embeddedness of communication in a social context. Considering the integration of the individual team member into a collective unit within a larger organizational context, we approach global virtual teamwork from a social capital perspective (Kozlowski & Bell, 2013; Kozlowski & Ilgen, 2006). Social capital refers to networks of relationships and the assets embedded within them. It offers several advantages, including increased resource and information exchange, trust, reciprocity, and collaboration (Adler & Kwon, 2002; Adner & Helfat, 2003; Heubeck & Meckl, 2022). Based on the benefits of social capital, we suggest that the level of ICT usage influences team effectiveness as it allows for the use of the intermediate advantages of social capital (Cao, Guo, Vogel, & Zhang, 2016; Staber, 2006). This study is a pioneering effort to examine the role of social capital as a multidimensional mediator between ICT usage and the effectiveness of global virtual teamwork. By integrating social capital into the study of teamwork, we shed light on the importance of social relationships, networks, and assets in global virtual teamwork settings.

Furthermore, previous studies, such as Ahuja (2000), have often failed to consider the multidimensional nature of social capital, disregarding the unique implications of its various dimensions. To investigate the relationship between ICT usage and the effectiveness of global virtual teamwork, we analyze the impact of social capital's structural, cognitive, and relational dimensions. Our research question is, therefore, the following:

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RQ: How do the three dimensions of social capital (structural, cognitive, and relational) influence the relationship between ICT usage and the effectiveness of global virtual teamwork?

To explore the complex relationships between ICT usage, social capital, and team effectiveness in global virtual teamwork settings, we test our research hypotheses on a sample of technologically sensitive and aware companies in the DACH region (Germany, Austria, and Switzerland).

Our study's findings indicate that ICT usage does not necessarily enhance team effectiveness in a global virtual teamwork setting, which stems from a compensatory effect between frequency and variety of ICT usage (Badir, Büchel, & Tucci, 2012; Straube, Meinecke, Schneider, & Kauffeld, 2018; Walther & Parks, 2002). By considering the social context of ICT usage in global virtual teamwork, we demonstrate that structural social capital represents the mechanism through which ICT usage can facilitate the effectiveness of global virtual teamwork (Huysman & Wulf, 2006; Riemer & Klein, 2008). Thus, our findings contribute to the multidimensional discourse on social capital, highlighting the critical role of structural social capital in the complex social web surrounding global virtual teamwork. In this sense, we shift the focus from intercultural team composition (Earley & Mosakowski, 2000; Straube et al., 2018) as well as from a technologically deterministic perspective that focuses on the number of ICTs as determinants of team effectiveness (Boland & Tenkasi, 1995; Huysman & Wulf, 2006) to a perspective that emphasizes the critical role of socialization mechanism in global virtual teamwork (Pianese, Errichiello, & Da Cunha, 2023).

The unique status of structural social capital is also reflected in the absence of intercorrelations with other dimensions of social capital. This finding could also be attributed to the limited ability of ICT usage and intercultural team composition (Hofstede, 2005) to build cognitive and relational social capital (Tsai & Ghoshal, 1998). Nevertheless, while we demonstrate that the positive effect of ICT usage on team effectiveness is driven by structural social capital, our findings highlight that the three dimensions collectively lead to the most beneficial outcomes of ICT usage on team effectiveness in virtual global teamwork. Through these findings, our study significantly advances the theoretical discourse on ICT usage as an antecedent to the effectiveness of global virtual teamwork and highlights the critical role of social capital in facilitating team effectiveness.

The remainder of this article is organized into six sections. Section 2 presents the theoretical background, while Section 3 derives the research model and formulates the hypotheses. Section 4 outlines the research methodology, and Section 5 presents the empirical results. Section 6 discusses their theoretical and practical implications and outlines research limitations and recommendations. Section 7 concludes.

2. Theoretical background

2.1. Global virtual teamwork

Teams consist of "(a) two or more individuals who (b) socially interact (face-to-face or, increasingly, virtually); (c) possess one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment" (Kozlowski & Ilgen, 2006, p. 79). Global virtual teamwork is a form of team organization that has evolved due to globalization and is made possible by advances in ICTs (Tavoletti & Taras, 2023). The proliferation of ICTs in all workplace areas enables virtual teamwork. Composed of members connected through ICTs and distributed across space and time, virtual teams can have different degrees of virtuality, ranging from face-to-face interaction to full ICT-mediated collaboration (Kozlowski & Ilgen, 2006; Rudolph et al., 2021). The global connotation of virtual teamwork implies that the team is culturally diverse and geographically dispersed (Jarvenpaa & Leidner, 1999). Various synonyms exist for global virtual teamwork, such as multinational and multicultural distributed teams, transnational teams, or multinational working groups (Jimenez et al., 2017). In essence, all of these terms share the definition of Jarvenpaa and Leidner (1999) as "…temporary, culturally diverse, geographically distributed, and electronically communicating working groups" (p. 792).

2.2. ICT usage

Spatial distance and technologically mediated communication are fundamental characteristics of global virtual teamwork (Bell & Kozlowski, 2002). To overcome geographical dispersion, global virtual teamwork employs various ICT tools such as telephone, video conferencing, email, or instant messaging (Niinimäki et al., 2012). This notion is consistent with the assumption of media synchronicity theory that "it is usually best to use several media either simultaneously […] or in succession" (Dennis et al., 2008, p. 576).

Media synchronicity theory builds on the widely used media richness theory, which refers to media richness—the ability of a medium to convey information effectively and bring about understanding within a given time frame, depending on factors such as immediate feedback, cues and channels, personalization, and language variety (Daft & Lengel, 1986). In contrast, media synchronicity theory refers to "the extent to which a communication environment encourages individuals to work together on the same activity, with the same information, at the same time; i.e., to have a shared focus" (Dennis, Valacich, Speier, & Morris, 1998, p. 48). Media synchronicity theory identifies five media capabilities that determine the level of synchronicity (Dennis et al., 2008). Effective communication requires a match between these media capabilities and the two fundamental communication processes: *conveyance* (exchanging new information) and *convergence* (a shared understanding) (Dennis et al., 2008; Niinimäki et al., 2012). Unlike media richness theory, media synchronicity theory does not consider particular media more suited for specific tasks. Instead, it emphasizes evaluating tasks in greater detail, considering conveyance and convergence requirements (Parlamis & Dibble, 2019).

According to media synchronicity theory, using media with lower synchronicity should result in better communication performance for conveyance processes, while using media that support higher synchronicity can improve communication performance for convergence processes. Because successful completion of most tasks involving both conveyance and convergence processes, relying on a single medium is inadequate for optimal communication performance. Instead, media synchronicity theory advocates using multiple media simultaneously or in succession (Dennis et al., 2008). We introduce the term *ICT usage* based on media synchronicity theory's assumption that most tasks involve conveyance and convergence processes. A high level of ICT usage can facilitate team effectiveness, encompassing performance, satisfaction, and longevity. What differentiates the concept of ICT usage from the aforementioned theories is its simultaneous consideration of two dimensions: the *frequency* and *variety* of ICT usage. Specifically, ICT usage encompasses commonly used ICTs such as telephone, video conferencing, emails, and instant messaging (Niinimäki et al., 2012). Thus, ICT usage includes technologies such as videoconferencing that are considered rich or synchronous according to the principles of media richness theory or media synchrony theory, as well as less rich or asynchronous ICTs such as emails (Kirkman, Cordery, Mathieu, Rosen, & Kukenberger, 2013).

2.3. Social capital

Social capital benefits individuals, teams, and organizations by providing access to valuable resources within their networks (Coleman, 1988; Staber, 2006). Although various theoretical perspectives on social

capital have emerged, they share two central commonalities. First, social capital is commonly viewed as a resource (Bourdieu, 1986; Lin, 2001; Nahapiet & Ghoshal, 1998; Putnam, Leonardi, & Nanetti, 1994). Second, unlike other forms of capital, such as economic capital, social capital arises from social relations and shared belief systems (Bourdieu, 1986; Coleman, 1988; Lin, 2001; Nahapiet & Ghoshal, 1998).

