# Investigating the effect of media synchronicity in professional use of video conferencing applications

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**This is the accepted author *manuscript of the following article published by EMERALD:***
Thomas, M. A., Sandhu, R. K., Oliveira, A., & Oliveira, T. (2023). Investigating the effect of media synchronicity in professional use of video conferencing applications. Internet Research. https://doi.org/10.1108/INTR-12-2021-0887

**Funding:** This work was supported by national funds through FCT (Fundação para a Ciência e a Tecnologia) under the project - UIDB/04152/2020 - Centro de Investigação em Gestão de Informação (MagIC).

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|---|---|
| Journal: | *Internet Research* |
| Manuscript ID | INTR-12-2021-0887.R3 |
| Manuscript Type: | Research Paper |
| Keywords: | Collaborative technologies, video conferencing apps, media synchronicity, employee productivity, well-being |
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## Abstract

**Purpose** - This research aims to gain a holistic understanding of how video conferencing (VC) apps' media characteristics influence individuals' perceptions of VC apps and, ultimately, their use and continued use in professional settings.

**Design/methodology/approach -** A conceptual research model is developed by integrating constructs from media synchronicity theory (MST), social presence theory, and the unified theory of acceptance and use of technology (UTAUT2) model, as well as ubiquity, technicality, and perceived fees. Structural equation modeling (SEM) is used to empirically test the conceptual model using data collected from 252 working professionals from the European Union.

**Findings -** The results reveal that while performance expectancy (PE) and facilitating conditions (FC) are fundamental to VC app use, these factors alone do not explain the use and continuing use of VC apps in the professional context. Media characteristics that include synchronicity, social presence, and ubiquity are equally crucial to professionals using VC apps. It also confirms the moderating effect of convergence on the relationship between synchronicity and PE and the moderating effect of technicality and perceived fees on the relationship between ubiquity and FC.

**Originality/value -** For researchers, the study offers insights into the extent to which technological and socially derived characteristics of VC apps influence the routine tasks undertaken by professionals in virtual work settings. For practitioners, recommendations pivotal to the use of VC apps are presented to promote higher acceptance and improved well-being of the professional workforce.


**Keywords:** Collaborative technologies, video conferencing apps, media synchronicity, employee, productivity, well-being

**Paper type:** Research paper

# Investigating the Effect of Media Synchronicity in Professional Use of Video Conferencing Applications

## 1. Introduction

In recent years, video conferencing (VC) applications (apps) such as Zoom, Skype, Microsoft teams, Google Hangouts, and Signal have become prominent communication platforms for working professionals. Compared to other communication platforms, VC apps offer distinct capabilities that enable professionals to undertake day-to-day activities in a virtual work environment. Capabilities that make VC apps attractive to professionals include direct two-way face-to-face communications with remote participants, seamless transmission of visual, verbal, and non-verbal cues (Archibald *et al.*, 2019, Hambley *et al.*, 2007), information sharing via screen sharing and file sharing, session recording (Li *et al.*, 2020), and real-time user engagement through polls and white-boards. The transformative power of VC apps was made prominent by the COVID-19 pandemic. Simply put, VC apps enable time savings and spatial flexibility (Archibald *et al.*, 2019, Hambley *et al.*, 2007) for working professionals engaging in virtual work environments.

Although VC app platforms have successfully extended their user base by offering abundant value-added features, little is known about how the rich media capabilities influence professionals' perceptions toward VC apps and, consequently, their continued use. Prior research on this topic has mostly taken a qualitative or descriptive approach (examples include Archibald *et al.*, 2019, Candarli and Yuksel, 2012, Correia *et al.*, 2020, Kysely *et al.*, 2020, Liu and Alexander, 2017, Nehls *et al.*, 2015, Yamada, 2009). A few studies have empirically investigated the usage of VC apps prior to the recent pandemic-induced popularity. Tang *et al.* (2013) examined how physical media capabilities of computer-mediated communications influence individuals' perceptions of social presence. The authors conducted a laboratory study in a simulated group collaborative environment with student participants communicating with each other using the text and audio features of MS NetMeeting, a communication medium for group collaboration. However, their study did not investigate video conferencing capabilities. The study by Brown *et al.* (2010) broadly conceptualized VC apps as collaborative technologies. However, their study does not separate work-related context from leisure-related context. This distinction has become increasingly relevant in recent years. For example, Park and Lee (2019) noted that the impact of media characteristics on individuals' perceptions differs depending on whether the context is professional or personal. Since conversations in the professional context tend to be more goal-oriented, the media that enables communication continuity would be more crucial to a professional context than the leisure context (Park and Lee, 2019). Modern technologies that enable discussions, document or file sharing, and enhance work efficiency and productivity are thus more essential for work-related purposes (Jong *et al.*, 2021) than for leisure-related interactions.

