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Understanding the Emergence of Team Perceived Virtuality: The Effects of Structural Virtuality, Collectivism, and E-leadership E-communication Competence on Collectively Perceived Information Deficits

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Resumo

A virtualidade é um tópico crucial nos estudos de gestão para explorar a forma como as equipas podem ser eficazes nesta era digital. Contudo, os estudos sobre o trabalho em equipa virtual têm-se fortemente centrado na análise da virtualidade como uma construção objetiva, tendo poucos explorado as suas dimensões subjetivas. Inspirado por esta questão, este estudo baseia-se na teoria da virtualidade percebida pela equipa (TPV) desenvolvida por Handke et al. (2021) e visa identificar os fatores que afetam a perceção que os indivíduos têm da sua equipa como mais ou menos virtual. Especificamente, investiga o impacto da virtualidade estrutural nos défices de informação coletivamente percebidos e os efeitos moderadores do coletivismo e da competência de e-comunicação da e-liderança nesta relação. 208 profissionais de diferentes nacionalidades, funções e setores participaram preenchendo um questionário *online*. Os resultados não apoiaram as hipóteses propostas, mas revelaram que a competência de e-comunicação exerce uma influência direta significativa e negativa sobre os níveis de défices de informação coletivamente percebidos ($\beta = -.344$, $p = < .001$), o que implica que as organizações devem considerar permitir que os e-líderes desenvolvam a capacidade de comunicar de forma clara e adequada através da utilização eficaz das tecnologias de informação e da comunicação (TIC). Os resultados revelam ainda oportunidades de investigação futura, como a exploração de outros mecanismos através dos quais a e-liderança pode influenciar a TPV e ir além das propriedades físicas de uma única TIC para compreender como a virtualidade estrutural faz surgir a TPV.

Palavras-chave: trabalho em equipa virtual; virtualidade percebida pela equipa; défices de informação coletivamente percebidos; competência de e-comunicação da e-liderança; coletivismo; virtualidade estrutural.

Classificação JEL: M54, D83.

Abstract

Virtuality is a crucial topic in management studies for exploring how teams can be effective in this digital age. However, prior research on virtual teamwork has focused almost exclusively on examining virtuality as an objective construct, with few studies exploring its subjective dimensions. Inspired by this issue, this study draws on the theory and framework of team perceived virtuality (TPV) developed by Handke et al. (2021) and aims to identify factors that affect how more or less virtual individuals perceive their team to be. Specifically, it investigates the impact of structural virtuality on collectively perceived information deficits and the moderating effects of collectivism and e-leadership e-communication competence on this relationship. 208 professionals of different nationalities, job functions, and industries participated by completing an online questionnaire. The findings did not support the proposed relationships but revealed that e-communication competence exerts a significant and negative direct influence on the levels of collectively perceived information deficits (β = –.344, p = < .001), which implies that organizations should seriously consider enabling e-leaders to develop the ability to communicate clearly and appropriately through the effective use of information and communication technologies (ICTs). In addition, the findings expose opportunities for future research, such as exploring other mechanisms through which e-leadership can influence TPV and reaching beyond the physical properties of a single ICT to understand how structural virtuality causes TPV to emerge.

Keywords: virtual teamwork; team perceived virtuality; collectively perceived information deficits; e-leadership e-communication competence; collectivism; structural virtuality.

JEL Classification: M54, D83.

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CHAPTER I

Introduction

The digital revolution brought about what many believe to be the largest workplace transition since the Industrial Revolution: the shift to remote work (Martin, 2022). In the last two decades, technological advancements made it possible for individuals to work together despite being physically distant. Today, as information and communication technologies (ICTs) have become a truism in the workplace and the COVID-19 pandemic with the stay-at-home policies suddenly forced individuals into the extreme situation of having to exclusively rely on virtual tools to collaborate with others, we witness a strong proliferation and popularization of virtual teams across various organizations, which makes adequate interaction via ICTs vital to team success (Costa et al., 2021; Klonek et al., 2022). Thus, understanding the concept of *virtuality* and the effects virtuality has on teamwork is fundamental to fruitfully addressing the challenges of working in virtual teams, and for the effectiveness of teams and organizations of the present and of the future (Costa et al., 2023).

Studies on the subject have mostly focused on virtuality as an objective construct, as the concept has been traditionally associated either with the idea of geographical or organizational dispersion or with the idea of structural media features. The first considers that a team is virtual when, because of having to work together from different locations, team members find it necessary to rely on technology; the second proposes describing virtual teams in a spectrum, as more or less virtual depending on the nature and frequency of cues that the ICTs used by the team members to collaborate can transmit (Costa et al., 2023; Foster et al., 2015; Klonek et al., 2022). These objective conceptualizations of virtuality, however, have met with pertinent skepticism. Team members do not necessarily need to be geographically or organizationally dispersed to work virtually, as co-located teams can also choose to deploy the technology available in their workplace to perform their tasks, and they can form effective teams without meeting face-to-face (Kirkman & Mathieu, 2005; Orlikowski & Yates, 2002). Similarly, different teams using the same technology to interact may experience working virtually in distinct ways, and feel distant in different degrees, because they will hardly perceive it and use it in the same way, or for the same purpose (Costa et al., 2021; Costa et al., 2023; Leonardi et al., 2010). What is more, the problems virtual teams come to experience are not always necessarily related to working virtually and relying on technology to collaborate, for instance, team members may forget to update each other on what they are currently working on, even

though they do not use technology to communicate and work or the virtual tools they use present high levels of synchronicity (Handke et al., 2024).

These arguments highlight a problem with the existent virtuality literature, that of having traditionally overlooked the subjective dimensions of virtuality (Costa et al., 2021). To address this need to account for how individuals perceive virtuality through their experiences of working in virtual teams, researchers have already come up with coherent proposals, that call for further exploration and validation. One such example is the theoretical framework Handke and colleagues (2021) proposed that accounts for both the subjective experience of team virtuality and the structural properties of the virtual tools used to collaborate, and has *team perceived virtuality* as its key construct.

A key assumption of this theoretical framework is that team members come to perceive their own level of virtuality when they experience disruptions in their interactions and try to make sense of them. The authors identify the structural properties of virtual tools as one of the potential causes that explain the occurrence of these disruptions (Handke et al., 2024). In fact, substantial studies have already shown that the objective qualities of the technology deployed can explain difficulties in virtual team functioning depending on how more or less adequate for a specific communication situation these are (e.g., Ganesh & Gupta, 2010; Ortiz De Guinea et al., 2012). Likewise, culture, conceptualized and operationalized at the national level, has also been pointed out in several studies as a cause of disruption in team interactions, as it is a group-level phenomenon that significantly guides and influences individual behaviors, perceptions and preferences, as well as their interactions with others (e.g., Carlsson et al., 1999; Leidner et al., 2006; Maznevski et al., 2002; Smith, 2008). The unsatisfactory user adoption of certain technologies, for instance, has been attributed in part to national culture (e.g., Hill et al., 1998; Huang et al., 2003; Lee, 2000; Thatcher et al., 2003).

On the other hand, e-leadership could help reduce the levels of team perceived virtuality (Costa et al., 2023). Substantial research has pointed out the fundamental role of e-leadership in achieving virtual teams' high performance and success, as it is a social influence process (e.g., Alkhayyal & Bajaba, 2023; Van Wart et al., 2019; Wang et al., 2022). E-leaders have the potential to take advantage of ICTs to fit functions and situations and to influence feelings, thinking, behaviors and performance in order to overcome challenges and achieve virtual teams' success (Avolio et al., 2014; Contreras et al., 2020; Wang et al., 2022). Particularly, e-leaders have the potential to fight followers' negative mindsets about specific behaviors by promoting positive behavioral beliefs (e.g., Buengeler et al., 2022; Leroy et al., 2016; Purnomo et al., 2023). However, studies on the interaction between e-leaders and virtual team members are still

scarce, the exploration of the concept of e-leadership is still lagging, and knowledge of the e-leadership competencies needed to address virtual teams success in complex work processes is lacking, even though technology continues to evolve and complexify at a rapid pace (Avolio et al., 2014; Contreras et al., 2020; Liu et al., 2020; Wang et al., 2022). Thus, addressing these issues constitutes a relevant challenge to the field of leadership.

Therefore, the goal of this work is to explore the subjective dimensions of virtuality using the conceptualization of virtuality coined by Handke and colleagues (2021) and their theoretical framework as a starting point and to determine some of the factors that influence teams' perceptions of their own level of virtuality and, consequently, the effectiveness of virtual teams, namely structural virtuality, national culture, and e-leadership.

This study contributes to the literature in several ways. Firstly, it addresses the current need to explore the subjective dimensions of virtuality and offers some empirical support. Secondly, it shows whether the factors examined are fruitful avenues for future research on team virtuality. Thirdly, it raises important questions about how to best capture structural virtuality and national culture in order to draw a better picture of the influence of the objective features of virtual tools and national cultural values on team perceived virtuality. Finally, it explores the so relevant concept of e-leadership and broadens our understanding of how e-leaders can positively influence the functioning of virtual teams. At a practical level, this study contributes to organizations by providing them with pertinent knowledge that assists them in determining factors with the potential to improve team functioning, so that they can manage their virtual teams more effectively, and, on the other hand, so that teams are able to fully seize the benefits of the various modern work arrangements characterized by virtuality.

In the sections that follow, a brief overview of the concepts and underlying dimensions of team perceived virtuality, structural virtuality, national culture, and e-leadership is provided, and their critical relationships for the development of hypotheses to be empirically tested are explored. Then, the hypotheses and research model of this study are identified, the research design is described, and the results of the analyses are presented. This work concludes with a summary of key points drawn from the analysis, implications, limitations, and suggestions for future research.

CHAPTER II

Literature Review

2.1. Defining Team Perceived Virtuality and Structural Virtuality

Communication quality is an important predictor of several positive outcomes for virtual teams, such as improved performance and commitment, and by extension their success (Chang et al., 2011; Morrison-Smith & Ruiz, 2020). In virtual teamwork, communication is fundamentally technology-mediated, so technology is a fundamental factor to consider when exploring communication quality in a virtual environment.

Much of the research on virtuality or virtual teamwork, however, has largely focused on studying virtuality as an objective construct, based on geographical or organizational dispersion, and to a larger extent on the properties of virtual tools, while the subjective dimensions of virtuality, the psychological and social factors and perceptions, has mainly been overlooked (Handke et al., 2021). In this regard, Orlikowski (2007) proposed that in everyday organizational life, both the material and the social are inextricably related, and therefore organizational studies of technology adoption that either focus exclusively on technology effects or interactions with technology are limited and limiting.

To address this issue, Handke and colleagues (2021) proposed a framework that accounts for both the teams' experience of team virtuality and the structural properties of the virtual tools used to collaborate (Costa et al., 2023). In it, the authors incorporated both objective and subjective elements and, in doing so, bridged the contributions of cues-filtered-out theories (such as media richness, Daft & Lengel, 1986; and social presence theory, Short et al., 1976) with those of social construction theories (such as channel expansion theory, Carlson & Zmud, 1999; and social construction of meaning about technology usage, Orlikowski & Yates, 2002). The key construct of this framework is *team perceived virtuality (TPV)* which is defined as "a shared affective-cognitive emergent state that is characterized by team members' co-constructed and collectively-experienced (1) distance and (2) information deficits, thereby capturing the unrealized nature of the team as a collective system" (Handke et al., 2021, p. 626). Therefore, the TPV conceptualization considers that virtuality directly arises from team experiences, not from the structural properties of the virtual tool (Handke et al., 2024).

Team perceived virtuality is bidimensional in nature because it is characterized by an aggregation of two continuous dimensions, one affective and another cognitive, that reflect

experiences shaped by how team members interact: collectively experienced distance and collectively experienced information deficits (Handke et al., 2021).

The affective dimension of TPV, collectively experienced distance, refers to the degree to which the members of a team feel distant from each other, which can be related to physical distance, but doesn't necessarily have to be (Costa & Handke, 2023). Team members will feel more distant from each other the more they are collectively aware of their mutual emotional inaccessibility, and the more their interactions and relationships are cold, unaffectionate, and less friendly and intimate, as opposed to relationships that are warm and reflect interpersonal liking, accessibility, and even friendship, which yield the feeling of being close and of being drawn together (Costa et al., 2021; Costa et al., 2023). Thus, it is possible for team members to be forced to rely exclusively on virtual tools to collaborate with each other and therefore to be physically distant, and yet experience low levels of TPV because the nature of their relationship makes them feel close (Costa & Handke, 2023). For example, they may take a few minutes before diving into the meeting agenda to share brief personal stories and events of their lives, send each other funny memes and complement written messages with emojis, or be available to give each other support and guidance when needed. Consequently, the opposite scenario is also possible: team members may be physically close, sitting right next to each other at the office, but feel disconnected and estranged as a whole. This dimension of TPV is, therefore, closely related to concepts such as perceived proximity (Wilson et al., 2008) and electronic propinquity (Korzenny, 1978), given that these suggest that psychological feelings of nearness or proximity in virtual teams depend on the salience of the communication media used to collaborate, on individuals using it and their perceptions.

This study, however, will focus on the cognitive dimension of TPV – collectively perceived information deficits – which refers to the collective perception within a team of their information exchange being poor or flawed, either because it is inefficient, doesn't allow for timely feedback or convergence on meaning, or because information gets lost, is incomplete or is misinterpreted (Costa & Handke, 2023; Costa et al., 2023). According to Handke et al. (2021), information exchange within a team is poor when it

> does not (1) enable timely feedback, (2) meet team members' personal requirements (e.g., by allowing to alter messages to enhance specific team members' understanding), (3) combine a variety of different cues (e.g., by conveying both the content of a message as well as its emotional tone), and (4) use rich and varied language (e.g., by enabling the use of symbol sets close to natural language; see also Carlson & Zmud, 1999). (p. 170)

The collective perception of information deficit is, thus, closely related to the concepts of information richness and synchronicity, which have greatly been associated with the physical properties of technology, meaning that a team's experience of poor information exchange can be generated by the physical properties of the ICT used to collaborate (Costa et al., 2023; Handke et al., 2024). However, similarly to what was previously said regarding collectively perceived distance, this influence is not direct and is not an absolute condition, which means collective perceptions of information deficits can also exist independently of high levels of structural virtuality (Costa & Handke, 2023; Handke et al., 2024). For instance, teams can experience a high degree of information deficits despite communicating face-to-face or through a richer communication media because they give each other more generalized feedback, and they can experience a low degree of information deficits despite using a leaner media such as email to communicate because they give more detailed and useful feedback to each other.