Unlike previous measurement models, social capital is no longer considered a one-dimensional factor but a multidimensional approach (Fornoni, Arribas, & Vila, 2011). Three dimensions of social capital that shape individual and collective action dominate the literature (Heubeck, 2023). Nahapiet and Ghoshal (1998) distinguish social capital into structural, relational, and cognitive dimensions. First, *structural social capital* refers to the overall network connection, including who is connected and how they are connected. Central elements of structural social capital include network ties, the arrangement of the network (e.g., density, connectivity, or hierarchy), and the capacity to leverage social capital (i.e., the transferability of social capital to different contexts). Second, *cognitive social capital* relates to shared interpretations, representations, and systems of meaning, shaping the absorption and processing of information and the creation of knowledge (Nahapiet & Ghoshal, 1998). It becomes evident through shared languages, codes, and narratives that reflect the retention of past experiences and the construction of new meanings (Staber, 2006). Third, *relational social capital* pertains to the characteristics and content of relationships, encompassing intangible assets developed and utilized through these connections. Facets of relational social capital include trust, norms, obligations, expectations, identity, and identification (Nahapiet & Ghoshal, 1998). Although the three dimensions of social capital are analyzed separately, they are highly interconnected (Nahapiet & Ghoshal, 1998).

3. Hypotheses development

We propose a research model at the team level. As illustrated in Fig. 1, we focus on the mediation effect of social capital between ICT usage and team effectiveness. Effective ICT usage encompasses the frequent utilization of multiple ICTs (Dennis et al., 2008). By adopting a social capital perspective, we argue that ICT usage influences team effectiveness through the intermediate benefits of social capital (Cao et al., 2016; Staber, 2006). Considering the social and relational complexities inherent in global virtual teamwork and the prevailing social landscape, social capital offers a valuable understanding of the functioning of social networks, including teams (Cao et al., 2016; Coleman, 1988).

We adopt Hackman (1987) conceptualization, designed explicitly for entrepreneurial work groups, to measure team effectiveness. It evaluates team effectiveness based on three criteria. *Performance* refers to whether the team's output meets or surpasses the performance standards of recipients or evaluators (Hackman, 1987). *Longevity* assesses whether the social processes employed by teams during their work enhance their members' ability for future collaboration (Wageman, Hackman, & Lehman, 2005). *Satisfaction* evaluates whether group experiences fulfill personal needs rather than frustrate them. This inclusive definition of team effectiveness incorporates social and personal criteria, deviating from traditional approaches that rely solely on objective performance indicators. Objective criteria were deliberately avoided due to the limited applicability of reliable and valid measures and the greater reliance of future teams on evaluations of group performance rather than objective standards (Hackman, 1987).

Effective teamwork often involves concurrently utilizing multiple communication media (Watson-Manheim & Bélanger, 2007). According to Dennis et al. (2008), employing multiple ICTs simultaneously or sequentially is more effective than relying on a single communication medium. This is because a single medium may not adequately support the processes of task convergence and conveyance (Dennis et al., 2008; Niinimäki et al., 2012). Since most tasks and activities involve convergence and conveyance processes, utilizing multiple communication media will likely enhance performance (Parlamis & Dibble, 2019). Furthermore, using only one communication medium can undermine group cohesion (Knight, Pearson, & Hunsinger, 2008), potentially reducing satisfaction and loyalty. Based on these arguments, we propose the following hypothesis:

H1: ICT usage has a positive effect on team effectiveness in global virtual teamwork.

Communication, encompassing ICT usage, is inherently embedded within a social context characterized by interactions and interpersonal relationships (Cao et al., 2016). Thus, we posit that ICT usage is vital in global virtual teamwork by shaping social capital. Social capital can be viewed as an outcome of daily interactions, with frequent interactions fostering the development of structural social capital (Cao, Vogel, Guo, Liu, & Gu, 2012). Additionally, regular communication nurtures confidence in social relationships, facilitating the sharing of mutual understanding and trust (Badir & O'Connor, 2015; Bstieler, 2006; Lee, Saunders, Panteli, & Wang, 2021; Paulraj, Lado, & Chen, 2008). Based on these arguments, we propose the following hypotheses:

H2: ICT usage has a positive effect on social capital in global virtual teamwork.

H2a: ICT usage has a positive effect on structural social capital in global virtual teamwork.

H2b: ICT usage has a positive effect on cognitive social capital in global virtual teamwork.

H2c: ICT usage has a positive effect on relational social capital in global virtual teamwork.

Previous research suggests that social capital is likely to promote team effectiveness (e.g., Andersson, Forsgren, & Holm, 2002; Castro & Roldán, 2013; Chang & Chuang, 2011; Huang, Chen, Ou, Davison, & Hua, 2017; Nahapiet & Ghoshal, 1998; Park & Luo, 2001; Sun, Fang, Lim, & Straub, 2012; Tsai & Ghoshal, 1998). Network ties, a key measure of structural social capital, not only connect individuals but also serve as channels for valuable resources, including knowledge and information (Castro & Roldán, 2013; Huang et al., 2017; Nahapiet & Ghoshal, 1998; W. Wu, 2008). Dense network ties offer several benefits that contribute to improved performance and satisfaction. Social interactions facilitated by network ties reduce the effort and time required for information exchange (Chang & Chuang, 2011; Huang et al., 2017). Moreover, high network density enhances the social aspects of jobs,

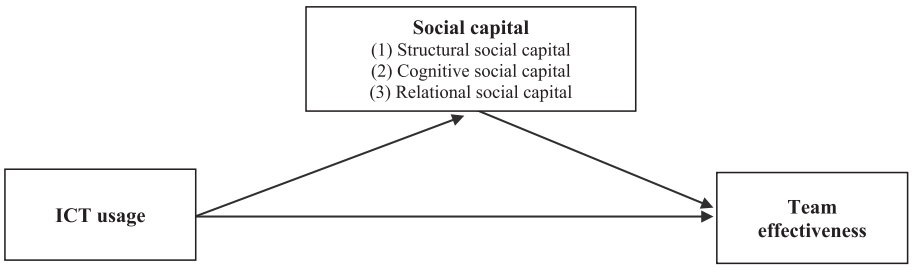

Fig. 1. Research model.

increasing job satisfaction (Flap & Völker, 2001; Yamaguchi, 2013). Cognitive social capital promotes resource exchange simultaneously (Villena, Revilla, & Choi, 2011). This shared cognitive framework fosters synergies and reduces conflicts, ultimately enhancing operational and strategic performance (Jones & Taylor, 2012; Nahapiet & Ghoshal, 1998; Villena et al., 2011). Furthermore, a shared language and common interpretation scheme facilitated by cognitive social capital prevent misunderstandings and reduce cognitive effort, contributing to satisfaction (Huang et al., 2017; Sun et al., 2012). Cognitive social capital also promotes longevity through shared visions and goals (M. Wu, Coleman, Abdul Rahaman, & Edziah, 2020; W. Wu, 2008). Finally, the relational dimension of social capital grants access to resources and facilitates their exchange due to greater trust (Castro & Roldán, 2013; Uzzi, 1996). Trust reduces information asymmetries in information exchange by mitigating opportunistic behavior (Castro & Roldán, 2013; Raghupathi & Benbunan-Fich, 2020). Trust-based relationships foster effective team performance by establishing predictable actions and reinforcing cooperation (Cao et al., 2012; Castro & Roldán, 2013; Liu, 2012; Raghupathi & Benbunan-Fich, 2020; Tsai & Ghoshal, 1998; W. Wu, 2008). Similarly, the effect of trust on satisfaction sets expectations for a satisfactory outcome (Gefen & Straub, 2003; Huang et al., 2017). Trust and reciprocity ensure resource exchange through mutual indebtedness, and individuals in reciprocal relationships tend to be more satisfied due to the expectation of equivalent returns in the future (Huang et al., 2017; McLure Wasko & Faraj, 2005). Based on this reasoning, we propose the following hypotheses:

H3: Social capital has a positive effect on team effectiveness in global virtual teams.

H3a: Structural social capital has a positive effect on team effectiveness in global virtual teams.

H3b: Cognitive social capital has a positive effect on team effectiveness in global virtual teams.

H3c: Relational social capital has a positive effect on team effectiveness in global virtual teams.