Modern VC apps offer media richness in the form of technological and socially derived characteristics (Dennis *et al.*, 2008). They include transmission velocity, reprocessability, parallelism (Dennis *et al.*, 2008), continuity (Johnson *et al.*, 2018), portability (Okazaki and Mendez, 2013), time savings, and spatial flexibility (Archibald *et al.*, 2019, Hambley *et al.*, 2007), immediacy, concurrency (Brown *et al.*, 2010), and social presence (Short *et al.*, 1976). Brown *et al.* (2010) examined the socially derived characteristics of VC apps, including social presence,

immediacy, and concurrency. Prior studies have called for the theoretical integration of the technological and socially derived characteristics as a means to gain a more thorough understanding of users' perceptions of communication media (Yoo and Alavi, 2001). The lack of a holistic picture obstructs us from gaining a clearer picture of how contemporary VC app platforms are perceived and used in the professional context.

It can be argued that the COVID-19 pandemic led to the decisive shift toward commercial off-the-shelf VC apps that are easy to use and instantly available. Commercial off-the-shelf systems are different from in-house systems in that the former are designed for a wide range of customers with differing needs, whereas the latter are built in-house and customized to exact business needs (Dennis *et al.*, 2019, Hatzipanagos, 2001). They also differ in terms of cost and capabilities (Dennis *et al.*, 2019, Hatzipanagos, 2001) as newer VC apps are cloud-based models (Lewis, 2020) compared to proprietary in-house solutions. To the best of our knowledge, an in-depth investigation of the new age commercial off-the-shelf VC apps in the professional context has not been conducted, which is a void that this research aims to address.

This research aims to gain a holistic understanding of how the media characteristics of VC apps influence individuals' perceptions toward VC apps and, ultimately, their use and continued use in professional settings. The comprehensive investigation will serve two purposes. First, the study will enable us to gauge the extent to which the technological and socially derived characteristics of VC apps impact routine tasks undertaken by professionals in virtual work settings. Second, the examination will help determine whether media richness appropriated by VC apps leads to greater acceptance and more effective use of the technology. A rigorous scientific assessment of the effects and consequences of VC app usage will be beneficial for professionals and other associates engaging in virtual collaborative environments frequently.

This study targets two related objectives. First, to examine the antecedents that influence professionals' perceptions toward VC app use, specifically two types of media characteristics, namely, technological characteristics and socially derived characteristics (Dennis *et al.*, 2008), we develop and test a conceptual research model that incorporates media synchronicity theory (MST) (Dennis *et al.*, 2008), social presence theory (Short *et al.*, 1976), ubiquity (Okazaki and Mendez, 2013), and two constructs from the popular unified theory of acceptance and use of technology (UTAUT2) model: performance expectancy and facilitating conditions. Although there are many IS adoption models, we use these two constructs in our conceptual model for the following reasons. First, we aim to draw a clear description of the relationship between users' perception of expected performance and conditions that facilitate the use of VC apps. Second, they are well-established constructs from prior technology adoption research (Chan *et al.*, 2010). Third, we seek substantial empirical improvement in variation explained by the intention and use of technology (Baptista and Oliveira, 2015). Finally, they allow for augmentation by modeling the antecedents of users' attitudes and beliefs (Chan *et al.*, 2010).

The study's second objective builds upon the first and aims to investigate how individuals' perceptions toward VC apps influence their use and continued use in the professional context. To address this objective, we used primary data to quantitatively assess professionals' actual usage of VC apps and their influence on continued use. In addition, we test how the relationship between

media characteristics and professionals' use of VC apps is moderated by the level of technical excellence (i.e., technicality) and cost (i.e., perceived fees) of VC apps (Kim *et al.*, 2007).