The two dimensions that jointly determine the levels of TPV are related but distinct, meaning that teams can find themselves in a state where they experience high levels of one dimension and low levels of another (Handke et al., 2021). In other words, they might simultaneously feel their virtual teamwork is satisfying because their interactions and relationships are warm and reflect interpersonal liking and accessibility, but not effective because their information exchange is flawed and inefficient. They can also feel the opposite, that their exchange of information is extremely effective, but that they feel emotionally disconnected and estranged (Costa & Handke, 2023). Thus, for the same level, the quality of TPV depends on the different combinations in which these two dimensions exist (Handke et al., 2021). Another characteristic of the dimensions of TPV is that they are continuous, meaning that teams will perceive their relations to be more or less distant and their information exchange to be more or less poor (Handke et al., 2021).

Team Perceived Virtuality is also a deficit-oriented state. High levels of TPV are associated with more negative team outcomes, whereas low levels of TPV are associated with more positive team outcomes (Costa et al., 2023). Since, as was previously mentioned, the two dimensions of TPV are heterogeneous in nature, their relationships with outcomes are different (Handke et al., 2021). Collectively experienced information deficits have a stronger relationship with performance-related outcomes, such as task performance, while collectively experienced distance has a stronger relationship with affective-related outcomes, such as trust and satisfaction (Handke et al., 2024). The relationship between TPV dimensions and outcomes is of a cyclical nature, because collectively perceived distance and information deficits will have

an impact on different outcomes, and these outcomes in turn will influence further team processes and interactions (Handke et al., 2021).

Additionally, team perceived virtuality is a team-level construct, because it is a collective manifestation that reflects group-level experiences and shared perceptions. However, it can be analyzed at the individual-level construct as well, representing the sum or mean of individual ratings (Handke et al., 2021; Handke et al., 2024). Finally, TPV is also an emergent state, meaning that it is in the course of being actualized and, therefore, varies dynamically over time, because teams change and evolve in their interactions while engaging in teamwork, causing shared experiences and the meaning team members attach to them to change and evolve accordingly (Costa et al., 2023; Handke et al., 2021; Handke et al., 2024).

The way the authors of the TPV conceptualization and theoretical framework propose collectively experience distance and information deficits emerge is through a sensemaking process triggered by disruptions that team members experience in their interactions, in which individuals take information from team processes and inputs from their shared context to construct a narrative that allows them to attribute meaning to their shared experience of these disruptions (Handke et al., 2021; Handke et al., 2024). The team's shared context that indirectly influences TPV via team processes refers to the conditions under which teams operate (Handke et al., 2024). These contextual factors are the antecedents of TPV. In their theoretical framework Handke and colleagues (2021) identified as antecedents of TPV the teams' technology use or structural virtuality, the team familiarity, and the team work design (team autonomy and task interdependence). The authors consider the influence of these antecedents on TPV to be additive, which means that for high levels of TPV to emerge, it is not mandatory that all these factors present high levels. Furthermore, the low levels of one factor can compensate for the high levels of another and in this way prevent high levels of TPV from emerging (Handke et al., 2021).

The antecedent of TPV in which the current study focuses, structural virtuality, which has traditionally been viewed as the defining feature of virtuality, has its roots in cues-filtered-out theories (such as media richness, Daft & Lengel, 1986; social presence theory, Short et al., 1976; and media synchronicity theory, Dennis et al., 2008), which focus on the material aspects of technology and on objective indexes to measure virtuality and explain the functioning and outcomes of teams. The key assumption of these theories is that every communication technology possesses certain objective qualities or structural properties that render it more or less adequate for a particular communication situation (Costa et al., 2023). Structural virtuality restricts real-time face-to-face communications and the virtual environment is characterized by lower levels of social presence and greater levels of cluelessness (Dennis et al., 2008; Kirkman

& Mathieu, 2005; Rutter & Stephenson, 1979; Rice, 1993). This can negatively affect teamwork processes, by, for example, hampering the convergence of meaning between team members and making it difficult for them to anticipate each other's actions and react properly, on time (Handke et al., 2021). For this reason, it is to be expected that higher levels of structural virtuality are associated with higher levels of collectively perceived information deficits.

To measure virtuality in teams using objective indexes, Kirkman and Mathiew (2005) proposed a three-dimensional model, according to which team virtuality can be defined by a combination of: (1) the extent to which team members rely on virtual tools to work and communicate; (2) the amount of informational value such tools can convey; (3) and the synchronicity of team members virtual interaction that the virtual tools used allow for.

Reliance on virtual tools has to do with the degree to which teams coordinate their efforts through the employment of ICTs (Kirkman & Mathiew, 2005). Teams can fall anywhere along a continuum that stretches from pure face-to-face interactions to interactions that exclusively rely on virtual tools to happen (Kramer et al., 2017). Thus, the bigger the proportion of team interaction that occurs via virtual tools, the more virtual a team is considered. Likewise, teams are considered less virtual the more their interactions resemble face-to-face interactions (Brown et al., 2020).

Even though this influence is not an absolute condition, teams' experience of poor or flawed information exchange can be generated by the physical properties of the ICT used to collaborate (Costa et al., 2023; Handke et al., 2024). This is because technologies have structural and technical limitations and cannot replicate the physical environment (Kahai & Cooper, 2003). As a consequence, the virtual environment is characterized by reduced social presence and more reduced numbers of social context clues that the individuals interacting have at their disposal when compared to the physical environment where face-to-face interactions take place (Rice, 1993; Rutter & Stephenson, 1979). For all this, it is likely that when collaboration occurs via virtual tools instead of face-to-face the chances of information getting lost, being incomplete, or misinterpreted will be greater. What is more, it is likely that the more virtual a team is, the greater these chances will be. Therefore, it is expected that:

> ***H1.a****: The extent of reliance on virtual tools will be positively related to experienced information deficits.*

Media synchronicity, on the other hand, refers to the speed with which the capabilities of a virtual tool allow for information to be transmitted back and forth during team interactions. (Brown et al., 2020; Dennis et al., 2008). More synchronous ICTs allow for simultaneous or

real-time exchanges of information, whereas more asynchronous ICTs originate time lags in team interactions. High transmission velocity, low parallelism, high symbol sets, low rehearsability, and low reprocessability are the primary media capabilities that allow for synchronicity (Dennis et al., 2008; Thomas et al., 2023). Dennis and colleagues (2008) define these capabilities as follows: transmission velocity is the capacity a virtual tool has to be fast enough to allow the recipient of a message to receive it as soon as it is sent and the sender to receive immediate feedback, in such a way that the communication approaches continuous exchanges and resembles conversations; parallelism has to do with the number of concurrent transmissions that can occur through a virtual tool; as for symbol sets, this capability refers to the variety of ways a virtual tool makes available for encoding a message; reharsability is the capacity an ICT has to enable the sender of a message to craft it before sending it; and finally, reprocessability has to do with the possibility of revisiting and reexamining messages previously sent and received during or after a conversation.

Dennis et al. (2008) argue that high synchronicity is essential for the convergence of meaning in virtual teamwork. A virtual tool low in synchronicity reduces interaction and shared focus between the sender and the receiver of a message and increases delays that hinder the rapid development of shared understanding (Dennis et al., 2008; Tu, 2001). On the other hand, ICTs high in synchronicity allow team members to quickly transmit and process information in smaller portions which facilitates the development of a shared understanding (Dennis et al., 2008). They also allow individuals to receive immediate feedback, which presents a valuable opportunity for the sender to break up messages to probe the understanding of the receiver and enhances the perception of social presence as communication can approach continuous exchanges and resemble conversations (Dennis et al., 2008; Tang et al., 2013).

For this reason, it is likely that when collaboration occurs via virtual tools low in synchronicity, team members will experience poor information exchanges, resulting in higher levels of collectively perceived information deficits. On the other hand, it is likely that when collaboration occurs via virtual tools high in synchronicity, team members will experience rich information exchanges, resulting in lower levels of collectively perceived information deficits. Therefore, it is expected that:

> ***H1.b:*** *The media synchronicity will be negatively related to experienced information deficits.*

Lastly, information value comes from the media richness theories of Daft and Legel (1986), and Venkatesh and Johson (2002), and has to do with the degree to which virtual tools are capable of transmitting rich and valuable information that benefits overall teamwork effectiveness (Brown et al., 2020; Kirkman & Mathiew, 2005). The idea is that the design and capability of a particular technology influence the nature and number of the cues (e.g., non-verbal, paraverbal, verbal, sound and visual) it can transmit (Costa & Handke, 2023). A technology low in information value does not enable a great variety of ways to encode information for communication (Sproull & Kiesler, 1986). It filters out a great number of social cues available for individuals to convey and process information such as physical presence, voice inflection, or body gestures, and is poor in natural symbols such as nodding the head, thus making it more difficult for team members to process more complex and subjective messages, to handle equivocality and to converge in meaning (Daft et al., 1987; Dennis et al., 2008). As a consequence, information exchanges within a team are more likely to be perceived as poor or flawed (Handke et al., 2021).

For this reason, it is likely that when collaboration occurs via virtual tools low in information value, team members will experience poor information exchanges, resulting in higher levels of collectively perceived information deficits. On the other hand, it is likely that when collaboration occurs via virtual tools high in information value, team members will experience rich information exchanges, resulting in lower levels of collectively perceived information deficits. Hence, it is expected that:

> ***H1.c:*** *The information value of virtual tools will be negatively related to experienced information deficits.*

2.2. Team Perceived Virtuality and National Culture

As was previously mentioned, the disruptions that team members experience in their interactions are the triggers that cause team perceived virtuality to emerge (Handke et al., 2023). Previous research has given indication that culture, conceptualized at the national level, could very well be one of the factors that may cause these disruptions to occur, because it can affect the adoption and use of virtual tools (e.g., Al-Gahtani et al., 2007; Alkhaldi & Yusof, 2013; Huang et al., 2003; Lee, 2000; Smith, 2008). In fact, Smith (2008) argues that, through employment, an individual brings their national cultural values into an organization and, as a consequence, these values end up more or less shaping their behaviors at work, which include patterns of adoption and use of technology to collaborate with others.

Our understanding of what "culture" and "national culture" mean has shifted over the years and many different definitions of these complex and multifaceted concepts have been put forward (Kramer et al., 2017; Leidner & Kayworth, 2006). To date, the most predominantly used definition of national culture is perhaps the one coined by Hofstede (Srite & Karahanna, 2006). According to this author, national culture is "the collective programming of the mind which distinguishes the members of one group or category of people [nation] from another" (Hofstede, 1980, p. 89). A programming of the mind refers to "patterns of thinking, feeling, and potential acting that every person carries within themselves which were learned throughout their lifetime" (Hofstede, 1991, p. 4). Collective mental programs, as opposed to universal and individual mental programs, are those shared not with all people, but with some that belong to the same social group or category, of which nation is an example (Hofstede, 2001). Mental programs can either be inherited or learned after birth, and it is at the collective level that most of an individual's mental programming is learned. Therefore, national culture does not derive from an individual's genes but is acquired from one's social environment through a learning process (Hofstede, 1980; Hofstede, 2001). All in all, culture guides the behavior of individuals and their interpretation of the behavior of others in distinct situations by providing them with an implicit theory about that (Keesing, 1974).

Systems of values are a core element for describing mental programming, and are, therefore, at the heart of the concept of national culture. It is around group value orientations that the majority of theories that conceptualize national culture tend to gravitate (e.g., Hall, 1976; Hofstede, 2001; Schwartz, 1992). Values are "broad tendencies [tendency] to prefer certain states of affairs over others" (Hofstede, 1980, p. 18). They are criteria for judgment, preferences, and choices, and guide behavioral decisions, thus, forming the basis for collective action (Homer & Kahle, 1988; Leidner & Kayworth, 2006). But, while symbols such as words, gestures, or objects represent the most superficial manifestations of culture and are, therefore, more visible, values represent the deepest manifestations of culture and can only be inferred from the way people behave under various circumstances (Hofstede, 1980).

One of the ways national culture can have an effect on virtual teamwork and team perceived virtuality is in the way individuals interact with technology to communicate and collaborate (Leidner & Kayworth, 2006). Many studies have uncovered relationships between ICTs and national culture. Some such as Huang and colleagues (2003) and Lee (2000), for example, have explored national cultural influences on technology acceptance in the workplace. Huang and colleagues (2003) demonstrated that the influence of subjective norms on the perceived usefulness of technologies was stronger among individuals with lower espoused power distance

values and Lee (2000) showed that the Confucian values of showing respect significantly influence the pattern of usage of email in virtual workplaces. Other studies such as Hill and colleagues (1998) and Straub (1994) have explored cultural influences on technology transferability and diffusion to other national markets. Hill and colleagues (1998) showed that cultural factors such as preference for face-to-face interactions and the tendency to build consensus and to create family-like environments within the organization have a significant influence on the transfer of technology from non-Arab to Arab cultures, and Straub (1994) found that high levels of uncertainty avoidance in Japan and low levels of uncertainty avoidance in the U.S. explained why Japanese companies were less predisposed toward using e-mail in the workplace than U.S. companies. Some studies have even examined how technology affects national cultural values. Salehan and colleagues (2018), for instance, found that technology plays an important role in pushing national cultures from around de world to converge towards higher individualism and lower power distance.

At the heart of this is the idea that, in addition to being both a structural and social construct, technology is also inherently symbolic (Trevino et al., 1987; Treviño et al., 2000). In other words, technology is not values neutral and can be perceived to signify different values according to the work behaviors that their features enable, such as formality, intimacy, competency, progress, equality, and subordination (Feldman & March, 1981; Robey & Markus, 1984; Scholz, 1990). Hence, there is a symbolic message behind the selection and use of a particular virtual tool to communicate (Trevino et al., 1987). For example, opting for a technology such as videoconference, that most resembles face-to-face communication, may imply a need and desire for involvement and for showing deference (Trevino et al., 1987; Treviño et al., 2000).