Building upon the previous hypotheses, we propose that social capital strengthens the relationship between ICT usage and team effectiveness. Focusing on the characteristics of ICTs is insufficient, as it is essential to consider the embeddedness of communication in a social context. Therefore, organizations face the challenge of cultivating social capital, which can be achieved by facilitating new connections among employees, providing dedicated time and space for relationship building, and establishing explicit norms, culture, language, and a shared purpose that influence the formation of team members' values, goals, and expectations (Ali-Hassan, Nevo, & Wade, 2015; Ghoshal & Moran, 1996; Lesser & Storck, 2001).

Studies have demonstrated that social capital mediates the relationship between ICT usage and performance (Ali-Hassan et al., 2015; Cao et al., 2012; Kamboj, Kumar, & Rahman, 2017). Furthermore, social capital has also been shown to mediate the relationship between ICT usage and satisfaction (Chan, 2015; Fu, Sawang, & Sun, 2019; Pang, 2018). By increasing their involvement through ICT usage in both strong and weak social networks, individuals gained access to valuable resources, opportunities, and supportive communities, ultimately enhancing their psychological state (Chen & Li, 2017; Pang, 2018). The preceding discussion underscores the significance of incorporating social capital for the effectiveness of virtual and global virtual teamwork due to its intrinsic connection to the social environment. In light of this rationale, we put forward the following hypothesis.

H4: Social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.

H4a: Structural social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.

H4b: Cognitive social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.

H4c: Relational social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.

4. Methodology

To investigate the complex relationships between ICT usage, social capital, and team effectiveness in global virtual teamwork settings, we collected data from Industry 4.0 due to their sensitivity and awareness toward technologies. The term "Industry 4.0" refers to companies that successfully implemented "DT [digital transformation] of manufacturing, in which interconnected processes and equipment allow the mass customisation of products and responses to market demands" (Grooss, Presser, & Tambo, 2022, p. 1). We focused on Industry 4.0 companies headquartered in the DACH region (Germany, Austria, and Switzerland), as the region has a significant presence of technologically advanced companies with a proactive approach to digital transformation (Heubeck, 2023; Schneider, 2018). To prevent cultural biases in respondents' perceptions, we restricted the sample to individuals with a cultural background from the Germanic Europe cluster, comprising Germany, Austria, Netherlands, and Switzerland. In addition to linguistic similarities, this cluster shares cultural values such as order, straightforwardness, honesty, and loyalty, which play an essential role in society (V. Gupta & Hanges, 2006). Initially, we compiled a company list using the member lists available on the websites of the three industry associations forming *Platform Industry 4.0*. To accurately represent the Industry 4.0 context, we researched the industry sector codes for these companies. We used Bureau van Dijk's *Amadeus* database, containing financial and business data from approximately 21 million European public and private companies (Bureau van Dijk, 2023), to generate a comprehensive list of companies operating in the selected industries within the DACH region, along with their contact information.

In September and October 2022, we emailed questionnaire invitations to 49,448 companies using the Qualtrics web-based survey tool. We utilized the key informant approach, with each company represented by someone with experience and knowledge of global virtual teamwork. Non-respondents received reminders after three weeks. The questionnaire consisted of two parts. The first part collected information on respondent, team, and company characteristics, while the second part measured the study constructs using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Certain items were reverse-coded to omit response bias (Price, 1997). Following the key informant approach, all items were based on the individual perceptions of company representatives in the context of global virtual teamwork. The respondents were requested to respond to the questions based on their experiences related to global virtual teamwork.

To ensure respondent validity, respondents were provided definitions of teamwork and global virtual teamwork to ensure response validity. They were then asked three questions: (1) if they worked with team members from other cultures, (2) if team members were located in different countries, and (3) if their team primarily communicated through ICTs. Respondents answering 'no' to any of these questions were unable to proceed with the remaining questionnaire. This was done to guarantee that the collected data pertains solely to experiences with global virtual teamwork. A total of 1082 company representatives answered the questionnaire, giving a response rate of 2.19%. Of the 1082 questionnaires received, 811 were excluded from the analysis for various reasons: firstly, 362 were irrelevant to the focus of the study on global virtual teamwork; secondly, the remaining questionnaires were either not fully completed, or the company respondents did not have a cultural background from the DACH region. The remaining 271 questionnaires were analyzed to ensure a culturally homogenous sample belonging to the so-called Germanic Europe Cluster, encompassing Germany, Austria, the Netherlands, and Switzerland (V. Gupta & Hanges, 2006). This cultural limitation does not mean that respondents only work with other team members from the Germanic Europe Cluster. The pertinent literature supports the adequacy of this sample size for analysis (Comrey & Lee, 1992; Osborne & Costello, 2019).

The final sample consisted of 271 company representatives, with respondents predominantly being German (87.45%), primarily male

(70.48%), and holding university degrees (75.65%). Our sample is a good representation of the Industry 4.0 population (S. Gupta, Modgil, Gunasekaran, & Bag, 2020). The respondents worked in different types of teams, including management, work, project, and parallel teams (S. G. Cohen & Bailey, 1997). Most respondents (66.79%) had the opportunity to meet face-to-face before starting global virtual teamwork. Table 1 provides an overview of the respondents' demographic characteristics.

Following established guidelines for questionnaire development, translation, and validation (e.g., Harkness, Pennell, & Schoua-Glusberg, 2004; Tsang, Royse, & Terkawi, 2017), we conducted a thorough literature search to identify validated measurement scales for the study variables. As the relevant literature was predominantly in English and the respondents were German-speaking, we decided to translate the validated scales into German using a recommended forward and backward translation process.

Initially, two of the authors (native German speakers) and a professional academic translator (native English speaker) independently translated the items into German (Beaton, Bombardier, Guillemin, & Ferraz, 2007; Guillemin, Bombardier, & Beaton, 1993). Subsequently, these translations were independently back-translated from German to English by all three parties (Beaton et al., 2007; Guillemin et al., 1993; Tsang et al., 2017). The forward and backward translations were then thoroughly reviewed and discussed among all the authors to ensure "semantic, idiomatic, experiential, and conceptual equivalence" (Tsang et al., 2017, 84). Minor discrepancies were resolved, and a consensus was reached on the final translations of the items.

The translated and validated questionnaire was subjected to a pilot test involving two sample respondents from the study's target population. Additionally, the third author, an expert in the field, provided additional feedback. The three experts reviewed the questionnaire and provided minor comments on the formulation of the questions. After incorporating their feedback and making necessary adjustments, all experts agreed on the questions' comprehensibility.

4.1. Variable measurements

Appendix A summarizes the measurement scales for latent constructs in their original English version. *Team effectiveness* was assessed using the scale developed by Wageman et al. (2005). According to their definition of team effectiveness, the respective items can be grouped into three dimensions: performance, satisfaction, and longevity of the team, as defined by Hackman (1987). The *social capital* scale used in this study is from Sun et al. (2012) and has been modified to align with the context of teamwork. *ICT usage* was measured using the scale developed by Eisenberg, Glikson, and Lisak (2021), which employs a Likert scale ranging from 1 ("did not use at all") to 5 ("used to a great extent"). The mean response on all four items of ICT usage was calculated to capture the frequency of diverse ICT usage in global virtual teamwork, indicating frequent and diverse communication.

Control variables were incorporated at the firm, team, and respondent levels. First, *firm size* was the natural logarithm of the number of current employees in the firm. Second, *team size* captured the number of team members. Third, *team age* represented the duration of the team's existence, including the period before the respondent joined. Fourth, *team familiarity* assessed whether team members had the opportunity to get to know each other through face-to-face interaction before engaging in global virtual teamwork (yes = 0; no = 1). Fifth, *team type* was classified based on S. G. Cohen and Bailey (1997) framework, encompassing four categories: work teams, parallel teams, project teams, and management teams. Sixth, *respondent age* indicated the current age of the respondent. Seventh, *respondent sex* was a dummy variable based on the German civil status law, which recognizes more than two sexes (Federal Anti-Discrimination Agency, 2018); our survey also included an option to select "diverse" for intersex people (male = 0; female = 1; no respondents identified as diverse). Eighth, *respondent team tenure* measured the number of months the respondent had been a member of this team. Ninth, *respondent education* captured the level of education attained by the respondent (no degree = 0; professional education = 1; applied scientific degree = 2; university degree = 3). Finally, *respondent nationality* was coded as follows: German = 1; Austrian = 2; Swiss = 3.