The study provides notable contributions to researchers and practitioners. Our study found that while performance expectancy and facilitating conditions are fundamental to VC app use, these factors alone do not explain the use and continuing use of VC apps in the professional context. Media characteristics that include value-adding technological characteristics and socially derived characteristics are equally important to professionals using VC apps in virtual work environments. While synchronicity and social presence are cherished features of VC apps, managers and developers need to recognize the impact they may bring upon the workforce. The study thus advances knowledge by providing new explanations and elaborations on the use and impact of modern collaborative technologies.
Furthermore, the research reinforces the significance of integrative models for comprehensively assessing up-and-coming technologies. For practitioners, the study provides key insights into the value-added features that are likely to improve the acceptance and more effective use of VC platforms and technologies. The study also raises caution on the need for research to assess the impact of extended VC app use on the well-being of the professional workforce.

The rest of the paper is organized as follows. Section 2 presents an overview of the theoretical foundations of the study. In section 3, the conceptual model and related hypotheses are presented. Section 4 presents the research methodology and design. Section 5 presents the analysis of results, and section 6 discusses the main findings, followed by theoretical contributions and practical implications. Section 7 concludes the study by examining the limitations and avenues for future research.

## 2. Theoretical Background

### 2.1 Media Synchronicity Theory (MST)

Media Synchronicity theory (MST), proposed by Dennis *et al.* (2008), relies on the notion of synchronicity, which they define as "the ability to support individuals working together at the same time with a shared pattern of coordinated behavior" (Dennis *et al.*, 2008). MST posits that the match between media capabilities and communication processes required to perform a task influences the appropriation and use of specific communication channels, which ultimately influences overall communication performance (Dennis *et al.*, 2008). In other words, media that fits users' communication needs well is more likely to be faithfully adopted and utilized.

MST identifies five media capabilities that influence users' appropriation and use of media: transmission velocity, parallelism, symbol sets, rehearsability, and reprocessability. Transmission velocity refers to the speed at which the media delivers the message to the intended receiver. Parallelism refers to the number of simultaneous transmissions that can occur through a medium. For example, mobile messaging applications support concurrent transmissions simultaneously, whereas conventional telephone media limits the number of simultaneous signal transmissions (Dennis *et al.*, 2008). Symbol sets refer to the *height* of the medium (Dennis *et al.*, 2008) and represent the variety of ways in which a communication medium enables information to be expressed or communicated (Park and Lee, 2019). Rehearsability is the extent to which the media

enables the sender to review or fine-tune the message before sending it to ensure that it conveys the intended meaning. Reprocessability indicates the extent to which the media enables the recipient to re-examine or re-process the message for better understanding, either within the context of communication event or after the event has occurred (Dennis *et al.*, 2008).

According to MST theory, communication processes fall into two categories: conveyance of information and convergence of meaning. The conveyance process involves the transmission of information, specifically new and raw information, from a sender to the receiver, who needs to interpret and understand the information and recreate their mental models. The convergence process involves rapid, back-and-forth transmission of small quantities of pre-processed information, not the raw information itself, between individuals to reach a common understanding of the meaning of the information being exchanged (e.g., for decision-making and negotiation) (Dennis *et al.*, 2008).

MST further argues that both conveyance and convergence are required to successfully complete most communication tasks, although only one may drive the choice of the media. If the main goal of the task is to distribute or deliver new information (conveyance), then the use of media with lower synchronicity will lead to higher performance. Conversely, if the goal is to obtain shared understanding (convergence), then media with higher synchronicity will yield better performance (Dennis *et al.*, 2008).

MST has been used to study virtual world collaboration systems and email (Hassell and Limayem, 2010), text and audio calls (Tang et al., 2013), MST training and group effectiveness (Lam, 2016), email and voice mail/phone (Anders et al., 2020), government social media services (Park et al., 2016), Wikis (He and Yang, 2016), media choice (face-to-face and email) in the negotiation (Geiger and Laubert, 2018), Twitter (Son et al., 2019), mobile messenger applications (Park and Lee, 2019), asynchronous (telephone) and synchronous channels during natural disasters (Diwanji et al., 2020), social mindtools (Huang, 2020), and patient training and education (Kashian and Walther, 2020). MST has not been investigated in the context of VC apps. In this study we use MST to assess individuals' perceptions toward VC apps and ultimately their use and continued use in professional settings. A summary of published studies on VC apps, including the theoretical models, methods, and context of each, is shown in Table I. Summary of studies on Media Synchronicity.