In this regard, Leidner and Kayworth (2006) argue that, because technology sends symbolic messages, when individuals interact with it, there will always exist a degree of divergence between the values embedded in the virtual tool used to collaborate and the national values held by the individual using it, that can result in values conflict. The greater the degree of divergence, the more significant the IT-culture conflict experienced, increasing the likelihood of individuals resisting the adoption of a particular technology and having a negative user experience. In their IT-culture conflict theory they explain that when the values team members associate with IT in general are not consistent with their dominant values, *contribution conflict* emerges, and when instead of supporting, the values implicit in a particular technology contradict the national values held by team members using it to collaborate with others, *system conflict* emerges. Thus, a team where members hold

individualistic values would experience low levels of contribution conflict if IT was perceived as a means to achieve empowerment, financial gain, or innovation, but would instead experience high levels of conflict if they saw IT as a means to build relationships at work. Similarly, the same team would experience low levels of system conflict if the virtual tool used to collaborate was designed to promote efficiency, but would instead experience high levels of conflict if the virtual tool was designed to foster communities. Kohli and Kettinger (2004), for instance, found that physicians who valued above all quality of care experience conflict with technology in the workplace because they associated IT in general with cost control. Additionally, Lee (2000) found that employees from South Korea, a nation where showing respect to seniors is highly valued and much more important than getting things done, tended to be discouraged from using email for upward communication, because they saw email as a more friendly and casual virtual tool, and, therefore, did not think it could be used to show appropriate respect to superiors. In fact, Zakaria and Talib (2011) found that in such circumstances email can even be seen as rude or distrustful. Similarly, Richardson and Smith (2007) discovered that to contact their professors, American students rated email as significantly more likely for use, whereas Japanese students rated face-to-face communication, telephone, and letters first.

Therefore, in their theory, Leidner and Kayworth (2006) provide us with an explanation as to how disruptions in team functioning related to national culture values can manifest when individuals interact with technology, highlighting the importance of understanding an individual's culture-driven expectations in virtual teams' management.

Amongst the many cultural theories and value constructs used to identify and measure differences in national value systems across nations and individuals, Hofstede's cultural dimensions theory seems to enjoy greater popularity in the social sciences, particularly in the fields of business management and information technology (Jan et al., 2022; Ortiz-Marcos & Patiño-Arenas, 2022; Rodríguez-Rivero et al., 2022). Hofstede (1980, 2001) defined six dimensions of culture: (1) individualism-collectivism – the extent to which the role of the individual is emphasized, personal goals dominate over collective goals, and identity is determined by individual achievements rather than group membership; (2) power distance – the degree to which the unequal distribution of power is expected and accepted by individuals; (3) masculinity-femininity (now designated as motivation towards achievement and success) – the degree to which a society is driven and motivated by competition, career achievement, ambition, success, and recognition, as opposed to caring, nurturing, cooperation, and valuing quality of life; (4) uncertainty avoidance – the degree to which individuals feel threatened by unknown,

unpredictable, and ambiguous situations; (5) long versus short-term orientation – the extent to which individuals are open to change and deal with events by delaying gratification, prioritizing thrift and personal development, and focusing on future gains; and (6) indulgence – the extent to which individuals are concerned with fulfillment and enjoyment, and the control exerted over their desires and impulses is weak (Jan et al., 2022; Minkov & Kaasa, 2021; Srite & Karahanna, 2006; Yoon, 2009).

Among Hofestede's dimensions of national culture, this study will focus on individualism-collectivism, because this is "the best-known and best-validated dimension of national culture" (Minkov & Kaasa, 2021, p. 4). It is very robust, replicates relatively well, and allows for a richer comparison with past study results (Minkov & Kaasa, 2021). Moreover, in terms of its relationship with technology, the results of several studies indicate that individualism-collectivism affects behavioral intention to adopt technologies (e.g., Alkhaldi & Yusof, 2013; Jan et al., 2022; Tarhini et al., 2017). To avoid misperceptions, individualism-collectivism will henceforth be referred to as collectivism (COL).

Individualism-collectivism is viewed as a spectrum, with individualistic nations occupying the high-end, and collectivistic nations occupying the low (Hofstede, 2001; Yoon, 2009). However, in this study, as the construct is referred to as collectivism, it is collectivistic nations that occupy the high-end of the spectrum, whereas individualistic nations occupy the low. In all cultures, both individualism and collectivism exist, but one of those tends to be more dominant (Gudykunst & Ting-Toomey, 1988). This dimension is essentially characterized by how individuals relate with the collectivity (e.g., nuclear families, extended families, teams) and the degree of interdependence reflected in this relationship (Smith, 2008). In more individualistic cultures, individuals are expected to be independent and self-reliant and to show concern and assume responsibility only for themselves and their immediate families (Gudykunst et al., 1996; Yoo et al., 2011). Independence, achievement, and self-direction are major values of the individualistic culture (Gudykunst et al., 1996; Schwartz, 1992). Identity is determined by individual achievements and their social behavior is guided primarily by personal goals and personal interests (Triandis, 1988). When making decisions, people from individualistic cultures consider what is best for them, rather than what is best for the group as a whole (Souren et al., 2004). When it comes to teamwork, individualism is associated with productivity, individual performance, the prioritization of tasks over relationships, working individually, and tight time management (Sørnes et al., 2004; Souren et al., 2004).

On the other hand, in more collectivistic cultures, individuals are expected to subordinate their personal needs and interests in favor of the interests of the group they belong to. Identity

is determined in terms of group membership, so there is greater interdependence between the members of a group, and great emphasis is placed on maintaining strong and harmonious relationships, even when they are disadvantageous (Hofstede, 1980; Sørnes et al., 2004). Goals that are shared collectively are prioritized over individual goals, decision-making is based on what is best for the group as a whole, and social behavior is dominantly guided by group rather than personal achievements (Triandis, 1989). People from collectivistic nations value group loyalty, trust, harmony, cooperation, and solidarity (Yoon, 2009). Great emotional dependence is expected among the members of a group, there is a sentimental need to feel as one, and separation leads to discomfort (Gudykunst et al., 1996; Triandis, 1988). Members of collectivistic cultures also care greatly for the opinions of others and are more concerned with avoiding hurting or imposing on others, and thus will seek consensus and harmony. Not surprisingly, these individuals are more willing to conform to the norms of their referent group (Erumban & de Jong, 2006; Hofstede, 1980; Srite & Karahana, 2006). When it comes to teamwork, individuals of collectivistic cultures view group membership as more long-term and permanent, and tasks undissociated from relationships (Gibson & Zellmer-Bruhn, 2001; Smith et al., 2011). There is also a tendency for team members to integrate work and personal life, for instance, by eating evening meals together (Earley & Gibson, 1998).

Collectivism is also associated with differences in communication style (Gudykunst & Ting-Toomey, 1988). People who have individualistic traits have been found to predominantly use and perceive as most effective a low-context and task-oriented communication style (Gudykunst & Ting-Toomey, 1988; Sanchez-Burks et al., 2003). After all, individualism is associated with a focus on the task at hand and with discounting the indirect and relational implications of information exchanges, and people with individualistic traits perceive clarity in conversations as extremely important for effective communication and direct requests as the best strategy to achieve it (Kim & Wilson, 1994; Sanchez-Burks et al., 2003). In low-context communication, the meanings of a message are mostly found in the code rather than in the interpersonal context (Hall, 1976). Thus, this style of communication involves relaying information through direct, clear, and precise messages, that is, through exact written or spoken words, revealing the speaker's true intentions. As a consequence of messages being more context-free, the statements made, positive or negative, are characterized by low levels of ambiguity, and greater levels of openness, specificity, succinctness, and precision (Würtz, 2005; Hall, 1976). A task-oriented communication style is one oriented toward supporting the speaker's job tasks, and, therefore, toward efficient task completion, individual achievements, and success in individual performance (Habermas, 1976). It deals with such processes as

problem-solving and making decisions and can involve the speaker asking the listener to do certain behaviors or discarding the relational implications of messages (Froehle, 2006; Sanchez-Burks et al., 2003).

In opposition, individuals from collectivistic cultures have been found to experience more communication satisfaction when communication is high-context and relationship-oriented (Gudykunst et al., 1996; Gudykunst & Ting-Toomey, 1988; Hall, 1976; Jarvenpaa & Leidner, 1998). A high-context communication style allows more tactful speakers to camouflage and conceal their true intentions for the sake of group harmony – something which is highly valued in collectivistic cultures – because the meanings of a message are mostly found in the interpersonal context rather than in code (Gudykunst et al., 1996; Gudykunst & Ting-Toomey, 1988; Hall, 1976). Therefore, it utilizes implicit, indirect, non-verbal communication, via contextual cues such as body language, tone of voice, silence, space, or time, to relay a message. For instance, individuals with dominant collectivistic traits could convey disagreement by being silent or by not being present at a meeting (Gelfand et al., 2004). Since very little of a message's meaning is embedded in direct verbal messages, not much is said or written when compared to the low-context communication style, and statements are characterized by high levels of ambiguity (Hall, 1976, Kittler et al., 2011). The idea is that there is no need to say something explicitly when it is self-evident in the surrounding environment (Hofstede & Hofstede, 2005). As for a relationship-oriented communication style, the goal of the communicators is to understand each other and establish connections and a sense of familiarity and belongingness (Froehle, 2006; Jarvenpaa & Leidner, 1998). Therefore, the information exchange is embedded with social meaning.

The authors Jayasekara and Fredriksson (2021) and Bass (1969, 2004) argue that people with individualistic traits will adopt new technology if the performance of that particular technology is perceived to be sufficiently high because more individualistic cultures make decisions and behave according to their self-interests and self-perception. High-performance or high-quality virtual tools, whose functionalities are a good match with specific tasks, have been linked to the improvement of technical efficiency, which means that these tools have the potential to facilitate the needs of these task-focused individuals, for tight time management, efficient task completion, and high individual performance (Ndubuisi et al., 2022; Triandis, 1988). So much so that societies with individualistic traits have been adopting more favorable attitudes toward technology and its adoption (Ang et al., 2020). The very notion that ICTs are created for and adopted in the workplace to enhance organizational efficiency and enable significant business improvements seems to be in line with what is important for individualistic

cultures (Fitzgerald et al., 2014; Huang & Chou, 2023). Additionally, the fact that, because communication mediated by virtual tools lacks in social context cues and social presence compared to face-to-face communication, it tends to favor work interactions that are more limited and task-focused (Berry, 2011). It also decreases the chances of overcomplicating communication and of the messages exchanged containing unnecessary and surplus meaning which could be frustrating for task-focused individuals (Daft et al., 1987). Having this perception will likely influence those with individualistic traits to be more willing to accept and adopt technology.

The opposite is expected for individuals with dominant collectivistic traits. In his study of the influence cultural values have on individual media choices, Rice and colleagues (1998) found that individuals from high-context cultures, with a high-context communication style, preferred face-to-face communication more than those from low-context cultures, with a low-context style of communication. Being able to convey and understand social cues that capture relationships, hierarchies, and other such social nuances, is very important for these individuals (Hofstede, 2001; Kramer et al., 2017; Smith et al., 2011). When compared to the real-life, physical environment where face-to-face interactions take place, the virtual environment is socially poor and characterized by greater levels of cluelessness, that is, by more reduced numbers of social context clues that the individuals interacting have at their disposal (Rutter & Stephenson, 1979). The aspects of the physical environment and nonverbal behaviors are to a greater or smaller extent depleted due to the structural and technical limitations of technologies (Kahai & Cooper, 2003). This should result in a reduction in social presence and in the perception of the other communicators as less real (Rice, 1993). As a consequence, individuals are more likely to perceive technology-mediated interactions as more task-oriented and impersonal which would present a disadvantage for them, even if certain features of technologies offer means to more or less circumvent these limitations (Derks et al., 2004; Rice & Love, 1987). This perception runs counter to the strong interpersonal connection that people with collectivistic traits crave, namely the sentimental need for belonging and being together, and for consensus and harmony (Dekker et al., 2008; Hofstede, 1980).

For all this, individuals with espoused collectivistic cultural values will likely be less willing to use virtual tools to collaborate and thus more likely to collectively experience information deficits when having to rely more on technology to collaborate, as opposed to individuals with espoused individualistic cultural values. Therefore, it is expected that:

> ***H2.a:*** *The relationship between the extent of reliance on virtual tools and experienced information deficits will be moderated by the national culture dimension of collectivism*

such that the positive relationship is stronger for individuals with dominant collectivistic cultural values.

A virtual tool low in synchronicity originates time lags and permits multiple simultaneous transmissions in team interactions, and this allows team members to express their thoughts and ideas entirely, without interruptions and at any moment, when it is desired and more convenient for them, without having to wait for the communication channel to be open or clear (Dennis et al. 1997; Gallupe et al. 1992). It also allows them to transmit a greater volume of information in a given time and to easily discount the indirect, relational implications of messages and focus exclusively on task-related information (Cappel & Windsor, 2000; Dennis et al., 2008; Smith et al., 2011). As a decrease in synchronicity is connected with a decrease in the levels of interaction between communicators, people from individualistic cultures who are more independent and prefer individual and self-organized work and a direct, clear form of communication, will likely derive more satisfaction from using asynchronous technology to collaborate with others (Rodríguez-Rivero et al., 2022; Tu, 2001). Additionally, asynchronous virtual tools also allow for the storing of messages and this, together with time lags, means that individuals have the possibility and time between messages to revisit and process more thoroughly information, which should be a useful feature for efficient task completion (Robert & Dennis, 2005; Straub & Karahanna, 1998).

On the other hand, time lags in team interactions may frustrate the efforts of people from collectivistic cultures – who view tasks as interconnected with the interpersonal context and relationships at work as long-term – to establish bonds and cultivate a feeling of oneness, and preserve harmonious interpersonal relations within the workgroup (Gudykunst et al., 1996; Hofstede, 2001; Srite & Karahana, 2006). Time is a part of the context of interactions and is, therefore, an important element that is just as powerful as language in communication, for those who prefer a more indirect style of communication (Hall, 1976). But more than that, real-time exchanges of information that high transmission velocity allows for provide a chance for team members to connect and feel more that they are part of the team (Dekker et al., 2008; Kirkman & Mathiew, 2005; Staples & Zhao, 2006). In other words, immediacy is connected with higher levels of social presence (Short et al., 1976). This is because the frequency of interaction amongst the communicators should increase as a consequence of them having the ability to rapidly respond to messages, and this increase in interaction should, in turn, lead to them experiencing more interpersonal connections and being more aware of each other (Burke & Chidambaram, 1999; Tu, 2001). This means that communications can approach continuous exchanges that resemble conversations. If, on the other hand, the expected immediacy of

response is not allowed, communicators should perceive low levels of social presence as a consequence of a decrease in interaction (Tu, 2001). Hence, in the case of collectivistic individuals, a virtual tool that allows for synchronicity would be preferred. This assumption is supported by the results of a considerable number of studies on the subject which show that the absence of immediate feedback that characterizes asynchronous ICTs can result in lower levels of satisfaction for individuals with a high context communication style (Montoya-Weiss et al., 2001).