4.2. Factor analysis, construct validity, and reliability

Factor analysis was conducted using *IBM SPSS Statistics Version 29*. Principal axis factor analysis was employed for each theoretically proposed factor, utilizing varimax rotation and Kaiser normalization. The appropriateness of factor analysis was assessed through the Bartlett test of sphericity, the measure of sample adequacy (MSA) criterion, and the Kaiser-Mayer-Olkin (KMO) criterion (Hair, Black, Babin, & Anderson, 2014). The determination of the number of extracted factors was based on the Kaiser-Guttman (KG) criterion, the scree test (Thompson, 2004), and the latent root criterion, which considers factor loadings >0.40 and eigenvalues of at least 1 (Gower, 1966). Factors consisting of a minimum of three items were retained (Hair et al., 2014). Reliability was assessed using Cronbach's alpha, with values >0.70 indicating acceptable reliability (Hair et al., 2014). Validity was evaluated based on the average variance extracted (AVE) and the Fornell-Larcker ratio (FLR), with an AVE >0.50 and an FLR below 1 indicating satisfactory validity (Fornell

Table 1
Demographic characteristics of respondents.

Variable			Frequency	%	Cumulated %
Respondent sex	Male		191	70.48	
	Female		80	29.52	100.00
Respondent education	No degree		8	2.95	
	Professional education		29	10.70	13.65
	Applied scientific degree		29	10.70	24.35
	University degree		205	62.00	100.00
	Of which	*Bachelor's degree*	*29*	*10.70*	
		Master's degree	*48*	*17.71*	
		Diploma	*105*	*38.75*	
		PhD	*23*	*8.49*	
Respondent nationality	German		237	87.45	
	Austrian		21	7.75	95.20
	Swiss		13	4.80	100.00
Team type	Work team		88	32.47	
	Parallel team		34	12.55	45.02
	Project team		59	18.08	63.10
	Management team		100	36.90	100.00
Team familiarity	Yes		181	66.79	
	No		90	33.21	100.00

Notes $N = 271$.

& Larcker, 1981). Convergent validity could also be established if the AVE fell between 0.40 and 0.50 and Cronbach's alpha coefficients exceeded 0.60 (Fornell & Larcker, 1981).

The factor analysis results are summarized in Appendix B, with detailed explanations provided below. The factor analysis for social capital met all the defined criteria. The three-factor solution aligned with the theoretically proposed dimensions of structural, cognitive, and relational social capital, extracting one factor for each dimension. The measurement scale for relational social capital underwent a slight modification, as Item 2 was removed to enhance the factor's reliability. The factor analysis for team effectiveness also satisfied all the defined criteria. Three factors were initially extracted for the performance dimension, but Item 3, which loaded onto a separate factor, was subsequently eliminated from the scale. Consequently, team performance comprised two factors. Regarding team satisfaction, three factors were retained, although Item 4 was excluded from the scale as it did not load onto any of the extracted factors. Despite the second factor comprising only two items, it was retained for further analysis due to its contribution to content validity and fulfillment of quality criteria (Gosling, Rentfrow, & Swann, 2003). Finally, two factors were extracted for team longevity, and no modifications were made to the measurement scale.

To address common method bias, various measures recommended in the literature were implemented (MacKenzie & Podsakoff, 2012; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, social desirability bias was minimized by ensuring participant confidentiality, clarifying that no additional personal data would be recorded through the online questionnaire, and guaranteeing that the statistical methods employed would not enable individual respondent identification. As previously mentioned, the questionnaire underwent a pilot test to ensure the clarity and comprehensibility of the questions (MacKenzie & Podsakoff, 2012). Different scales and reverse-coded items were also used to mitigate common method bias (MacKenzie & Podsakoff, 2012; Podsakoff et al., 2003). Harman's single-factor test, which loads all items measuring latent variables onto a single common factor, was employed to examine potential common method bias. The single factor explained a total variance of 26.98%, well below the commonly accepted threshold of 50% (Harman, 1976; Podsakoff et al., 2003). Based on the outlined procedure and the assessment using Harman's test, it is unlikely that common method bias significantly influenced the research data in this study.

4.3. Analysis method

The proposed research model posited that social capital acts as a strengthening mediator in the relationship between ICT usage and team effectiveness. The bootstrapping method was employed using Hayes' (2021) PROCESS macro for SPSS to test this model. Confidence intervals were calculated based on 5000 bootstrap samples, and heteroscedasticity-robust inference HC4 (Cribari-Neto) was utilized for standard errors. The robustness of significant mediation effects was further assessed using Sobel's test (Baron & Kenny, 1986; Sobel, 1982). According to Baron and Kenny (1986), mediation is established if (1) the independent variable significantly impacts the mediating variable and (2) the mediating variable significantly affects the dependent variable in the full regression model. It should be noted that a significant total effect of the independent variable on the dependent variable is not always necessary for mediation (Hayes, 2009; Zhao, Lynch, & Chen, 2010).

5. Results

Table 2 presents descriptive statistics and bivariate results, while Appendix C displays regression results with social capital as the independent and mediating variable. Regression results for the three social capital dimensions are presented in Appendix D. The effect sizes and confidence intervals obtained through bootstrapping, as well as Sobel's test results, are compiled in Appendix E. A summary of the hypothesis test results can be found in Table 3.

The presence of multicollinearity was examined, and the maximum variance inflation factor of 1.411 was found to be well below critical values (Johnston, Jones, & Manley, 2018; Menard, 2002). Effect sizes are classified according to J. Cohen (1988) criteria: $\beta > 0.02$ (weak effect), $\beta > 0.15$ (moderate effect), and $\beta > 0.35$ (strong effect). Significance levels are ranked as follows: $p < 0.001$ (extremely significant), $p < 0.01$ (highly significant), $p < 0.05$ (significant), and $p > 0.05$ (insignificant) (Wooldridge, 2019).

Hypothesis 1 posited that ICT usage increases team effectiveness. However, the findings do not support this hypothesis as the direct effect is not significant (H1: $b = 0.061$, $se = 0.046$, $p = 0.305$). Thus, Hypothesis 1 is rejected.

Hypothesis 2 proposed that ICT usage increases social capital. The results support the general benefits of ICT usage for social capital, as it shows a highly significant and moderate effect (H2: $b = 0.217$, $se = 0.071$, $p = 0.003$). The inclusion of ICT usage in the model improves the explanatory power by 3.6%. Thus, Hypothesis 2 is supported.

Hypotheses 2a–c further conjectured that ICT usage positively affects the three social capital dimensions. The results provide support for Hypothesis 2a, indicating an extremely significant and strong positive effect of ICT usage on structural social capital (H2a: $b = 0.583$, $se = 0.104$, $p < 0.001$). However, the effect of ICT usage on cognitive social capital is negative and insignificant (H2b: $b = -0.019$, $se = 0.117$, $p = 0.870$, and the effect on relational social capital is positive but insignificant (H2c: $b = 0.086$, $se = 0.091$, $p = 0.345$). Therefore, Hypothesis 2a is supported, while Hypotheses 2b and 2c are rejected.

Hypothesis 3 suggested that social capital positively affects team effectiveness, and the results support this hypothesis with a strong positive and extremely significant coefficient (H1: $b = 0.707$, $se = 0.048$, $p < 0.001$). Including the study variables in the regression model significantly increases explanatory power from 0.031 to 0.514.

Relatedly, Hypothesis 3a–c proposed that the three social capital dimensions increase team effectiveness. The results support this hypothesis for each dimension, indicating that structural social capital has an extremely significant and moderate effect (H3a: $b = 0.190$, $se = 0.031$, $p < 0.001$), cognitive social capital has an extremely significant and moderate effect (H3b: $b = 0.174$, $se = 0.029$, $p < 0.001$), and relational social capital has an extremely significant and strong positive effect (H3c: $b = 0.343$, $se = 0.036$, $p < 0.001$) on team effectiveness.