## 2.2 Extended Unified Theory of Acceptance and Use of Technology (UTAUT2)

Venkatesh *et al.* (2003) provided a comprehensive review of eight prominent user acceptance models. They formulated the unified theory of acceptance and use of technology (UTAUT) to explain the adoption of Information Technology (IT) in an organizational context. The model postulates that the behavioral intentions to use a technology are influenced by four key variables: performance expectancy, effort expectancy, social influence, and facilitating conditions. (Venkatesh *et al.*, 2012) proposed UTAUT2 to explain IT adoption in a consumer context, where the IT adoption is voluntary. The revised model includes three additional constructs: hedonic motivation, habit, and price value. A literature review by Tamilmani *et al.* (2021) revealed that UTAUT2 has not been investigated in the context of off-the-shelf consumer VC apps, which is the focus of the study. In this study, we use two key constructs from UTAUT2 (performance

expectancy and facilitating conditions) as our objective includes understanding professionals' perceptions toward the use and continuing use of VC apps.

**Table I.** Summary of studies on Media Synchronicity Theory

| Reference | Context | Theoretical Foundation | Variables | Methodology | Major Findings |
|---|---|---|---|---|---|
| Hassell and Limayem (2010) | Virtual world collaboration systems and email | Media Synchronicity Theory (MST), Social Presence Theory | Media synchronicity, presence, social presence, and job satisfaction | Multiple Regression | Media synchronicity has a direct effect on job satisfaction; Media synchronicity has no direct effect on presence and social presence. |
| Tang *et al.* (2013) | Computer-mediated communications (MS NetMeeting investigated for only text and audio features) | MST | Transmission Velocity, parallelism, natural symbol, rehearsability, reprocessibility, extroversion, social presence, process satisfaction, and outcome satisfaction | Structural Equation Modelling (SEM) | All media capabilities and extraversion have a significant influence on social presence, except social presence; Social presence has a significant influence on process satisfaction and outcome satisfaction; Extraversion and symbol sets have a significant influence on outcome satisfaction. |
| He and Yang (2016) | Wikis | MST | Immediacy of feedback, parallelism, symbol sets, rehearsability, reprocessability, Collaboration, Effectiveness and Communication performance | Linear Regression Analysis | Transmission velocity positively predicts perceived collaboration effectiveness; Reprocessibility, no other wiki capabilities, plays a significant role in collaboration effectiveness, whereas Wiki as a tool for information transmission does not guarantee desirable collaboration outcomes. |
| Lam (2016) | MST training and group effectiveness | MST | Media synchronicity training, media fit behavior, communication quality, communication quantity, group effectiveness | t-test | The group that receives media synchronicity training reports high media fit, communicates more, reports high-quality group discussions, and has a higher level of communication richness and openness. |

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| Park *et al.* (2016) | Government social media services | MST | Utilitarian value, hedonic value, social value, media synchronicity, satisfaction, loyalty, alternative attractiveness, and intentions to behavior | SEM | Media synchronicity does not moderate the relationship between hedonic value and satisfaction; media synchronicity moderates the relationship between utilitarian value and satisfaction, as well as social value and satisfaction |
| Geiger and Laubert (2018) | Media Choice (Face to Face - FTF and Email) in the negotiation | MST | Partner familiarity, task familiarity, task importance, degree of conveyance and convergence (DCC), increased preparation and control (IPC), enhanced meaning and emotion, reduced anxiety, and inhibition | Multi-level modeling | The more a communication process in negotiation is characterized as conveyance, the more likely the negotiators are to use media with low synchronicity; the better a communication partner is known, the less likely the negotiator is to use media with high synchronicity; the less significant the negotiation is, the less likely the negotiator is to use media with high synchronicity; the better the negotiator partner is known, the less obvious the effect of DCC on the media choice; when negotiators score lower on the IPC, they are more likely to choose email for negotiation; when negotiators score lower on the EME, they are more likely to choose email for negotiation |
| Park and Lee (2019) | mobile messenger services (personal v/ business context) | MST | Immediacy of feedback, parallelism, symbol sets, rehearsability, reprocessability, communication continuity, benevolence, social intimacy, and fatigue, communication context (personal use and business use) | SEM supported by Partial Least Square | Immediacy of feedback in a mobile messenger (MM) is important to maintain good relationships when using MM for personal use, not professional use; If one does not respond immediately to a friend, then the fatigue increases; Reprocessibility impacts fatigue more than social intimacy; Parallelism and symbol sets do not influence social intimacy and fatigue in both communication contexts; Rehearsability has a significant influence on fatigue in a business context than in a personal context; communication continuity has a significant influence on social intimacy and fatigue in a personal use context; however, in a business use context, it only influences social intimacy, not fatigue; Benevolence reduces fatigue in both the personal and business use contexts; however, it significantly influences social intimacy in the business use context. |