For all this, it is likely that individuals with espoused collectivistic cultural values will prefer to use virtual tools high in synchronicity to collaborate with others and are thus more likely to collectively experience information deficits when their team relies on less synchronous virtual tools to communicate, as opposed to individuals with espoused individualistic cultural values. Therefore, it is expected that:

> ***H2.b:*** *The relationship between media synchronicity and experienced information deficits will be moderated by the national culture dimension of collectivism such that the negative relationship is stronger for individuals with dominant collectivistic cultural values.*

The capacity a virtual tool has to provide language variety and non-verbal cues for communication should be more important for individuals with collectivistic traits than for those with individualistic traits because, as was previously mentioned, people with individualistic traits predominantly use a low-context, task-oriented communication in their interactions. They tend to convey and derive meaning directly from explicit, succinct, and specific words, spoken or written, so what they would be expected to ask from an ICT in terms of information value would be, fundamentally, to convey words and numbers clearly and in the quantity necessary to allow communicators to be thorough when conveying an explicit message (Grice, 1975; Hall, 1976). As they are not so dependent on missing elements from the environment of the interaction, they would not be handicapped by the use of such a lean virtual tool (Hall, 1976; Würtz, 2005). In reality, they could even find it convenient, because of their inclination to see context-related information as irrelevant and to discount it for the sake of focusing on the task at hand (Gudykunst & Nishida, 1993; Sanchez-Burks et al., 2003).

On the other hand, communicating through words tends to be restrictive for people with collectivistic traits since these have little meaning invested in them (Hall, 1976). These individuals rely greatly on indirect messages and non-verbal, context-related cues to communicate, since these allow speakers to know more about the other communicators and to

display affective behaviors (Hall, 1976; Treven, 2003). Communication and information technologies that enable information to be expressed in a greater variety of ways can generate higher levels of perceived social presence and therefore should be preferred by those who champion a high-context and relationship-oriented communication style (Dennis et al., 2008; Tu, 2001). According to the theory 'filtered out cues', a technology low in information value does not enable a great variety of ways to encode information for communication that more collectivistic people require (Sproull & Kiesler, 1986; Sproull et al., 1984). Additionally, the few cues it enables communicators to convey and interpret (e.g., graphics, pictures, punctuation) are not natural symbols, like nodding the head is, for example (Dennis et al., 2008). In fact, studies show that when more natural social cues are depleted as a consequence of having adopted a virtual tool to collaborate with a lower level of information value, people with a more high-context relationship-oriented communication seek strategies to compensate for this and generate interpersonal context, which involves using other less natural non-verbal elements like emojis (Kahai & Cooper, 2003).

For all this, individuals with espoused collectivistic traits should see greater benefit in using a virtual tool with higher information value compared to individuals with individualistic cultural values, due to its capacity to put more social context clues at the communicators' disposal. These individuals are, thus, more likely to collectively experience information deficits when their team relies on virtual tools poorer in information value to communicate. Therefore, it is expected that:

> ***H2.c:*** *The relationship between the information value of virtual tools and experienced information deficits will be moderated by the national culture dimension of collectivism such that the negative relationship is stronger for individuals with dominant collectivistic cultural values.*

2.3. Team Perceived Virtuality and E-leadership

E-leadership has been described by the most important voices in the literature as a social impact construct or a social influence process facilitated by virtual tools (Avolio et al., 2014; Contreras et al., 2020; Roman et al., 2018). As such, e-leaders have the potential to induce changes in individuals' feelings, thinking, attitudes, and behaviors with the help of ICTs (Avolio et al., 2014; Savolainen, 2014).

Despite studies on e-leadership being currently scarce, some have already empirically tested this premise and showed how e-leadership as a social influence process can exert a

positive influence on individual and team outcomes in virtual teams, such as employee commitment, employee performance, workplace well-being, and organizational innovation performance (e.g., Ahmed et al., 2022; Maheshwari et al., 2024; Zhong et al., 2023). Particularly, the findings of a few studies suggest the potential impact of e-leadership on ICT utilization patterns in virtual workplaces (e.g., Purnomo et al., 2023; Wang et al., 2022). A significant correlation has also been found between leadership and national culture. Studies suggest that the influence e-leadership can exert on individual and team outcomes is culturally contingent (Gelfand et al., 2007; House et al., 2004; Li et al., 2021). That is, employees' perception of leader behavior and their leadership preferences are significantly related to national values. Consequently, the greater the leadership-national culture values fit, the greater the leader's influence (e.g., House et al., 2004; Lian et al., 2012; Rabl et al., 2014). Despite research on the subject being so far scarce, a few studies suggest that all this could be true in the case of e-leadership (e.g., Gallenkamp et al., 2011; Liu et al, 2020).

E-leadership is not an extension of traditional leadership (Avolio & Kahai, 2003). Between these two constructs, there is a fundamental difference: whereas traditional leadership is mediated solely by face-to-face communication, e-leadership is, to a greater or smaller extent, mediated by information and communication technologies (Van Wart et al., 2019). Hence, e-leadership presents unique challenges since communication done through virtual tools is more complex than communication done purely in traditional physical settings; challenges such as time and space separation, diversity of backgrounds, and the technical limitations of technology, which imply greater levels of cluelessness, reduced social presence, a less organic and natural relationship building process, and can originate distortions in information interpretation (Cascio, 2000; Contreras et al., 2020; Rice, 1993; Rutter & Stephenson, 1979). Additionally, leaders are expected to be competent in using ICTs that continue to evolve and complexify at a rapid pace (Avolio et al., 2014; Liu et al., 2020).

Because of this many scholars agree that e-leadership is a distinct crucial ability in organization management, which is more challenging than traditional leadership, making the competencies required for successful traditional leadership insufficient for effectively leading in a virtual context (Bell & Kozlowski, 2002; Hoch & Kozlowski, 2014). Successful e-leaders, therefore, need to develop distinct competencies and adopt distinct practices (Fan et al., 2014; Roman et al., 2018). Consequently, e-leadership theories incorporate some propositions from generic leadership theories but extend beyond them to address the unique demands of virtual environments (Liu et al., 2020).

The most commonly accepted definition of e-leadership is the one provided by Avolio and colleagues (2014). According to the authors, e-leadership is "a social influence process embedded in both proximal and distal contexts mediated by AIT that can produce a change in attitudes, feelings, thinking, behavior, and performance" (p. 107). Based on this conceptualization, Van Wart et al. (2019) came up with a new definition that could be applied theoretically and empirically in different settings: "e-leadership is the effective use and blending of electronic and traditional methods of communication. It implies an awareness of current ICTs, selective adoption of new ICTs for oneself and the organization, and technical competence in using those ICTs selected" (p. 83). This definition suggests that e-leadership is not about completely replacing traditional communication methods with technology-mediated communication, nor is it solely about using or failing to use ICTs to influence beliefs, attitudes, and behaviors. Instead, e-leadership involves leveraging efficient collaborative work by taking advantage of advancements in communication technology, knowing how to use a variety of them competently, selecting the most appropriate ones for specific purposes, and integrating them with traditional communication methods when appropriate (Van Wart et al., 2019).

According to Van Wart et al.'s (2019) conceptualization, effective electronic leadership depends on six interrelated e-leader competencies: e-communication, e-social skills, e-team building, e-change management, e-technology skills, and e-trustworthiness. Building on these competencies, Roman et al. (2018) developed a scale to measure effective e-leadership: the SEC (Six E-Competency) model. This model has already been used in several studies and, consequently, has received significant empirical validation (e.g., Ahmed et al., 2022; Alkhayyal & Bajaba, 2023; Chaudhary et al., 2022; Liu et al., 2020; Zhong et al., 2023).

According to Roman et al. (2018), e-communication reflects a leader's ability to communicate clearly and appropriately through the effective use of ICTs, e-social skills involve creating a virtual work atmosphere characterized by adequate social interactions and collaboration, where individuals feel supported and connected, and e-team building refers to a leader's capacity to motivate virtual team members and hold them accountable. As for e-change management, it highlights the ability that leaders should have to inspire change and manage change initiatives effectively in a digital environment. E-technology skills have to do with how technologically savvy a leader is, and these imply that leaders should possess the technical knowledge needed to use virtual tools effectively, be well informed on current technology developments and security issues, and know how to find the best ICT-situation fit. Finally, e-trustworthiness refers to a leader's ability to build trust in a virtual environment by fostering a sense of honesty, fairness, consistency, integrity, and support of diversity.

The authors of the TPV conceptualization and framework argue that e-leadership can have a critical positive social impact in reducing the levels of team perceived virtuality because a leader can help develop more positive virtuality beliefs, which include those beliefs about technology use (Costa & Handke, 2023). Leidner & Kayworth (2006) propose something similar: that management could reduce contribution and system conflict by promoting positive IT values. Therefore, an individual with dominant collectivistic traits, who thinks of ICTs in general as isolating could be inspired by their leader to think of them in a more positive light, as, for instance, conducive to connectedness across time and space.

Studies have already shown that leaders can positively affect employee and team outcomes by cultivating positive beliefs. Leroy and colleagues (2022), for instance, showed that by promoting value-in-diversity beliefs, leaders could facilitate collective creativity. Similarly, Schaubroeck and colleagues (2016) found that peer transformational leadership led to increases in coworkers' adherence to the desired customer service behaviors and in their service performance by enhancing the coworkers' positive beliefs about exhibiting such behaviors. Likewise, Groves and LaRocca (2012) demonstrated that transformational leadership can elicit follower extra effort partly by cultivating positive beliefs about corporate social responsibility. Several studies show that cultivating positive beliefs involves showing the benefits and highlighting the value of the object of the beliefs for positive personal and organizational outcomes, such as task completion, effective performance, and organizational effectiveness (Al-Obaydi, 2020; Groves & LaRocca, 2012; Schaubroeck et al., 2016; Van Knippenberg et al., 2007).

The study conducted by Purnomo et al. (2023) shows that a similar dynamic can occur in a virtual environment. The authors found that e-leadership can have a significant effect on teacher attitudes in using virtual learning environments (VLE) and that these attitudes are mainly influenced by perceived benefits, namely that using a particular VLE system will improve job performance. In fact, studies on technology acceptance found that the perceived usefulness of using a certain IT tool for work performance, based on system characteristics, significantly explains why users accept or reject IT tools (e.g., Davis, 1989; Elkhani et al., 2014; Na et al., 2023). Some of these studies showed that national cultural value orientation is one of the factors that can influence perceived usefulness (Alshare et al., 2014; Nistor et al., 2013; Sun et al., 2019).

These findings are supported by the Theory of Planned Behavior which states that favorable or unfavorable attitudes toward behaviors explain behavior engagement and are in turn explained by *behavioral beliefs* – the beliefs that individuals hold about a certain behavior based on the outcomes they associate with the behavior and their expected value (Ajzen, 1991).

Therefore, individuals could develop more favorable attitudes toward a behavior if they were led to believe performing it would result in desirable outcomes (Schaubroeck et al., 2016).

According to Schaubroeck and colleagues (2016) by serving as role models for a desired behavior, leaders can influence and change behavioral beliefs, for in doing so they demonstrate the positive outcomes associated with the behavior. Potipiroon and Thawornprasert (2023) propose something similar: by demonstrating that changes in the work routines can be made, leaders can shape followers' belief in their ability to carry out change efforts.

Based on these reasonings, it is expected that by demonstrating to team members that using ICTs for collaborating results in effective information exchanges, e-leaders would be cultivating more positive beliefs about technology and virtuality, which in turn would result in low levels of national culture-IT conflict.

However, what constitutes effective information exchanges or effective communication varies according to the espoused national cultural values of individuals. In the case of the national culture dimension of collectivism, whereas individuals with dominant collectivistic traits experience more communication satisfaction when communication is high-context and relationship-oriented, those with more individualistic traits perceive as most effective a low-context and task-oriented communication style (Gudykunst & Ting-Toomey, 1988; Hall, 1976; Jarvenpaa & Leidner, 1998; Sanchez-Burks et al., 2003). A leader would then need to make sure they cultivate positive ICT beliefs that take into consideration what is important in terms of communication for each national culture dimension.

For all this, it would be expected that e-leaders who demonstrate strong e-communication skills would effectively cultivate positive technology beliefs and reduce levels of national culture-IT conflict, because they would be able to show that technology-mediated communication can be effective and valuable for team functioning, considering an individual's espoused national values. E-communication skills have a strong positive impact on employee communication, job performance, and job satisfaction (Ahmed et al., 2022). Leaders with strong e-communication skills are adept at choosing from a variety of ICTs and using them effectively to communicate in a clear and organized manner, to allow for feedback, and to avoid errors, miscommunication, and information overload, with the ultimate goal of enhancing performance (Ahmed et al., 2022; Brake, 2006; Snellman, 2014; Wang et al., 2022). They must, therefore, make crucial decisions about the most appropriate ICT to use according to the specific situation, bearing in mind the objective features of the medium, the task at hand, relational requirements, and the expectations of team members (Gallenkamp et al., 2011; Kortsch et al., 2022; Leonardi et al., 2012; Roman et al., 2018). In this regard, Wang and colleagues (2022) argue that strong

e-leaders differ from weak e-leaders in that they have a greater, more consistent, and more flexible use of multiple ICTs to communicate with members, which involves alternating and combining uses of diverse lean and rich media to match specific tasks and relational requirements.