Hypothesis 4 consolidated all previous hypotheses, proposing that social capital acts as a strengthening mediator between ICT usage and team effectiveness. The bootstrapping results confirm a highly significant and moderately positive indirect effect of ICT usage on team effectiveness via social capital (H4: $b = 0.153$, $se = 0.069$, 99% *CI*: 0.023, 0.290). Sobel's test also confirms the significance of this indirect effect ($b = 0.148$, $p = 0.004$). The total effect of ICT usage on team effectiveness is highly significant and positive ($b = 0.214$, $se = 0.069$, $p = 0.002$), while the direct effect is insignificant ($b = 0.061$, $se = 0.046$, $p = 0.190$). Thus, the results support Hypothesis 4 by confirming the indirect-only mediation effect of ICT usage on team effectiveness via social capital.

Three additional hypotheses were proposed to investigate this indirect effect further, suggesting the relationship between ICT usage and team effectiveness through the three social capital dimensions. The data confirm Hypothesis 4a, showing that structural social capital acts as a strengthening mediator between ICT usage and team effectiveness (H4a: $b = 0.111$, $se = 0.026$, 99% *CI*: 0.052, 0.189). Sobel's test provides additional support for Hypothesis 4a ($b = 0.153$, $p = 0.003$). However, the data do not support Hypotheses 4b and 4c. The indirect effect of ICT usage on team effectiveness via cognitive social capital is negative yet insignificant (H4b: $b = -0.003$, $se = 0.021$, 90% *CI*: −0.037, 0.030). Sobel's test confirms the insignificance of this effect ($b = -0.003$, $p = 0.872$). Similarly, the indirect effect of ICT usage on team effectiveness through relational social capital is positive yet insignificant (H4c: $b = 0.029$, $se = 0.031$, 90% *CI*: −0.037, 0.030). Sobel's test confirms the

Table 2
Descriptive statistics and bivariate results.

	Variable	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Team effectiveness	0.010	0.527	1															
2	Social capital	0.022	0.523	0.702***	1														
3	Structural social capital	0.042	0.848	0.373***	0.608***	1													
4	Cognitive social capital	0.008	0.864	0.359***	0.629***	0.029	1												
5	Relational social capital	0.017	0.804	0.590***	0.634***	0.100	0.122*	1											
6	ICT usage	3.705	0.524	0.194**	0.209***	0.373***	−0.030	0.047	1										
7	Firm size	4.596	1.950	−0.052	−0.115	−0.113	−0.028	−0.075	−0.004	1									
8	Team size	17.625	26.847	0.021	0.026	0.124*	−0.074	−0.001	0.105	0.105	1								
9	Team age	70.033	89.302	0.041	0.051	0.120*	−0.038	0.014	0.168**	0.028	0.225***	1							
10	Team familiarity	0.332	0.472	−0.069	−0.151*	−0.227***	−0.031	−0.023	−0.070	0.148*	−0.019	−0.035	1						
11	Team type	2.594	1.279	−0.079	−0.073	−0.008	−0.054	−0.075	0.126*	0.056	0.191**	0.025	−0.169**	1					
12	Respondent age	48.435	10.426	0.128*	0.079	−0.050	0.079	0.123*	−0.020	−0.076	0.100	0.117	−0.086	0.033	1				
13	Respondent sex	0.295	0.457	−0.022	−0.036	−0.017	0.027	−0.080	−0.099	−0.032	−0.138*	−0.084	0.162**	−0.092	−0.226***	1			
14	Respondent education	2.590	0.797	−0.010	0.034	0.015	0.037	0.010	0.035	0.016	0.055	0.001	0.048	0.091	0.001	−0.104	1		
15	Respondent nationality	1.173	0.490	−0.023	−0.065	−0.084	−0.005	−0.032	0.085	0.061	−0.047	0.011	0.006	0.024	−0.053	−0.031	0.012	1	
16	Respondent team tenure	87.915	99.668	0.042	0.138*	0.114	0.036	0.110	0.089	−0.129*	0.078	0.374***	−0.160**	0.100	0.338***	−0.192**	−0.089	0.072	1

Notes: SD = Standard deviation; ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; $N = 271$.

Table 3
Summary of hypotheses test results.

Hypothesis		Result
H1	ICT usage has a positive effect on team effectiveness in global virtual teamwork.	Rejected
H2	ICT usage has a positive effect on social capital in global virtual teamwork.	Supported
H2a	ICT usage has a positive effect on structural social capital in global virtual teamwork.	Supported
H2b	ICT usage has a positive effect on cognitive social capital in global virtual teamwork.	Rejected
H2c	ICT usage has a positive effect on relational social capital in global virtual teamwork.	Rejected
H3	Social capital has a positive effect on team effectiveness in global virtual teams.	Supported
H3a	Structural social capital has a positive effect on team effectiveness in global virtual teams.	Supported
H3b	Cognitive social capital has a positive effect on team effectiveness in global virtual teams.	Supported
H3c	Relational social capital has a positive effect on team effectiveness in global virtual teams.	Supported
H4	Social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.	Supported
H4a	Structural social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.	Supported
H4b	Cognitive social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.	Rejected
H4c	Relational social capital mediates the relationship between ICT usage and team effectiveness in global virtual teams.	Rejected

insignificance of this effect ($b = 0.029$, $p = 0.349$). A summary of the hypothesis test results can be found in Table 3.

6. Discussion and contributions

In the current age of digitalization and globalization, the evolving work landscape necessitates understanding how successful global virtual teamwork can be achieved with the help of ICTs. Due to the embeddedness of teams in a social context, where social interactions and interpersonal relationships are essential, it is not sufficient to study only the use of ICTs. Research requires a profound comprehension of how recognizing social context can leverage ICTs to increase the effectiveness of global virtual teamwork.

To fill this research gap, we employed social capital, which distinguishes between the structural, cognitive, and relational dimensions, as multidimensional mediators in the relationship between ICT usage and team effectiveness, encompassing performance, satisfaction, and longevity (Hackman, 1987; Nahapiet & Ghoshal, 1998).

6.1. Theoretical contributions

The empirical findings enhance our understanding of the mediating effects of individual social capital dimensions between adopting ICTs and team effectiveness. From these results, we derive four main theoretical contributions and managerial implications, which are summarized in Table 4.

First, our findings are consistent with previous research (Parlamis & Dibble, 2019; Straube et al., 2018) by showing that in global virtual teamwork, ICT usage advice to use multiple ICTs frequently does not increase team effectiveness. One potential explanation for this finding is the compensatory effect between media richness and communication intensity, as defined by Straube et al. (2018) as "a subjective perception of the informational value that is conveyed through communication" (p. 689). Compensatory adaptation theory suggests that ICTs interfere with the successful transmission of messages (Kock, 1998; Straube et al., 2018). Rather than relying on richer ICTs, these limitations can be overcome through intensive communication activities related to information richness. For example, when using email, it is possible to explain a complex problem in more detail. Since intensive communication using rich ICTs can be perceived as burdensome by stakeholders, the choice of richer ICTs is not inherently better, as efficient communication is characterized by the lowest possible costs (Badir et al., 2012; Straube et al., 2018; Walther & Parks, 2002). Accordingly, combining high media richness and low communication intensity or high communication intensity and low media richness is considered the most advantageous. Applied to the concept of ICT usage, this implies that, contrary to initial assumptions, the frequent use of different ICTs does not necessarily lead to increased team effectiveness. Conversely, some participants may perceive it as a burden. Rather than focusing on the variety of ICTs utilized, directing attention toward the richness of the individual medium is more beneficial. In the previous conception of ICT usage, the individual ICT were considered to be of equal value. Nevertheless, the compensatory adaptation theory explains that individual ICTs are differentially suited to increasing the effectiveness of global virtual teams, depending on the frequency of their use. According to the compensatory adaptation theory, a balance should be struck between the frequency and media richness of ICT. In this case, this implies that for richer media (e.g., video conferencing), global virtual team members communicate less frequently. Conversely, for less rich media (e.g., e-mail), it is important to communicate more frequently.

The insignificant result challenges the initial assumptions regarding

Table 4
Summary of main findings and their theoretical contributions and managerial implications.