Thus, it is likely that when leaders demonstrate a strong e-communication competence, individuals with espoused collectivistic cultural values will be more willing to use virtual tools to collaborate and will be less likely to experience system conflict when they use virtual tools to interact that are less asynchronous and have lower information value. As a consequence, they will be less likely to collectively experience information deficits. Likewise, it is likely that when leaders demonstrate a strong e-communication competence, individuals with espoused individualistic cultural values will be less likely to experience system conflict when they use virtual tools to interact that are more synchronous and have higher information value. As a consequence, they will be less likely to collectively experience information deficits. Therefore, it is expected that:

H3.a: *The effects of the national culture dimension of collectivism on the relationship between the reliance on virtual tools and experienced information deficits will be moderated by e-leadership such that the effect is weaker when the team leader demonstrates e-communication competence.*

H3.b: *The effects of the national culture dimension of collectivism on the relationship between media synchronicity and experienced information deficits will be moderated by e-leadership such that the effect is weaker when the team leader demonstrates e-communication competence.*

H3.c: *The effects of the national culture dimension of collectivism on the relationship between the information value of virtual tools and experienced information deficits will be moderated by e-leadership such that the effect is weaker when the team leader demonstrates e-communication competence.*

2.4. Research Model

Considering the hypotheses mentioned, the following research model was proposed and tested:

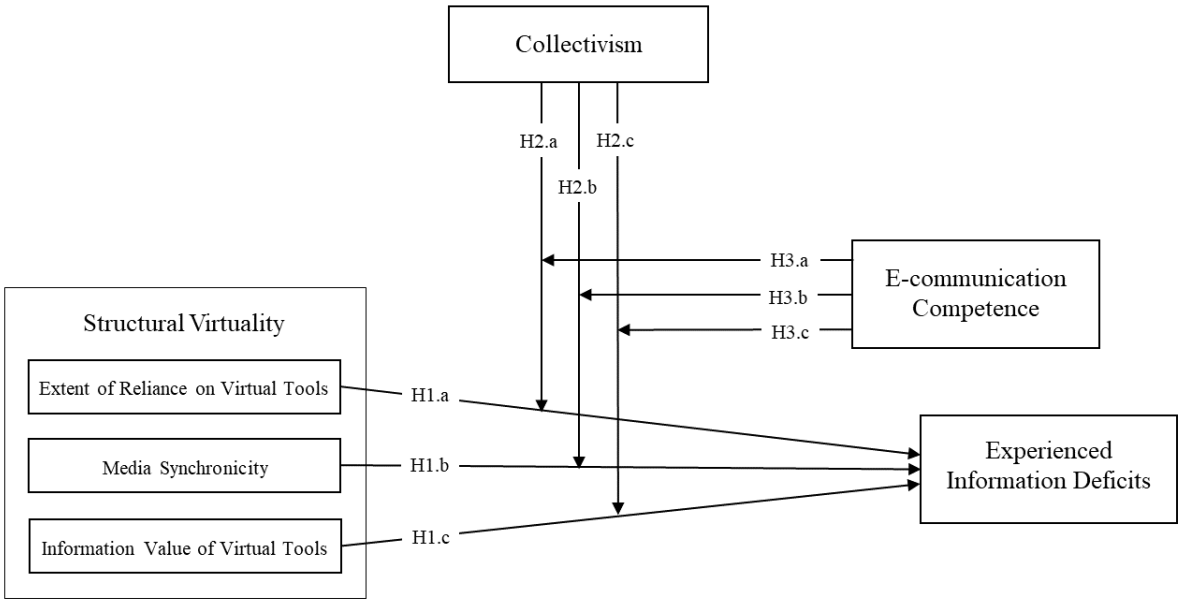

Figure 2.1: Relation Chart of Variables: Experienced Information Deficits, Structural Virtuality (Extent of Reliance on Virtual Tools, Information Value of Virtual Tools, and Media Synchronicity), Collectivism, and E-communication Competence.

CHAPTER III

Methodology

3.1. Procedure

This study is a quantitative research study and applied a cross-sectional survey design which referred to the individual level of analysis. Data were collected from individuals worldwide through a self-administered online questionnaire from 1 May to 30 June 2024. A convenience sampling method was employed to collect the data, which allows for more diverse samples to be obtained and is thus advantageous when an international sample is concerned (Landers & Behrend, 2015). Industry, job function, and nationality diversity were consciously sought. Accordingly, an invitation to participate in the online survey containing the link to access the questionnaire was sent to approximately 1200 individuals via direct message on LinkedIn. In this way, individuals who were easiest to access at random were selected. The response rate was 20.8%.

The online survey was designed on Qualtrics, organized into five sections, and took approximately 10 minutes to complete. The language adopted was English. After a short debriefing text explaining the nature and goals of the research, participants were asked whether they worked or had worked in a team and whether they used or had used virtual tools, to a greater or lesser extent, to collaborate with their team members. If they answered “no” to one of these questions, the questionnaire ended automatically, as the participants did not fulfill the selection criteria. If they answered “yes” to both questions, they could continue filling in the questionnaire and would be asked to answer sociodemographic questions (Section A) and to state, according to their thoughts, emotions, and perceptions, their level of agreement with statements about their national cultural values (Section B), the objective qualities of the virtual tools their team used/had used to collaborate (Section C), the quality of their information exchanges (Section D), and the communication skills of their virtual team leader (Section E). All participants were assured of absolute anonymity and the confidentiality of their information, and they provided informed consent.

3.2. Sample

Of the 1200 individuals invited to participate in the survey, 249 fulfilled the basic criteria for further analysis (worked or had worked in a team and used or had used virtual tools, to a greater or lesser extent, to collaborate with their team members), but only 208 were included in the final analysis. Exclusion reasons were as follows: stopped answering before the completion of

the online survey (n = 38); selected the same response to all questions (n = 3). The final sample characteristics are shown in Table 3.1.

In the final sample (n = 208), participants' age ranged from 20 to 68 years (*M* = 30.8, *SD* = 8.358), and most of them, 69.7% (n = 145), identified as female. In total, 54 nationalities were represented in the sample. Most participants were Portuguese (22.1%), German (8.2%), Italian (3.8%), Dutch (3.8%), Brazilian (3.4%), Chinese (3.4%) and Swiss (3.4%), and 3.8% of them had dual nationality. The large majority of respondents (93.7%) held a higher educational degree, with 58.2% of them having completed a master's degree and 31.7% a bachelor's degree.

The sample comprised mainly ICT professionals (30.3%) such as software developers, web developers, and data analysts, but also administration professionals (26%), sales and marketing professionals (13%), finance professionals (9.1%), engineering professionals (3.8%), teaching professionals (3.8%), designers (3.4%), or other (10.6%). Respondents were employed in various business sectors: mainly in IT services activities (36.1%), but also in finance, insurance and real estate (13.9%), business administration (8.2%), education (7.2%), media industry (4.3%), wholesale and retail trade (3.8%), transportation and storage (3.4%), construction (3.4%), human health and social services activities (3.4%), manufacturing of food and beverages (2.4%), or other (13.9%) areas.

Participants' team size ranged from 2 to 70 members (M = 10.68, *SD* = 9.319). About half (55.3%) of respondents indicated that a member of the team was formally responsible for the team's leadership and performance. The other half indicated other leadership sources, namely that leadership responsibilities were shared among team members or certain team members emerged informally as leaders (38%), that an individual outside the team was formally responsible for the team's leadership and performance (5.3%), and that individuals outside the team sought to meet the team's critical needs, like mentors or champions (1.4%). Moreover, most participants reported that not all of their team members shared their nationality (60.6%). Accordingly, the sample was characterized by a considerably high degree of team multiculturality.

Table 3.1: Sample Characteristics.

		(n = 208)	
Variables	Distribution	Frequency or Min-Max	% or M ± SD
Gender	Male	63	30.3%
	Female	145	69.7%
Age (years)		20-68	30.8 ± 8.358
Education level	High school	13	6.3%
	Bachelor's degree	66	31.7%
	Postgraduation	3	1.4%
	Master's degree	121	58.2%
	PhD	5	2.4%
Nationality	Portuguese	46	22.1%
	German	17	8.2%
	Italian	8	3.8%
	Dutch	8	3.8%
	Brazilian	7	3.4%
	Chinese	7	3.4%
	Swiss	7	3.4%
	Other	100	51.9%
Job function	ICT professionals	63	30.3%
	Administration professionals	54	26%
	Sales and marketing professionals	27	13%
	Finance professionals	19	9.1%
	Engineering professionals	8	3.8%
	Teaching professionals	8	3.8%
	Designers	7	3.4%
	Other	22	10.6%
Industry	IT services activities	75	36.1%
	Finance, insurance, and real estate	29	13.9%
	Business administration	17	8.2%
	Education	15	7.2%
	Media industry	9	4.3%
	Wholesale and retail trade	8	3.8%
	Transportation and storage	7	3.4%
	Construction	7	3.4%
	Human health and social services activities	7	3.4%
	Manufacturing of food and beverages	5	2.4%
	Other	29	13.9%
Team size		2-70	10.68 ± 9.319
Team leadership source	A member of the team is formally responsible for the team's leadership and performance.	115	55.3%
	Leadership responsibilities are shared among team members or certain team members emerge informally as leaders.	79	38%
	An individual outside the team is formally responsible for the team's leadership and performance.	11	5.3%
	Individuals outside the team seek to meet the team's critical needs, like mentors or champions.	3	1.4%
Team multiculturality	Yes	126	60.6%
	No	82	39.4%

3.3. Measures

3.3.1. Perceived Information Deficits

The cognitive dimension of team perceived virtuality – perceived information deficits – was measured using the 5-item subscale related to this dimension from the TPV scale developed by Handke and colleagues (2024). The items were classified on a 7-point Likert scale and participants had to position themselves on a continuum ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). High values indicate a high manifestation of perceived information deficits. An example item is "When we exchange information in my team it's difficult to understand if we are on the same page or not". The scale showed a very good reliability, with Cronbach's $\alpha = .88$.

3.3.2. Structural Virtuality

To measure the 3 dimensions identified by Kirkman and Mathieu (2005) in their objective conceptualization of virtuality, different scales were used for each dimension.

The extent of reliance on virtual tools was measured according to duration, frequency, and intensity of use, by adapting 3 items from Venkatesh et al.'s (2008) scale for the predictors of system use: (1) "In general, what is the percentage of time you spend using virtual tools to work and interact with your team members each week?", (2) "How often do you use the virtual tools to work and interact with team members?" and (3) "How do you consider the extent of your current virtual tool use?". In the case of frequency and intensity of use, the respondents used a 7-point Likert-type scale, anchored in (1) *don't use at all* to (7) *use several times each day* and in (1) *never* to (7) *many times a week*, respectively. In the case of duration, however, the survey asked for a percentage to indicate time per week. High values indicate a high level of reliance on virtual tools for teamwork. The scale showed good reliability, with Cronbach's $\alpha = .83$.

As for media synchronicity, this dimension was measured using 6 items taken from He and Yang's (2016) media capabilities scale, related to transmission velocity and reprocessability, which was based on Dennis et al.'s (2008) conceptualization of media synchronicity. The scale was adapted to apply to virtual tools in general (rather than just *wikis*). Exemplary items are "The virtual tool allows my messages to reach the recipients as soon as they are sent" (transmission velocity) and "The virtual tool allows me to reexamine and reprocess previously sent content during the interaction" (reprocessability). The items were classified on a Likert 7-point scale and responses ranged from 1 (*strongly disagree*) to 7 (*strongly agree*), such that high values indicate a high level of media synchronicity. Given that high levels of media synchronicity are conceptualized as comprising both high levels of transmission velocity and

low levels of reprocessability, the reprocessability items were reverse coded so that high values would indicate low reprocessability and sub-scores were collapsed into one overall score. The scale showed good reliability, with a very good Cronbach's α = .92.

Finally, in the case of the information value of virtual tools, no scale designed specifically to measure this construct was found. However, the concept of information value is similar to that of media richness, and the variety of language and multiplicity of cues are criteria used to characterize both (Brown et al., 2020; Kirkman & Matthew, 2005). As such, the concept was measured using 3 items reflective of language variety and 2 items reflective of multiple cues from Chao et al.'s (2020) media richness perception scale. The items were rewritten to specifically apply to the properties of ICTs (rather than just *the design of the learning process*) and to enhance clarity and were measured using the 7-point Likert scale method. Responses from "*strongly disagree*" to "*strongly agree*" were assigned scores of 1 to 7, respectively, such that high values indicate a high level of information value. Sample items are "The virtual tool provides a more flexible way of expression that allows me to freely use the language with which I am familiar, such as my mother tongue, English, graphics, symbols, that can help convey clearly the intended message" (language variety) and "The virtual tool allows me to use, besides language and numbers, other non-verbal cues when communicating with others (such as facial expression, body language, emotional tone, formality, audio-visuals)" (multiple cues). Given that high levels of information value are conceptualized as comprising both high levels of language variety and multiple cues sub-scores were collapsed into one overall score. The scale showed a very good reliability, with Cronbach's α = .87.

3.3.3. Collectivism

Collectivism was measured using 6 items taken from the CVSCALE, a 26-item five-dimensional scale of individual cultural values that assesses Hofstede's (1994) cultural dimensions at the individual level, developed by Yoo et al. (2011). This scale is reliable with validity and generalizability across sample types and countries (Yoo et al., 2011). The items were classified on a 5-point Likert scale and participants had to position themselves on a continuum ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). High values indicate a dominance of collectivistic values, whereas low values indicate a dominance of individualistic values. An example item is "Group welfare is more important than individual rewards". Factor loadings were calculated to test the fit of each item with the construct. To improve model fit, 2 items with low factor loadings were deleted: "Individuals should sacrifice self-interest for the group" (λ = .34) and "Individuals should stick with the group even through difficulties" (λ = .34).

Consequently, collectivism was measured using 4 items. The analysis for internal consistency yielded a Cronbach's α of .78 which suggests good reliability.

3.3.4. E-communication Competence

To measure the e-leader competence considered in this study, e-communication, the 3 items from the e-leadership scale developed by Roman et al. (2018) related to e-communication were used. The items were classified on a Likert 7-point scale, where participants had to position themselves on a continuum ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). High values indicate a high perception of the leader's e-communication skills. One exemplary item is "The leader ensures that their virtual communication is not excessive to the point of impeding the ability of employees to get their work done". The Cronbach's α of this scale was .79, revealing a good reliability.

3.3.5. Control Variables

The demographic variables gender (male or female) and team multiculturality (yes or no) were also controlled for in the analysis since these two were significantly correlated with the extent of reliance on virtual tools, and gender was also correlated with collectivism.

Table 3.2 below presents the Cronbach's α values used to assess the reliability of each construct featured in this study, along with the factor loadings calculated to evaluate the fit of each item with its respective construct.

Table 3.2: Internal Validity of Constructs and Item Loadings.

	Factor loading	CA
Perceived Information Deficits (PID) (Handke et al., 2024)		0.88
PID1: When we exchange information in my team the ways in which we can express ourselves are limited.	0.81	
PID2: When we exchange information in my team it's hard to convey the actual meaning of what we are saying.	0.89	
PID3: When we exchange information in my team it's difficult to understand if we are on the same page or not.	0.86	
PID4: When we exchange information in my team we are unable to convey the necessary information in its entirety.	0.81	
PID5: When we exchange information in my team we don't know whether everyone has had access to the same information.	0.74	
Extent of Reliance on Virtual Tools (ER) (Venkatesh et al., 2008)		0.83
ER1: In general, what is the percentage of time you spend using virtual tools to work and interact with your team members each week?	0.83	
ER2: How often do you use the virtual tools to work and interact with team members?	0.87	
ER3: How do you consider the extent of your current virtual tool use?	0.91	
Media Synchronicity (MS) (He & Yang, 2016)		0.92
MS1: The virtual tool allows my messages to reach the recipients as soon as they are sent.	0.83	
MS2: The virtual tool allows my messages to be responded immediately.	0.82	
MS3: The virtual tool allows instantaneous feedback.	0.85	
MS4: The virtual tool allows me to reexamine and reprocess previously sent content during the interaction. [R]	0.88	
MS5: The virtual tool allows me to reexamine and reprocess previously sent content after the interaction. [R]	0.85	
MS6: The virtual tool allows me to reexamine and consider previously sent content for developing understanding and additional consideration. [R]	0.84	
Information Value of Virtual Tools (IV) (Chao et al., 2020)		0.87
IV1: The virtual tool provides a more flexible way of expression that allows me to freely use the language with which I am familiar, such as my mother tongue, English, graphics, symbols, that can help convey clearly the intended message.	0.77	
IV2: The virtual tool offers me richer and more diverse ways of accentuate the meaning of the words (such as pace, volume, pauses, punctuations, font size, color).	0.86	
IV3: The virtual tool offers the option of attaching elements like pictures and graphs that can help with understanding the information when transmitting the information.	0.81	
IV4: The virtual tool allows me to use, besides language and numbers, other non-verbal cues when communicating with others (such as facial expression, body language, emotional tone, formality, audio-visuals, pictures, graphs).	0.85	
IV5: The virtual tool allows me to provide more detailed non-verbal cues as auxiliary information when I am communicating with others.	0.80	
Collectivism (COL) (Yoo et al., 2011)		0.78
COL1: Group welfare is more important than individual rewards.	0.77	
COL2: Group success is more important than individual success.	0.85	
COL3: Individuals should only pursue their goals after considering the welfare of the group.	0.74	
COL4: Group loyalty should be encouraged even if individual goals suffer.	0.75	
E-communication Competence (EC) (Roman et al., 2018)		0.79
EC1: In their virtual communication, the leader is clear, well organized, and allows for feedback to avoid errors and untested assumptions.	0.86	
EC2: In their virtual communication the leader sometimes conveys unintended messages that leave the receiver feeling insulted or angry because of tone or misunderstandings. [R]	0.85	
EC3: The leader ensures that their virtual communication is not excessive to the point of impeding the ability of employees to get their work done.	0.81	

CHAPTER IV

Results

4.1. Hypotheses Testing

Prior to testing the hypotheses, a correlation analysis was conducted to inspect the data for possible multicollinearity. The correlations among the focal variables in the study, as well as the means, and standard deviations, are reported in Table 4.1. The results showed that collectivism did not correlate significantly with perceived information deficits ($r = –.06$). This construct also did not significantly correlate with any of the three dimensions of structural virtuality ($r = –.08, .01, .02$, respectively), nor did perceived information deficits ($r = –.04, –.09, –.08$, respectively) or e-communication competence ($r = .04, .12, .13$, respectively). The results also showed that collectivism and e-communication competence were not significantly correlated ($r = –.09$). However, a moderate negative correlation was found between e-communication competence and perceived information deficits ($r = –.34$; $\rho < .001$), and significant positive correlations were observed amongst the three dimensions of structural virtuality: between the extent of reliance on virtual tools and media synchronicity ($r = .31$; $\rho < .001$); between media synchronicity and information value of virtual tools ($r = .69$; $\rho < .001$); and between extent of reliance on virtual tools and information value of virtual tools ($r = .20$; $\rho < .001$). As for the control variables, team multiculturality was slightly positively correlated with the extent of reliance on virtual tools ($r = .24$; $\rho < .001$), and gender was slightly negatively correlated with collectivism ($r = –.29$; $\rho < .001$) and the extent of reliance on virtual tools ($r = –.18$; $\rho < .01$). All in all, the results of the correlation analysis indicate no initial support for any of the study hypotheses but point to the existence of other possible significant relationships between variables.

Table 4.1: Means, Standard Deviations, and Correlations of Relevant Variables.

	M	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Gender	1.70	.46							
2. T. Multiculturality	1.61	.49	.03						
3. COL	3.56	1.11	-.29**	.00					
4. ER	5.54	1.43	-.18*	.24**	-.08				
5. MS	5.73	1.34	.05	.06	.01	.31**			
6. IV	5.47	1.28	-.01	.05	.02	.20**	-.69**		
7. EC	5.45	1.15	-.08	-.06	.09	.04	.12	.13	
8. PID	3.71	1.32	-.12	.10	-.06	-.04	-.09	-.08	-.34**

N = 208. *p <.01. **p <.001. COL, collectivism; ER, the extent of reliance on virtual tools; MS, media synchronicity; IV, information value of virtual tools; PID, perceived information deficits; EC, e-communication competence.

The research model was assessed empirically using Hayes's PROCESS Macro for SPSS version 29.0, a useful data analysis technique to explore the effects of one or more moderating variables (W and Z) on the relationship between an independent variable (X) and a dependent variable (Y), that does not require normal distributed samples, reduces the possibility of Type l errors, and performs better than other tools when the sample is small (Hayes, 2013; Hayes & Preacher, 2010). Under this technique, a 5000-sample bootstrap procedure is used to estimate bias-corrected 95% confidence intervals (CIs) and when the value "zero" is not comprehended in the interval from the lower to the upper bound of the CI, any interaction effect is judged as significant (Hayes & Preacher, 2010). On the other hand, if the lower bound CI is negative and the upper bound CI is positive, one cannot trust the effect to be significant.

Model 1 (one moderator) of the PROCESS Macro was used to test the direct relationship between structural virtuality dimensions and perceived information deficits as well as the moderating effect of collectivism on this relationship (*H1.a, H1.b, H1.c, H2.a, H2.b, H2.c*), and Model 3 (two interacting moderators) was used to estimate the moderating effect of an e-leader's e-communication competence on the first moderation (*H3.a, H3.b, H3.c*) (Hayes, 2013). Gender and team multiculturality were used as control variables in both models.

Table 4.2 presents the results of the Hayes PROCESS Macro regression to test the direct effects of structural virtuality dimensions on perceived information deficits and the moderation effects of collectivism (*H1.a, H1.b, H1.c, H2.a, H2.b, H2.c*). In the case of the extent of reliance on virtual tools, the results clearly show an insignificant interaction effect between this variable and perceived information deficits (B = –.0601, *95%CI* [–.1932, .0729], p = .3739) and there is no evidence of a moderating effect of collectivism on the relationship between these two variables (B = –.0969, *95%CI* [–.2146, .0208], p = .1060). Thus, hypotheses *1.a* and *2.a* were not supported. However, the results did show a significant positive interaction effect between the control variable team multiculturality and perceived information deficits (B = .4167, *95%CI* [.0368, .7966], p =.0317) and a significant negative interaction effect between the control variable gender and perceived information deficits (B = –.4171, *95%CI* [–.8227, –.0115], p = .0439). This implies that higher levels of team multiculturality could lead to higher levels of perceived information deficits and that team members who identify as females could experience lower levels of perceived information deficits compared to those who identify as male.

As for media synchronicity, this dimension of structural virtuality is also not a significant predictor of perceived information deficits (B = –.0263, *95%CI* [–.0549, .0023], p = .0711), and there is no evidence of a moderating effect of collectivism on the relationship between these two variables (B = –.0050, *95%CI* [–.0316, .0216], p = .7122). Hence, the results also do not

support hypotheses *1.b* and *2.b*. However, as happened in the previous case, the analysis indicates that the control variable team multiculturality positively influences perceived information deficits (*B* = .4026, *95%CI* [.0306, .7746], *p* = .0341) and gender negatively influences perceived information deficits (*B* = –.4139, *95%CI* [–.8197, –.0081], *p* = .0456).

The results also show that the information value of virtual tools does not have a significant direct effect on perceived information deficits (*B* = –.0902, *95%CI* [–.2295, .0491], *p* = .2031) and that there is no significant moderating effect of collectivism on the relationship between these two variables (*B* = –.0676, *95%CI* [.2792, –.1904], *p* = .0553). Thus, hypotheses *1.c* and *2.c* were also not supported by the results of this analysis. However, once again, a significant positive interaction effect was found between the control variable team multiculturality and perceived information (*B* = .4006, *95%CI* [.0291, .7720], *p* = .0347) and a significant negative interaction effect was found between the control variable gender and perceived information deficits (*B* = –.4376, *95%CI* [–.8413, –.0339], *p* = .0338).

Table 4.2: Results of Hayes PROCESS Macro Model 1: Moderation.

	B	***SE***	***t(df)***	***LL CI***	***UL CI***	***p***
Test 1: ER as independent variable (X)						
ER	-.0601	.0675	-.8912	-.1932	.0729	.3739
COL	-.1175	.0859	-1.3674	-.2868	.0519	.1730
Inter 1 (ER x COL)	-.0969	.0597	-1.6236	-.2146	.0208	.1060
Team Multiculturality	.4167	.1927	2.1631	.0368	.7966	.0317
Gender	-.4171	.2057	-2.0279	-.8227	-.0115	.0439
Test 2: MS as independent variable (X)						
MS	-.0263	.0145	-1.8143	-.0549	.0023	.0711
COL	-.1290	.0849	-1.5200	-.2963	.0383	.1301
Inter_1 (MS x COL)	-.0050	.0135	-.3695	-.0316	.0216	.7122
Team Multiculturality	.4026	.1887	2.1339	.0306	.7746	.0341
Gender	-.4139	.2058	-2.0112	-.8197	-.0081	.0456
Test 3: IV as independent variable (X)						
IV	-.0902	.0706	-1.2770	-.2295	.0491	.2031
COL	-.1294	.0850	-1.5227	-.2971	.0382	.1294
Inter 1 (IV x COL)	-.0676	.0623	-1.0850	.2792	-.1904	.0553
Team Multiculturality	.4006	.1884	2.1265	.0291	.7720	.0347
Gender	-.4376	.2047	-2.1374	-.8413	-.0339	.0338

ER, the extent of reliance on virtual tools; MS, media synchronicity; IV, information value of virtual tools; COL, collectivism; SE, standard error; LL CI, lower level of the 95% confidence interval; UL CI, upper level of the 95% confidence interval. All predictor variables were mean-centered.

Table 4.3: Results of Hayes PROCESS Macro Model 3: Moderated Moderation.

	B	*SE*	*t(df)*	*LL 95%CI*	*UL 95%CI*	*p*
Test 1: ER as independent variable (X)						
ER	-.0261	.0647	-.4041	-.1537	.1014	.6866
COL	-.0820	.0829	-.9895	-.2454	.0814	.3236
Inter_1 (ER x COL)	-.0807	.0619	-1.3033	-.2029	.0414	.1940
EC	-.4009	.0771	-5.2012	-.5529	-.2489	.0000
Inter_2 (ER x EC)	.0670	.0538	1.2455	-.0391	.1732	.2144
Inter_3 (COL x EC)	-.0811	.0814	-.9963	-.2416	.0794	.3203
Inter_4 (ER x COL x EC)	-.0292	.0647	-.4507	-.1568	.0984	.6527
Team Multiculturality	.4219	.1843	2.2886	.0583	.7854	.0232
Gender	-.4621	.1935	-2.3884	-.8436	-.0805	.0179
Test 2: MS as independent variable (X)						
MS	-.0156	.0138	-1.1323	-.0427	.0116	.2589
COL	-.1057	.0817	-1.2945	-.2668	.0553	.1970
Inter_1 (MS x COL)	-.0010	.0130	-.0751	-.0267	.0248	.9402
EC	-.4044	.0765	-5.2892	-.5552	-.2536	.0000
Inter_2 (MS x EC)	.0195	.0127	1.5298	-.0056	.0445	.1277
Inter_3 (COL x EC)	-.0795	.0788	-1.0088	-.2350	.0759	.3143
Inter_4 (MS x COL x EC)	.0116	.0132	.8795	-.0144	.0375	.3802
Team Multiculturality	.3858	.1793	2.1510	.0321	.7394	.0327
Gender	-.4472	.1938	-2.3072	-.8294	-.0650	.0221
Test 3: IV as independent variable (X)						
IV	-.0404	.0677	-.5977	-.1739	.0930	.5507
COL	-.0999	.0819	-1.2202	-.2614	.0616	.2238
Inter_1 (IV x COL)	-.0265	.0607	-.4365	-.1461	.0931	.6629
EC	-.4172	.0767	-5.4371	-.5685	-.2659	.0000
Inter_2 (IV x EC)	.0765	.0627	1.2206	-.0471	.2000	.2237
Inter_3 (COL x EC)	-.0919	.0791	-1.1628	-.2479	.0640	.2463
Inter_4 (IV x COL x EC)	.0230	.0621	.3701	-.0994	.1454	.7117
Team Multiculturality	.3862	.1811	2.1331	.0292	.7433	.0342
Gender	-.4496	.1949	-2.3065	-.8340	-.0652	.0221

ER, the extent of reliance on virtual tools; MS, media synchronicity; IV, information value of virtual tools; COL, collectivism; EC, e-communication competence; SE, standard error; LL CI, lower level of the 95% confidence interval; UL CI, upper level of the 95% confidence interval. All predictor variables were mean-centered.

The results of Model 3, demonstrated in Table 4.3, do not support *H3.a*, *H3.b*, and *H3.c*, because the interaction of the extent of reliance on virtual tools, collectivism, and e-communication competence was not significant (B = –.0292, *95%CI* [–.1568, .0984], p = .6527), neither was the interaction of media synchronicity, collectivism, and e-communication competence (B = .0116, *95%CI* [–.0144, .0375], p = .3802), nor the interaction of information value of virtual tools, collectivism, and e-communication competence (B = .0230, *95%CI* [–.0994, .1454], p = .7117). This indicates that a leader's e-communication competence does not strengthen nor weaken the

moderating effects of collectivism on the relationship between structural virtuality and perceived information deficits. In fact, the results show that the interaction effect between collectivism and e-communication competence is insignificant (Test 1: $B = –.0811$, *95%CI* [–.2416, .0794], $p = .3203$; Test 2: $B = –.0795$, *95%CI* [–.2350, .0759], $p = .3143$; Test 3: $B = –.0919$, *95%CI* [–.2479, .0640], $p = .2463$).