Relationship	Finding	Theoretical contribution	Managerial implications
ICT usage → team effectiveness	High ICT usage does not increase team effectiveness in global virtual teams.	There is a compensating effect between the frequency and media richness of ICTs used.	Global virtual teams can enhance team effectiveness by: • Communicating less frequently with richer ICT (e.g., video-conferencing) or • Communicating more frequently with less rich ICT (e.g., e-mail).
ICT usage → social capital	ICT usage only increases structural social capital in global virtual teams; building cognitive and relational social capital is only possible to a limited extent in global virtual teams	There are several reasons why the construction of cognitive and relational social capital in global virtual teams is impeded. These include: • Different cultural backgrounds of team members, • A technologically deterministic perspective on ICT usage, and • A lack of focus on planning and innovating organizational structures, management practices, and resources that promote sharing norms, beliefs, and values.	Global virtual teams can build cognitive and relational social capital through organizational redesign. This can be achieved by: • Utilizing brokers to connect individuals and • By providing time and a shared physical space for global virtual teamwork.
Social capital → team effectiveness	Social capital increases team effectiveness in global virtual teamwork.	Team effectiveness is enhanced when all dimensions of social capital are considered, emphasizing the direct impact of each dimension.	

the relationship between ICT usage and team effectiveness. It underscores the importance of considering the social context, which shapes the ability of communication to increase the effectiveness of global virtual teams. This finding aligns with this study's social capital perspective. Besides social capital, team composition also shapes social context regarding demographic characteristics (Straube et al., 2018). In the case of global virtual teams, as in the current study, this also includes their interculturality. As already mentioned, social context determines the type of communication. Building on the findings of Straube et al. (2018), it can be concluded that such teams suffer from a high expression of ICT usage but instead benefit from a balanced communication mix between the frequency and media richness of ICTs used. Consequently, the social context cannot be disregarded when assessing the effectiveness of ICTs.

Second, the partial mediation of the relationship between ICT usage and team effectiveness suggests that the contribution of ICT to social capital formation is limited (e.g., D. Cohen & Prusak, 2001; Riemer & Klein, 2008). Consistent with prior research, most ICT applications are primarily suited for building structural social capital (Huysman & Wulf, 2006; Riemer & Klein, 2008). These applications provide a technological infrastructure that enables human actors to connect, communicate, and collaborate, thereby offering the necessary infrastructure and creating opportunities conducive to knowledge exchange (Huysman & Wulf, 2006). On the contrary, ICT effectiveness fosters cognitive and relational social capital to a limited extent (Huysman & Wulf, 2006; Riemer & Klein, 2008). Research examining ICT's role in enhancing cognitive and relational social capital is scarce (Huysman & Wulf, 2006).

There are several reasons for the insignificance of ICT usage–cognitive social capital and ICT usage–relational social capital relationships. One potential explanation for this phenomenon is the intercultural composition of global virtual teams manifested in diverse values and norms (Hofstede, 2005). The study participants confirmed that they collaborate with individuals from diverse cultures across various countries, primarily through ICTs. The presence of individuals from different cultural backgrounds, or more generally diverse backgrounds, impairs the development of cognitive social capital regarding shared understanding (Earley & Mosakowski, 2000; Straube et al., 2018). This, and the tendency to trust within the team, subsequently affects the team's performance and effectiveness (Earley & Mosakowski, 2000). However, the current research model does not account for the degree to which interculturality is emphasized. For future research, it would be beneficial to explicitly incorporate the degree of interculturality.

Another reason for the insignificance of ICT usage–cognitive social capital and ICT usage–relational social capital relationships is the technologically deterministic view of ICTs. Huysman and Wulf (2006) argue that most ICTs focus neither on interpersonal relationships nor reducing the cognitive distance between the actors. A socio-technical perspective may be more appropriate for assessing how social capital can design ICTs than considering social capital as a result of ICT usage. This perspective might provide significant results because, according to the socio-technical perspective, ICTs can only be used for knowledge sharing if the design of ICTs preserves the integrity of the community in which the knowledge is embedded (Boland & Tenkasi, 1995; Huysman & Wulf, 2006). This study's participants corroborated that they primarily collaborate through the use of ICTs. However, the current research model does not consider how these ICTs facilitate the formation of relational and cognitive capital. It would be beneficial to conduct further research with a more precise query on the properties of the ICT used.

Finally, it can be argued that the narrow focus on ICT usage may be responsible for insufficient cognitive and relational social capital development. Companies should not only focus on the amount of ICT used but also on planning and innovating organizational structures, management practices, and resources to support the transition of companies in the post-COVID-19 pandemic era. According to Pianese et al. (2023), forming trusting relationships—a component of relational social capital—is also possible in a virtual context. However, to achieve this, organizations must implement effective socialization mechanisms that promote sharing norms, beliefs, and values among employees. The function of leaders is to encourage innovative processes and cultivate trustworthy relationships among individuals who may not have met in person (Pfister, 2009; Pianese et al., 2023). These measures are essential for coherence and consistency in the attitudes and behaviors of team members to create a shared "culture of control" (Pianese et al., 2023, p. 337).

Third, this study provides empirical support for the positive impact of increased social capital on team effectiveness, which is consistent with the findings from previous studies (e.g., Andersson et al., 2002; Castro & Roldán, 2013; Chang & Chuang, 2011; Huang et al., 2017; Nahapiet & Ghoshal, 1998; Park & Luo, 2001; Sun et al., 2012; Tsai & Ghoshal, 1998). Thus, our study challenges the research stream that argues for a negative (e.g., Rowley, Behrens, & Krackhardt, 2000) or a curvilinear relationship (e.g., Villena et al., 2011) between the expression of social capital and performance. Concerns that high or excessive expressions of social capital may lead to adverse outcomes such as loss of objectivity, opportunism, ineffective decision-making, and costly investments (Gargiulo & Benassi, 1999; Villena et al., 2011) can be refuted in the context of this study.

Therefore, this study finds support for the positive effect of social capital on team effectiveness in a virtual and global context, highlighting its effectiveness in distributed collaboration and the management of complex tasks (Badrinarayanan, Madhavaram, & Granot, 2011; Riemer & Klein, 2008). This study demonstrates that team effectiveness is enhanced when all dimensions of social capital are considered, supporting previous research that emphasizes the direct impact of specific dimensions (e.g., Jarvenpaa, Shaw, & Staples, 2004). Contrary to prior research (e.g., Gedajlovic, Honig, Moore, Payne, & Wright, 2013; Sun et al., 2012), it is evident that the individual dimensions do not operate in a specific sequential order. Unlike previous research, this study considered all dimensions of social capital and Hackman (1987) three criteria for team effectiveness: performance, satisfaction, and longevity. The specificity of this study lies in the research context of global virtual teamwork. Although forming social capital in the virtual environment is sometimes difficult, a high level of social capital and its dimensions positively affect team effectiveness. Similarly, regarding cultural differences, social capital and its components directly affect team effectiveness.

6.2. *Managerial implications*

The findings of this study hold significant implications for managers, which are summarized in Table 4.

In the first instance, managers must be mindful that the advice to utilize various ICTs frequently is not necessarily applicable in global virtual teams, where the social context (e.g., intercultural considerations) must be considered. It is not always beneficial for every team member to be in frequent contact via different ICTs with every colleague, particularly when such contact may be perceived as excessive. Following the principles of compensatory adaptation theory, global virtual teams should communicate less frequently through richer media (e.g., video conferencing), while conversely, less rich media should be employed with more frequency. Clear and concise communication, with established rules governing ICT use, can facilitate effective global virtual teamwork. Consequently, every team can enhance its performance with a balanced mix of frequency and media richness of ICTs (Straube et al., 2018).

Second, frequent use of different ICTs leads to the development of structural social capital in the form of strong relationships, frequent interactions, familiarity on a personal level, and much time spent together (Nahapiet & Ghoshal, 1998; Sun et al., 2012).

Concerning the relationships between ICT usage and cognitive social

capital, as well as ICT usage and relational social capital, it is evident that organizational redesign is necessary. One possible solution is using brokers, whose main task is connecting individuals. Knowledge brokers within the organization can facilitate the development of cognitive social capital. Their primary role is to act as intermediaries between various social communities rather than connecting the social and technical systems (Huysman & Wulf, 2006). The practice of knowledge-sharing research has identified several different types of such "socio-technical brokers." For instance, some serve as "reviewers" and assess the quality of the knowledge base. There are also "boosters" who facilitate connections between individuals. "Commuters" navigate between users and content providers at the front and back offices. Finally, "experts" seek additional knowledge beyond what is available in the repository (Huysman & Wulf, 2006).