However, the findings revealed a significant negative interaction effect between a leader's e-communication competence and perceived information deficits (Test 1: $B = –.4009$, *95%CI* [–.5529, –.2489], $p = .0000$; Test 2: $B = –.4044$, *95%CI* [–.5552, –.2536], $p = .0000$; Test 3: $B = –.4172$, *95%CI* [–.5685, –.2659], $p = .0000$), suggesting that higher levels of e-communication competence could directly lead to lower levels of perceived information deficits.

4.2. Post Hoc Analysis

Given that all hypotheses formulated in this study were rejected, but the results suggested that e-communication competence, despite not having a moderating effect, could be a significant predictor of the outcome variable (perceived information deficits), and that team multiculturality was also identified as a potential predictor, an additional analysis was conducted to examine whether this influence was direct. Hence, the following hypotheses were tested:

> ***H4:*** *A leader's e-communication competence will be negatively related to experienced information deficits.*
>
> ***H5:*** *Team multiculturality will be positively related to experienced information deficits.*

The results of the multiple regression analysis reported in Table 4.4 indicate that 12% of the variation in the levels of perceived information deficits is significantly explained by a leader's e-communication competence ($r^2 = .119$; $t = –5.266$; $p < .001$). Hence, hypothesis *4* was supported. Specifically, a leader's e-communication competence negatively impacts perceived information deficits with $\beta = –.344$ ($p < .001$). However, the cognitive dimension of TPV is not significantly impacted by the diversity of nationalities within a team ($t = 1.470$; $p = 0.143$). Therefore, *H5* was rejected.

Table 4.4: Team Multiculturality and a Leader's E-communication Competence Regression on Perceived Information Deficits.

Dependent variable	Independent variable	*B (SE)*	*β*	*t*	*p*	*Model R^2*
		1st Regression Analysis				
PID	EC	-.391(.075)	-.341	-5.228	< .001	.128*
PID	TM	.258(.175)	.096	1.470	.143	.128*
		2nd Regression Analysis				
PID	EC	-.394(.075)	-.344	-5.266	< .001	.119*

N = 208. *p = .05. PID, perceived information deficits; EC, e-communication competence; TM, team multiculturality; *B,* unstandardized parameter estimate; *SE,* standard error; *β,* standardized regression weight.

CHAPTER V

Discussions and Conclusions

5.1. Discussion

The primary goal of the present study was to explore what are some of the factors that impact team perceived virtuality, namely structural virtuality, national culture values, and e-leadership competencies. Drawing upon Handke and colleagues' (2021) TPV framework, this study tested a moderated moderation model to assess the direct impact of structural virtuality and the indirect effects of collectivism and leaders' e-communication competence on perceived information deficits, using survey data collected from 208 professionals of different nationalities, job functions and industries, who worked in teams using ICTs to collaborate. A summary of this study's hypotheses test results is provided in Table 5.1. The results do not support structural virtuality as an antecedent of collectively perceived information deficits, nor do they provide evidence that the relationship between these two variables is moderated by the cultural dimension of collectivism. However, the results demonstrate that a leader's e-communication competence is significantly and negatively related to perceived information deficits – not indirectly through moderating the effects of collectivism, as initially hypothesized, but rather directly. This means that when leaders exhibit a strong e-communication competence, team members experience lower levels of information deficits when they collaborate in a virtual environment.

Table 5.1: Path Analysis and Hypotheses Test Results.

Hypotheses	*Path*	*Support Level*	Path Weight
H1.a	ER → PID	Not supported	
H1.b	MS → PID	Not supported	
H1.c	IV → PID	Not supported	
H2.a	ER × COL → PID	Not supported	
H2.b	MS × COL → PID	Not supported	
H2.c	IV × COL → PID	Not supported	
H3.a	ER × COL × EC → PID	Not supported	
H3.b	MS × COL × EC → PID	Not supported	
H3.c	IV × COL × EC → PID	Not supported	
H4	EC → PID	Supported	-.394*
H5	TM → PID	Not supported	

PID, perceived information deficits; ER, the extent of reliance on virtual tools; MS, media synchronicity; IV, the information value of virtual tools; COL, collectivism; EC, e-communication competence; TM, team multiculturality. ∗Significant at 0.05.

This study thus provides empirical support for Handke and colleagues' (2021) TPV construct proposal and contributes toward an understanding of how e-leaders can ensure virtual teams' high performance and success. In the following sections, the theoretical and practical implications of the results of this study are considered as well as its limitations, and directions for future research.

5.2. Theoretical Implications

The study did not confirm hypotheses *1.a*, *1.b*, and *1.c*, thus rejecting the influence of structural virtuality on collectively perceived information deficits, even though the authors of the TPV theoretical framework, Handke and colleagues (2021), identified structural virtuality as an antecedent of TPV and substantial other studies showed that the physical properties of the virtual tool deployed can explain difficulties in virtual team functioning depending on their suitability for specific communication situations (e.g., Ganesh & Gupta, 2010; Ortiz De Guinea et al., 2012). This study, therefore, does not validate structural virtuality as an antecedent of TPV. However, as noted by the authors of the TPV framework, structural virtuality is not an absolute condition; other factors can also directly impact TPV (e.g., team familiarity, team autonomy, and task interdependence), meaning that the objective features of virtual tools do not always explain this virtual teamwork outcome (Costa et al., 2023).

Hypotheses *2.a, 2.b*, and *2.c* were also rejected, meaning that collectivism was found to not moderate the relationship between structural virtuality and perceived information deficits, as it was not significantly related to both structural virtuality and perceived information deficits. These findings contrast with those of previous studies such as those authored by Erumban and de Jong (2006), Huang et al. (2003), Lee (2000), and Zakaria and Talib (2011) that guided the hypotheses formulation in this study and suggested that culture, conceptualized at the national level, can affect the adoption and use of virtual tools and be the cause of disruptions in team interactions such as unsatisfactory user adoption of certain technologies. They do not concur with Smith (2008), who argued that through employment, an individual brings their national cultural values into an organization and, as a consequence, these values end up more or less shaping their behaviors at work, which include patterns of adoption and use of technology to collaborate with others. Nevertheless, the literature is not without studies that have produced similar results (e.g., McCoy et al., 2005; Sørnes et al., 2004; Srite & Karahanna, 2006).

The failure of collectivism to play a moderating role could be explained by the fact that this particular data set could not find the subtle differences that were hypothesized, particularly due to the low sample size (n = 208) and weak variability in collectivism scores (*SD* = 1.11). Another

possible reason is that focusing solely on the effects of one national cultural dimension may oversimplify the multifaceted phenomenon that is the concept of culture (Şahin et al., 2024). Hofstede (1980) argues that cultural dimensions are interrelated, which means that they interact with one another and influence each other. Furthermore, Kirkman and Shapiro (2001) defend that the cultural values of a team represent an aggregate of the cultural values that each member brings to the team. An approach that focuses solely on exploring the effects of collectivism does not account for the complex interactions among the different cultural values within a team and the holistic nature of the construct, and this could lead to misleading results (Woodside, 2013). The findings of the research conducted by Şahin et al. (2024), for instance, showed that the presence of collectivism was needed for high-performing GVTs only when in conjunction with other cultural dimensions (either uncertainty avoidance + long-term orientation + gender egalitarianism, or uncertainty avoidance + long-term orientation + masculinity). This reasoning might also explain why the results of the analysis of both models showed a potential influence of team multiculturality.

On the other hand, asking respondents to evaluate the physical features of a single virtual tool – the one they most use to collaborate with their team members –, may oversimplify the complex and dynamic phenomenon of media adoption and use in the context of teamwork, as it does not account for the use of ICTs in combination, whether simultaneously or sequentially, nor for the variation of media use patterns over the course of a project (Handke et al., 2019; Stephens, 2007; Munkejord, 2007; Stephens et al., 2008; Wang et al., 2022). In such cases, the objective features of one virtual tool might not account for the sum of the objective features of different technologies combined, and it could be the case that virtual tools used in combination complement each other and expand channels, number of cues, and other objective features in such a way that they meet the communication needs and expectations of both individuals with espoused individualistic values and individuals with more collectivistic traits.

Furthermore, the results could be explained by factors not considered in this model, for instance, compensatory adaptative behaviors, which have been found to enhance the perceived richness of a virtual tool and, because they are prompted by the knowledge-building experience individuals have with a virtual tool, their team members, tasks and context, they imply looking at the adoption and use of ICTs from a temporal perspective, which was not the case in this study (Costa & Handke, 2023; Kock, 1998; Handke et al., 2018). For instance, Fleischmann and colleagues (2020) found that after seven weeks of working with smart communication technologies (SCT), most cultural differences in perceptions of the technology among team members had vanished.

In the case of a leader's e-communication competence, this construct also failed to play an indirect effect on perceived information deficits, through moderated moderation. In fact, no significant relationship was found between this construct and collectivism. Hence, hypotheses *3.a, 3.b, 3.c* were also rejected and it was not possible to support the theory that e-leadership is significantly correlated with national culture, such that the influence e-leadership exerts on individual and team outcomes is culturally contingent, as previous studies have done (e.g., Gallenkamp et al., 2011; Kortsch et al., 2022; Li, 2021; Sertel et al., 2022).

A possible reason for these results is that the structural dimensions of virtuality did not affect perceived information deficits and were not contingent on collectivism, therefore even if an e-leader's e-communication competence was related to collectivism, it could not interact with collectivism in its influence on the dependent variable because no such influence was found (Hayes, 2013). Another possibility is that this particular data set could not find the subtle differences that were hypothesized, given the low sample size (n = 208) and narrow variability in EC scores (*SD* = 1.15). It could also be that by focusing on exploring the moderating effects of one specific e-competence of electronic leaders, this study does not account for the complex nature of e-leadership. According to Roman and colleagues (2018), e-leadership is a multidimensional, integrated, and comprehensive concept, and its effectiveness depends on six e-leader e-competencies that are interrelated. Not accounting for the complex interactions among the different e-competencies could lead to misleading results.

However, the post hoc analysis demonstrates that a leader's e-communication competence significantly directly impacts perceived information deficits. Thus, the present study has discovered that, in a virtual team, when leaders demonstrate a strong e-communication competence, team members will collectively experience lower levels of information deficits, and, consequently, when leaders demonstrate a weak e-communication competence, team members will collectively experience higher levels of information deficits. This finding aligns with those of previous studies that point out the fundamental role e-leadership plays in positively influencing individual and team outcomes in virtual teams and thus in achieving virtual teams' high performance and success (e.g., Ahmed et al., 2022; Maheshwari et al., 2024; Zhong et al., 2023). What is more, these results concur with Avolio and colleagues (2014), who characterized e-leadership as a social impact construct or a social influence process facilitated by virtual tools, thus pointing out that e-leaders have the potential to induce changes in individuals' feelings, thinking, attitudes, and behaviors with the help of advanced ICTs. They also concur with Van Wart et al. (2019), who, in their conceptualization of e-leadership, stated that effective electronic leadership depends on six interrelated e-competencies, one of those being

e-communication competence. In this way, this study expands the theoretical framework for TPV developed by Handke and colleagues (2021), by adding to its nomological network one more antecedent – an e-leader's e-communication competence – and provides the e-leadership scale developed by Roman et al. (2018) with some empirical support.

5.3. Implications for Practice

Considering that an e-leader's e-communication competence negatively impacts perceived information deficits, and therefore could have a positive impact on the information exchanges that occur between team members, effectively managing virtual teams entails that the team leader has the ability to communicate clearly and appropriately through the effective use of ICTs. Accordingly, one way of achieving lower levels of collectively perceived information deficits within a team is to enable e-leaders to develop an e-communication competence that increases their ability to enhance communication quality within a team and foster performance (Alkhayyal & Bajaba, 2023; Van Wart et al., 2019). Thus, organizations would benefit from including this aspect in their leadership training programs to enhance e-leaders' capacity to select and combine the most appropriate ICTs from a variety available, according to the specific situation, bearing in mind the objective features of the medium, the task at hand, relational requirements, and the expectations of team members, and use them effectively to communicate in a clear and organized manner, to allow for feedback, avoid errors, miscommunication, and information overload. In addition, the results encourage organizations to consider e-communication competence when selecting team leaders and when assessing their performance. In this sense, the e-leadership scale developed by Roman and colleagues (2018) could be used as a practical tool to measure the leader's e-communication competence and address training needs. Finally, to be able to select and combine the most appropriate ICTs, e-leaders need to have a variety of ICTs available to choose from, therefore organizations are also encouraged to continuously invest in diversifying and updating their technological resources to establish and maintain a rich media toolbox (Woerner et al., 2004).

5.4. Limitations and Suggestions for Future Research

When evaluating the results of this study, however, there are a few limitations that should be acknowledged. Firstly, the generalization of the findings may be limited by the small size of the sample and weak variability in the scores of some key constructs, which make the analysis more susceptible to Type I and Type II errors (Makin & de Xivry, 2019). Hence, a larger, more

representative sample is needed in future studies. It may also be limited by the fact that the cognitive dimension of TPV was measured at the individual level, even though TPV is a collective construct – specifically, a shared affective-cognitive emergent state, that represents the team-level sum or mean of individual ratings (Handke et al., 2021). It's possible that an individual's perceptions regarding information deficits may not correspond to the shared perceptions that characterize the team as a whole. Thus, a team-level analysis of this research model is called for to explore how national cultural values, the structural properties of ICTs, e-leadership competencies, and perceived information deficits are related at the team level.

Third, participants were surveyed via LinkedIn, a method that allows for conducting surveys on a global scale, quickly and at low costs, as it is the world's largest platform for employees from various industries and has a network structure, many criteria available to adjust the scope of any search, and no geographical barriers (Kozłowski et al., 2021). However, one of its challenges is the low response rates obtained, which reduce both sample size and statistical power of statistical-based empirical studies (Kozłowski et al., 2021; Sauermann and Roach, 2013). Such was the case in this study (R = 20,75%). In order to mitigate the issue of low response rates, future research should consider strategies that have been found to influence the likelihood of respondents to participate in web-based surveys (e.g., Basa-Martinez et al., 2018; Sauermann & Roach, 2013) or consider alternatives, such as platforms specifically designed for global surveys like Prolific or Amazon Mechanical Turk.