Regarding relational social capital, "trust brokers" (Pianese et al., 2023, p. 337) can help mediate trust between unconnected individuals. Alternatively, the lead can act as a "team integrator" (Pianese et al., 2023, p. 337). Besides, formal procedures and the availability of ICTs can increase trust among team members by ensuring effective interactions and the pursuit of common goals (Olson, Appunn, McAllister, Walters, & Grinnell, 2014; Pianese et al., 2023; Thomas & Bostrom, 2008).

Another potential avenue for organizational restructuring to cultivate cognitive and relational social capital is to provide time and a shared physical space for global virtual teamwork (D. Cohen & Prusak, 2001). Setting that conduce personal interactions, such as cafés, chat rooms, libraries, or coffee kitchens, serve as ideal venues for sharing knowledge, exploring common interests, and establishing trust and mutual understanding (D. Cohen & Prusak, 2001; Prousak & Cohen, 2001). For managers overseeing global virtual teamwork, this implies a great need to create social spaces that facilitate the formation of cognitive and relational social capital when teams cannot conduct face-to-face meetings.

6.3. Research limitations and recommendations

Despite new theoretical and practical implications, it is essential to recognize the study's limitations. First, the chosen key informant approach bears the risk that a single representative cannot reflect the majority opinion of an entire global virtual team (Marshall, 1996). For this reason, it would be interesting to interview several team members, resulting in a different methodological approach in the form of case studies. Furthermore, relying on the subjective assessments of respondents introduces bias (Maier, Thatcher, Grover, & Dwivedi, 2023). Although several measures were taken to minimize biases, such as ensuring data confidentiality and mitigating socially desirable responses, future research could incorporate objective, secondary data on global virtual teamwork to complement the findings. Second, the study focused specifically on technology-sensitive and aware companies in the DACH region, which may limit the generalizability of the findings. While the research setting was appropriate for addressing the research question, and control variables were included in the research model to account for external influences on team effectiveness, it is necessary to conduct further research to explore potential variations in the findings across industries or countries. Third, the sample predominantly consisted of male respondents, reflecting the sex composition commonly found in manufacturing firms in developed countries (Cropley & Cropley, 2017; Reshef, Aneja, & Subramani, 2021). Although respondent sex was controlled for in the research model, future research could specifically investigate the role of sex in global virtual teamwork. Fourth, the study gathered cross-sectional data from a single respondent within a homogeneous industry and region, which may limit the generalizability of the findings. To enhance the transferability and robustness of the results across different industries and countries, future research could adopt a longitudinal approach and collect data from multiple respondents based on the research model proposed in this study.

7. Conclusion

The confluence of digitalization and globalization has had an enduring influence on utilizing virtual and global collaboration in the workplace. Due to their embeddedness in a social context, teams are a focal point of multiple levels, linking the individual team members and the organizational system holistically (Kozlowski & Bell, 2013). This requires a profound comprehension of the social context, which can enhance the uptake of ICTs and the effectiveness of global virtual teamwork. To fill this research gap, we conceptualized social capital as a multidimensional mediator, encompassing structural, cognitive, and relational social capital (Nahapiet & Ghoshal, 1998), between the adoption of ICTs and team effectiveness composed of performance, satisfaction, and longevity.

In summary, this study provides a solid foundation for integrating social capital in global virtual teamwork. The results of our study indicate that frequent use of multiple ICTs does not influence the effectiveness of global virtual teams. Instead, a significant positive relationship was found between ICT use and social capital. Regarding the individual dimensions of social capital, this relationship was only found for structural social capital. Similar results were obtained for the mediator hypotheses, with both total and structural social capital acting as strengthening mediators between ICT usage and team effectiveness. Conversely, cognitive and relational social capital did not show significant mediating effects. The present research context makes developing cognitive and relational social capital difficult, although their importance cannot be denied, as both social capital and its individual dimensions show a positive relationship with team effectiveness. Possible ways to build cognitive and relational social capital include allocating sufficient time for team interactions and creating shared physical spaces, such as face-to-face meetings, to balance them. Overall, our study provides insights into the extent to which the integration of social capital enhances team effectiveness in today's digitized and globalized world.

Declarations

Consent to participate. Consent was obtained from all individual participants included in the study.

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CRediT authorship contribution statement

Tim Heubeck: Writing – review & editing, Writing – original draft, Visualization, Supervision, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Anne-Sophie Storz:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Reinhard Meckl:** Supervision, Project administration.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used DeepL Write (https://www.deepl.com/write), ChatGPT (https://chat.openai.com/), and Grammarly (https://www.grammarly.com/) in order to provide suggestions for revising the formulations of this manuscript and check its grammatical correctness. After using these tools/services, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

Data availability

Data will be made available on request.

Appendix

Table A1
Questionnaire items (English version).

Variable	Dimension	Item	
Team effectiveness	Performance	1	Members demonstrate their commitment to our team by putting in extra time and effort to help it succeed.
Adapted from Wageman et al. (2005)		2	Everyone on this team is motivated to have the team succeed.
		3	Some members of our team do not carry their fair share of the overall workload. (R)
		4	Our team often comes up with innovative ways of proceeding with the work that turns out to be just what is needed.
		5	Our team often falls into mindless routines without noticing any changes that may have occurred in our situation. (R)
		6	Our team has a great deal of difficulty actually carrying out the plans we make for how we will proceed with the task. (R)
		7	How seriously a member's ideas are taken by others on our team often depends more on who the person is than on how much he or she actually knows. (R)
		8	Members of our team actively share their special knowledge and expertise with one another.
		9	Our team is quite skilled at capturing the lessons that can be learned from our work experiences.
	Satisfaction	1	I feel a real sense of personal satisfaction when our team does well.
		2	I feel bad and unhappy when our team has performed poorly.
		3	My own feelings are not affected one way or the other by how well our team performs. (R)
		4	When our team has done well, I have done well.
		5	I learn a great deal from my work on this team.
		6	My own creativity and initiative are suppressed by this team. (R)
		7	Working on this team stretches my personal knowledge and skills.
		8	I enjoy the kind of work we do in this team.
		9	Working on this team is an exercise in frustration. (R)
		10	Generally speaking, I am very satisfied with this team.
	Longevity	1	There is a lot of unpleasantness among members of this team. (R)
		2	The longer we work together as a team, the less well we do. (R)
		3	Working together energizes and uplifts members of our team.
		4	Every time someone attempts to correct a team member whose behavior is not acceptable, things seem to get worse rather than better. (R)
		5	My relations with other team members are strained. (R)
		6	I very much enjoy talking and working with my teammates.
		7	The chance to get to know my teammates is one of the best parts of working on this team.
Social capital	Structural social capital	1	In our team, we maintain close social relationships with each other.
Adapted from Sun et al. (2012)		2	In our team, we spend a lot of time interacting with other team members.
		3	In our team, we know some team members at a personal level.
		4	In our team, we have frequent communication with other team members.
	Cognitive social capital	1	When interacting in our team, we use common terms or jargon.
		2	During the discussion in our team, we use understandable communication patterns.
		3	When communicating in our team, we use understandable narrative forms.
	Relational social capital	1	The relationship is characterized by mutual respect in our team.
		2	The relationship is characterized by personal friendship in our team.
		3	The relationship is characterized by mutual trust in our team.
		4	The relationship is characterized by high reciprocity in our team.
ICT usage		Please indicate to what extent you have been using the following communication technologies to communicate with other members of your team:	
Adapted from Eisenberg et al. (2021)		1	Instant text-based messaging (chat, e.g., MSN, WhatsApp)
		2	Tele-conferencing (using voice and audio-based devices, such as telephone, etc.)
		3	Video-conferencing (voice and video-based devices, such as video-call on Microsoft Teams, etc.)
		4	Emails and social networks (e.g., Facebook)

Notes: (R) = reverse coded

Table B1
Results of confirmatory factor analysis.