Fourth, this study applied a cross-sectional survey design, which means that data was only collected from team members at one point in time, providing a static view of team virtuality (Maier et al., 2023). Consequently, it could not account for the influence of time and experience on the different variables studied. According to the authors of the TPV theoretical framework, no construct in the TPV model is static, though some may be less dynamic than others (Handke et al., 2021). The experience people have with working in virtual teams and using specific virtual tools may lead to the adoption of compensatory adaptative behaviors which can delude cultural differences in their perception of the technology and lower the levels of perceived information deficits (Costa & Handke, 2023; Fleischmann et al., 2020; Handke et al., 2021; Kock, 1998). Moreover, in virtual teams, the lifespan of a project encompasses distinct phases, and teams may vary their use of ICTs from one phase to another, which means that at a given point in time, team members may perceive technology positively and experience low levels of information deficits, and at another, they may perceive technology negatively and experience high levels of information deficits (LePine et al., 2008; Marks et al., 2001). Hence, future

research should focus on employing a longitudinal design to account for such changes over time (Ployhart & Vandenberg, 2010).

Another potential limitation of this study is that the measurement approach does not capture the complexity and fluidity of ICT use in today's virtual teams, as participants were asked to state how they perceived the physical properties of a single ICT, overlooking the dynamics and effects of using multiple ICTs in combination (Munkejord, 2007; Stephens, 2007; Stephens et al., 2008). The fact that the findings of this study showed no relationship between structural virtuality and perceived information deficits might indicate a need to reach beyond the physical properties of a single virtual tool to understand how TPV emerges as a consequence of team members using technology to collaborate. Rather than asking individuals what the virtual tool they mostly use to collaborate with their team members allows for, studies should, therefore, find ways to capture the characteristics of multiple media practices (Munkejord, 2007). As such, future research should look at the effect of different combinations of ICTs to draw a better picture of the influence of the objective features of virtual tools on perceived virtuality. In fact, several researchers highlighted the importance of including a combinatorial ICT perspective on the current view of ICT use and have issued calls for work within this area (Munkejord, 2007; Saunders & Jones, 1990; Stephens, 2007; Stephens et al., 2008). Specifically, Wang and colleagues (2022) found out that effective e-leaders alternate the uses of various ICT modalities throughout a project to achieve communication richness and that weaker and stronger e-leaders can be distinguished in terms of their chosen ICT utilization patterns.

Additionally, while many previous studies have demonstrated the merits of including national cultural conceptualized at the national level when examining factors that disrupt virtual team interactions (e.g., Al-Gahtani et al., 2007; Alkhaldi & Yusof, 2013; Huang et al., 2003; Lee, 2000; Smith, 2008), this study did not find evidence that national culture has a disruptive effect on these interactions. Future research should consider including more than one dimension of culture and test whether the effects of collectivism in conjunction with other dimensions are similar to what was found in this study. Such examination is important because Hofstede's dimensions of national culture are interrelated and thus examining the effects of only one dimension may result in an underestimation of the true relationship between national culture dimensions and team perceived virtuality (Hofstede, 1980; Şahin et al., 2024). Furthermore, this study employed Hofstede's cultural dimensions to measure differences in national value systems due to its widespread acceptance in the social sciences, particularly in the field of business management and information technology, nonetheless, Hofstede's model has received some criticism. Future research could, therefore, test whether other cultural values frameworks,

such as those proposed by Schwartz (1992), Trompenaars and Hampden-Turner (1997), or the GLOBE study (House et al., 2004), might better demonstrate the interaction between national culture values and team perceived virtuality (Jan et al., 2022; Javidan et al., 2006; Rodríguez-Rivero et al., 2022).

Lastly, in their conceptualization of e-leadership, Van Wart and colleagues (2019) identified six interrelated e-leader e-competencies on which effective electronic leadership is dependent, but, in this study, only one was examined. Since e-leadership is a multidimensional, integrated, and comprehensive concept where all six e-competencies are interrelated and can influence each other, future research could incorporate all six e-competencies and test whether the effects of e-communication competence in conjunction with other competencies are similar to what was found in this study for this construct alone. Perhaps, such exploration would reveal a relationship between e-leadership competencies, national culture values, and structural virtuality, and demonstrate the moderating effects of e-leadership, which did not happen in this study. This would make a valuable theoretical contribution to a more holistic understanding of the complex concept of e-leadership and its effects on team perceived virtuality.

Despite these limitations, this study is the first one that investigates the influence the objective features of ICTs have on collectively perceived information deficits and the moderating role of national culture values and e-leadership competencies on this relationship. It contributes to enriching the research on virtual teamwork and e-leadership, by demonstrating that a leader's e-communication competence negatively influences how poor or flawed team members perceive their information exchange to be, such that when the team leader demonstrates strong e-communication skills, team members perceive low levels of information deficits in their information exchanges. Thus, this study supplements the nomological network of Handke and colleagues' (2021) TPV framework with one more key factor that affects the levels of team perceived virtuality. Future research is encouraged to explore additional aspects that could directly or indirectly affect the emergence of perceived information deficits, thereby continuing to validate this measure and expand the framework's nomological network. For instance: are perceived information deficits significantly impacted by individual traits (Oh et al., 2018)? How does juggling several projects and simultaneously being a member of more than one team influence team members' perceptions of virtuality (Mortensen et al., 2007)? How can emotion regulation strategies lower the levels of team perceived information deficits (Theodorou et al., 2023)?

Future research is also encouraged to explore the key factors that explain both dimensions of TPV, rather than merely focusing on one. In this way, future studies would account for the

two dimensions' interrelation and their different combinations, which determine the quality of TPV (Handke et al., 2021).

Furthermore, this study did not exhaust the possibilities for investigating the influence of e-leadership on TPV. As such, future research is encouraged to explore other mechanisms through which e-leadership can influence TPV. Does a leader's e-communication competence also influence collectively perceived distance? Can the relationship between team familiarity and TPV be mediated by e-leadership? Are national cultural values capable of moderating this mediating effect? Can e-leadership moderate the moderating effects of team familiarity on the relationship between team-perceived information deficits and team coordination? These are some examples of questions that could be investigated regarding the relationship between e-leadership and team perceived virtuality.

A final note must be made here about team multiculturality, given that the findings of this study revealed that this variable could impact the levels of perceived information deficits, but this exact relationship was not identified, as no direct relationship was found between team multiculturality and perceived information deficits. The inclusion of other variables in the analysis, such as "task interdependence" (Pinjani & Palvia, 2013), "team cohesion" (Garrison et al., 2010), or "team tenure" (Stahl & Maznevski, 2021), would help clarify this detection. Hence, the question of how national culture diversity in teams affects team members' perceptions of information deficits during their information exchanges is waiting to be addressed.

5.5. Conclusion

Overall, the findings of this study shed some light on the importance of e-leadership for the success of virtual teams, by showing that an e-leader with strong e-communication competence can lead team members to perceive low levels of information deficits in their information exchanges, and thus enhance communication quality, which is an important predictor of several positive outcomes for virtual teams (Chang et al., 2011; Morrison-Smith & Ruiz, 2020). Thus, the results provide enough motivation for future studies on how e-leadership influences team members' perceptions of virtuality and encourage organizations to continuously invest in their media toolbox and enable e-leaders to develop the ability to communicate clearly and appropriately through the effective use of ICTs (Alkhayyal & Bajaba, 2023; Van Wart et al., 2019; Woerner et al., 2004). They also supplement the nomological network of Handke and colleagues' theoretical framework for the emergence of TPV with one more antecedent and

encourage future studies to continue seeking to identify the factors that affect team perceived virtuality in order to contribute to a better understanding of this phenomenon. Finally, the results suggest that future research on team perceived virtuality should reach beyond the physical properties of a single virtual tool to better understand how TPV emerges as a consequence of the objective features of virtual tools.

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Annexes

Annex A – Questionnaire

The present questionnaire aims to collect data for a study focused on the impact of National Culture on the relationship between Structural Virtuality and Team Perceived Virtuality, as well as on the moderating role that E-leadership plays in this dynamic. It is an essential part of an investigation for a Master's Thesis, conducted at the ISCTE Business School in Lisbon. Therefore, your participation is of the utmost importance.

The questionnaire is divided into 5 parts. You will be asked questions regarding your national cultural values; the virtual tools you use to work and interact with your team members; how you experience team virtuality; and how you feel about your e-leader. It will take approximately 7-10 minutes to answer all questions. Please answer all questions honestly, selecting the answer that best suits you, as there are no right or wrong answers. We are only interested in your personal opinion. Your sincere answers are crucial to guarantee the quality of the study. For each question, there is a scale. You can use any point on the scale as long as you consider it to be appropriate. All of your responses will be kept confidential and will be processed in an anonymous way, to be used only for academic purposes.

Your participation is voluntary, which means you have the right to withdraw at any time during the questionnaire, for any reason and without prejudice. However, we once again kindly remind you that your participation is crucial to the success of our study.

For any clarification, or to receive additional information about the study, please contact the Researchers of the study by sending an email to patricia_costa@iscte-iul.pt or jpbgs@iscte-iul.pt.

By clicking on "Continue", you indicate that you have understood the conditions and with the information provided you agree to participate in this study.

○ Continue

Section A: Demographic

Instruction: Please select or write down the appropriate response for each of the items given below.

1. What is your nationality? _____

2. Gender

   ☐ Male

   ☐ Female

   ☐ Other

   ☐ Prefer not to answer

3. Please specify your age: ____ years old.

4. What is your highest level of education?

   ☐ High School

   ☐ Bachelor's Degree

   ☐ Master's Degree

   ☐ PhD

   ☐ Other. Please specify: _____

5. Please state what is your occupation: _____

6. Please state in which industry are you working / or did you have your latest work experience: _____

7. How many members are there in your team? ____

8. Do all the members of your team share the same nationality as you?

   ☐ Yes

   ☐ No

9. Which statement is true regarding the leadership source of your team?

   ☐ A member of the team is formally responsible for the team's leadership and performance.

   ☐ Leadership responsibilities are shared among team members or certain team members emerge informally as leaders.

☐ An individual outside the team is formally responsible for the team's leadership and performance (i.e.: sponsor, coach, team advisor).

☐ Individuals outside the team seek to meet the team's critical needs (i.e.: mentor, champion, executive coordinator).

Section B

This part of the questionnaire aims to analyze your national cultural values in the work context.

Indicate to what extent you agree or disagree with each statement presented. Please answer honestly and spontaneously and select only one option.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1 - Individuals should sacrifice self-interest for the group.	○	○	○	○	○
2 - Individuals should stick with the group even through difficulties.	○	○	○	○	○
3 - Group welfare is more important than individual rewards.	○	○	○	○	○
4 - Group success is more important than individual success.	○	○	○	○	○
5 - Individuals should only pursue their goals after considering the welfare of the group.	○	○	○	○	○
6 - Group loyalty should be encouraged even if individual goals suffer.	○	○	○	○	○

Section C

This part of the questionnaire aims to analyze what the virtual tools you use to work and interact with your team members often allow for and how much you rely on them.

1. In general, what is the percentage of time you spend using virtual tools to work and interact with your team members each week? _____ %.

2. How often do you use the virtual tools to work and interact with team members?

Don't use at all	Use less than once each week	Use about once each week	Use a few times a week	Use several times a week	Use about once each day	Use several times each day
○	○	○	○	○	○	○

3. How do you consider the extent of your current virtual tool use?

	1	2	3	4	5	6	7	
Non use	○	○	○	○	○	○	○	Heavy use

4. Indicate to what extent you agree or disagree with each of the following statements regarding the what the virtual tool you use most frequently to work and interact with your team members allow for. Please answer honestly and spontaneously and select only one option.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1 – The virtual tool allows my messages to reach the recipients as soon as they are sent.	○	○	○	○	○	○	○
2 – The virtual tool allows my messages to be responded immediately.	○	○	○	○	○	○	○
3 – The virtual tool allows instantaneous feedback.	○	○	○	○	○	○	○
4 – The virtual tool allows me to reexamine and reprocess previously sent content during the interaction.	○	○	○	○	○	○	○
5 -The virtual tool allows me to reexamine and reprocess previously sent content after the interaction.	○	○	○	○	○	○	○
6 – The virtual tool allows me to reexamine and consider previously sent content for developing understanding and additional consideration.	○	○	○	○	○	○	○

7 - The virtual tool provides a more flexible way of expression that allows me to freely use the language with which I am familiar, such as my mother tongue, English, graphics, symbols, that can help convey clearly the intended message.	○	○	○	○	○	○	○
8 - The virtual tool offers me richer and more diverse ways of accentuate the meaning of the words (such as pace, volume, pauses, punctuations, font, size, color).	○	○	○	○	○	○	○
9 - The virtual tool offers the option of attaching elements like pictures and graphs that can help with understanding the information when transmitting the information.	○	○	○	○	○	○	○
10 - The virtual tool allows me to use, besides language and numbers, other non-verbal cues when communicating with others (such as facial expression, body language, audio-visuals, pictures, graphs).	○	○	○	○	○	○	○
11 - The virtual tool allows me to provide more detailed non-verbal cues as auxiliary information when I am communicating with others.	○	○	○	○	○	○	○

Section D

This part of the questionnaire aims to analyze how you experience virtual collaboration with your team members in terms of information deficits.

Indicate to what extent you agree or disagree with each of the statements presented. Please answer honestly and spontaneously and select only one option.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
When we exchange information in my team…							
1- ...the ways in which we can express ourselves are limited.	○	○	○	○	○	○	○
2- ...it's hard to convey the actual meaning of what we are saying.	○	○	○	○	○	○	○
3- ...it's difficult to understand if we are on the same page or not.	○	○	○	○	○	○	○
4- ...we are unable to convey the necessary information in its entirety.	○	○	○	○	○	○	○
5- ...we don't know whether everyone has had access to the same information.	○	○	○	○	○	○	○

Section E

This part of the questionnaire aims to analyze how you feel about your virtual team leader's communication competence.

Indicate to what extent you agree or disagree with each of the statements presented. Please answer honestly and spontaneously and select only one option.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1- In their virtual communication, the leader is clear, well organized, and allows for feedback to avoid errors and untested assumptions.	○	○	○	○	○	○	○
2- In their virtual communication the leader sometimes conveys unintended messages that leave the receiver feeling insulted or angry because of tone or misunderstandings.	○	○	○	○	○	○	○
3- The leader ensures that their virtual communication is not excessive to the point of impeding the ability of employees to get their work done.	○	○	○	○	○	○	○