Factor	*N*	KMO	Bartlett significance	AVE	FLR	α	Item	Std. FL
Structural social capital	314	0.733	< 0.001	0.470	0.363	0.774	1	0.714
							2	0.783
							3	0.559
							4	0.667
Cognitive social capital	309	0.655	< 0.001	0.558	0.259	0.773	1	0.562
							2	0.884
							3	0.760
Relational social capital	311	0.665	< 0.001	0.480	0.692	0.710	1	0.735
							3	0.759
							4	0.568
Team performance (Factor 1)	302	0.792	< 0.001	0.415	0.911	0.776	1	0.536
							2	0.713
							4	0.627
							8	0.613
							9	0.715
Team performance (Factor 2)	303	0.638	< 0.001	0.415	0.684	0.666	5	0.641
							6	0.767
							7	0.502
Team satisfaction (Factor 1)	300	0.668	< 0.001	0.434	0.124	0.695	1	0.601
							2	0.697
							3	0.674
Team satisfaction (Factor 2)	299	0.500	< 0.001	0.608	0.383	0.757	5	0.780
							7	0.780
Team satisfaction (Factor 3)	298	0.728	< 0.001	0.467	0.829	0.763	6	0.600
							8	0.779
							9	0.495
							10	0.810
Team longevity (Factor 1)	294	0.787	< 0.001	0.509	0.707	0.805	1	0.764
							2	0.702
							4	0.685
							5	0.700
Team longevity (Factor 2)	295	0.633	< 0.001	0.503	0.752	0.726	3	0.655
							6	0.895
							7	0.529

Notes: α = Cronbach's alpha; AVE = Average variance extracted; FLR = Fornell-Larcker-ratio; KMO = Kaiser-Meyer-Olkin; *N* = Sample size; Std. FL = Standardized factor loading

Table C1
Regression results: Social capital model.

	DV: Social capital				DV: Team effectiveness			
	Control variables		Study variables		Control variables		Study variables	
	b (*se*)	β	*b* (*se*)	β	*b* (*se*)	β	*b* (*se*)	β
Study variables								
ICT usage			0.217** (0.071)	0.217**			0.061 (0.046)	0.060
Social capital							0.707*** (0.048)	0.702***
Control variables								
Firm size	−0.019 (0.017)	−0.070	−0.017 (0.017)	−0.065	−0.008 (0.017)	−0.031	0.005 (0.012)	0.020
Team size	0.001 (0.001)	0.037	0.001 (0.001)	0.026	0.000 (0.001)	0.025	−0.000 (0.001)	−0.004
Team age	−0.000 (0.000)	−0.004	−0.000 (0.000)	−0.036	0.000 (0.000)	0.028	0.000 (0.001)	0.022
Team familiarity	0.159* (0.070)	0.143*	−0.150* (0.074)	−0.135*	0.081 (0.071)	0.072	−0.034 (0.054)	−0.030
Team type	−0.047 (0.026)	−0.116	−0.056* (0.026)	−0.137*	−0.040 (0.026)	−0.097	−0.009 (0.020)	−0.021
Respondent age	0.001 (0.003)	0.020	0.002 (0.003)	0.035	0.006 (0.003)	0.125	0.006* (0.003)	0.115*
Respondent sex	0.014 (0.072)	0.012	0.027 (0.071)	0.028	0.012 (0.075)	0.011	0.008 (0.052)	0.007
Respondent education	0.042 (0.040)	0.063	0.039 (0.043)	0.059	0.000 (0.041)	0.001	−0.030 (0.027)	−0.045
Respondent nationality	−0.067 (0.065)	−0.063	−0.085 (0.081)	−0.080	−0.010 (0.066)	−0.010	0.032 (0.050)	0.030
Respondent team tenure	0.001 (0.000)	0.121	0.001 (0.000)	0.118	−0.000 (0.000)	−0.016	−0.001 (0.000)	−0.102
Constant	−0.024 (0.238)		−0.800* (0.340)		−0.213 (0.244)		−0.413 (0.241)	
R^2	0.063		0.107***		0.031		0.514***	
p	0.071		< 0.001		0.591		< 0.001	
N	271		271		271		271	

Notes: *b* = regression coefficient, β = standardized regression coefficient, DV = dependent variable, *N* = sample size, *p* = significance value, R^2 = coefficient of determination, *se* = standard error, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; number of bootstrap samples = 5000, bootstrap inference for model coefficients, heteroscedasticity-consistent standard errors HC4 (Cribari-Neto)

Table D1
Regression results: Social capital dimensions model.

	DV: Structural social capital		DV: Cognitive social capital		DV: Relational social capital		DV: Team effectiveness	
	b (*se*)	β	*b* (*se*)	β	*b* (*se*)	β	*b* (*se*)	β
Study variables								
ICT usage	0.583*** (0.104)	0.360***	−0.019 (0.117)	−0.012	0.086 (0.091)	0.056	0.077 (0.046)	0.076
Structural social capital							0.190*** (0.031)	0.306***
Cognitive social capital							0.174*** (0.029)	0.286***
Relational social capital							0.343*** (0.036)	0.523***
Control variables								
Firm size	−0.032 (0.025)	−0.075	0.001 (0.028)	0.002	−0.021 (0.027)	−0.050	0.006 (0.012)	0.022
Team size	0.004* (0.002)	0.110*	−0.002 (0.003)	−0.061	0.000 (0.002)	0.001	0.000 (0.002)	−0.003
Team age	0.000 (0.001)	0.016	−0.000 (0.001)	−0.045	−0.000 (0.001)	−0.038	0.000 (0.001)	0.025
Team familiarity	−0.377** (0.114)	−0.210**	0.073 (0.122)	0.010	−0.000 (0.114)	−0.000	−0.012 (0.052)	−0.011
Team type	−0.071 (0.038)	−0.107	−0.037 (0.046)	−0.054	−0.060 (0.041)	−0.096	−0.008 (0.019)	−0.019
Respondent age	−0.008 (0.005)	−0.100	0.007 (0.006)	0.084	0.007 (0.006)	0.085	0.005 (0.003)	0.102
Respondent sex	0.095 (0.107)	0.051	0.091 (0.122)	0.048	−0.090 (0.121)	−0.051	0.027 (0.049)	0.023
Respondent education	0.034 (0.063)	0.032	0.062 (0.075)	0.057	0.021 (0.067)	0.021	−0.027 (0.028)	−0.040
Respondent nationality	−0.193 (0.130)	−0.112	−0.005 (0.122)	−0.003	−0.056 (0.128)	−0.034	0.029 (0.047)	0.027
Respondent team tenure	0.001 (0.001)	0.089	0.000 (0.001)	0.044	0.001 (0.001)	0.088	−0.001 (0.000)	−0.106
Constant	−1.670*** (0.519)		−0.364 (0.552)		−0.366 (0.549)		−0.472* (0.240)	
R^2	0.231***		0.022		0.038		0.549***	
p	< 0.001		0.956		0.376		< 0.001	
N	271		271		271		271	

Notes: *b* = regression coefficient, β = standardized regression coefficient, DV = dependent variable, *N* = sample size, *p* = significance value, R^2 = coefficient of determination, *se* = standard error, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; number of bootstrap samples = 5000, bootstrap inference for model coefficients, heteroscedasticity-consistent standard errors HC4 (Cribari-Neto)

Table E1
Bootstrapping regression results and Sobel's test.

Total effect	Indirect effects	*b* (*se*)	Confidence interval			β (*se*)	Confidence interval			Sobel's test	
			Lower	Upper	Level		Lower	Upper	Level	*b*	*p*
ICT usage ➔ Team effectiveness		0.214** (0.069)	0.035	0.393	99%						
	ICT usage ➔ Social capital ➔ Team effectiveness	0.153** (0.049)	0.023	0.290	99%	0.152** (0.047)	0.031	0.277	99%	0.153**	0.003
	ICT usage ➔ Structural social capital ➔ Team effectiveness	0.111** (0.026)	0.052	0.189	99%	0.110** (0.025)	0.055	0.181	99%	0.111***	< 0.001
	ICT usage ➔ Cognitive social capital ➔ Team effectiveness	−0.003 (0.021)	−0.037	0.030	90%	−0.003 (0.021)	−0.037	0.029	90%	−0.003	0.872
	ICT usage ➔ Relational social capital ➔ Team effectiveness	0.029 (0.031)	−0.022	0.079	90%	0.029 (0.030)	−0.021	0.078	90%	0.029	0.349

Notes: *se* = Standard error, *b* = coefficient, *N* = Sample size; ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; number of bootstrap samples = 5000, bootstrap inference for model coefficients, heteroscedasticity-consistent standard errors HC4 (Cribari-Neto), $N = 271$.

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