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| Son *et al.* (2019) | Twitter | MST | Symbol sets (word, URL Hashtag, and importance of hashtag), Communication topics (crisis v/s risk), and average retweet time | Regression Analysis | The number of words in a tweet does not influence the average retweet time; An increase in the number of URLs in a tweet increases the average tweet time; An increase in the number of hashtags decreases the average retweet time; the average tweet time of crisis-related tweets is faster; The average retweet time of crisis-related tweets is significantly faster on average than that of risk related tweets; An increase in the number of URLs to risk related tweets increases the average retweet time relative to crisis-related tweets; The importance of a hashtag has a significant negative influence on the average retweet time for crisis-related tweets than for risk-related tweets. |
| Anders *et al.* (2020) | Communication media preferences (email and voice mail/phone) amongst business-to-business (B2B) buyers | Media Richness theory (MRT), MST, Channel Expansion Theory | Experience, perceived social influence, and perceived richness | t-tests, Regression Analysis | Email is the preferred means of communication for lean tasks, whereas voice mail/phone is the preferred means of communication for rich tasks; For email, both perceived social influence and experience positively influence perceived richness; For voice mail/phone, perceived richness is influenced by social influence only; Email is considered having higher social influence than voice mail; Voice mail/telephone is perceived to have narrow richness advantage. |
| Diwanji *et al.* (2020) | Effectiveness of asynchronous (telephone) and synchronous channels (email, the city website, and the city management mobile app) during a natural disaster | MST, Channel Expansion Theory | Channel synchronicity, perceived speed of response and perceived response of quality of information | Mixed methods: t-test and Geospatial analysis (Two-phase study: Hurricane 1 and 2) | Citizens perceive that the responses received after reporting problems through synchronous communication channels are faster (Phase 1). However, during phase 2, participants did not perceive any difference in the speed of response received from synchronous v/s asynchronous communication channels; During Hurricane 1, citizens perceived synchronous media as providing high-quality information, whereas during Hurricane 2, citizens perceived information quality to be higher for asynchronous channels |
| Huang (2020) | Social mind tools (Mindomo) | MST | Perceived synchronicity, social support, social influence, and social support | Conventional SEM | Perceived synchronicity positively influences individuals' continuance intentions to use social media tools via social support and social influence, in which social support significantly influences social influence. |

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| Kashian and Walther (2020) | Patient training and education | MST | Written material for monitoring blood glucose level (MBGL), Personal meetings for MBGL, Group classes for MBGL, written materials for Meal planning (Tomprou *et al.*), Personal meetings for MP, Group classes for MP, Effective performance for MBGL, Effective performance for MP, Improve health condition | SEM | Using group classes significantly enhanced monitoring blood glucose level (MBGL) patient effective health behaviors; Using personal meetings and group classes to train patients for meal plan enhanced patient effective health behaviors; Using written materials to train patients for meal plan enhances patient effective health behaviors. |

## 2.3 Social Presence Theory

Social presence is a socially derived characteristic of media (Brown *et al.*, 2010, Dennis *et al.*, 2008) and the main construct in the study of computer-mediated communications (Park and Sundar, 2015). Short *et al.* (1976) defined social presence as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships." They conceived social presence as not simply the property of the communication media but as a perceptual and attitudinal dimension of participants in mediated communication. The participant's perceptions of how socially present a communication media is, can be measured by determining the degree to which the user perceived the media as sociable, warm, sensitive, and personal (Short *et al.*, 1976).

Short *et al.* (1976) also argued that the suitability of a communication media for a specific type of interaction hinged on two things: the degree of social presence of the communication media and the degree of social presence required by the task (Short *et al.*, 1976). If the media provides a variety of social cues promoting reciprocity and interactivity among interacting partners, its social presence degree is higher (Choi, 2016). Higher social presence allows interacting partners to make immediate, synchronous responses to each other (Park and Sundar, 2015). Prior literature argues that professionals routinely undertake tasks of negotiating and decision-making and therefore require a higher social presence of the media (Yoo and Alavi, 2001).

Social presence theory has been used to study mobile multimedia services (Sung and Yun, 2010), collaborative technologies such as proprietary video conferencing systems (Brown *et al.*, 2010), second life (Saunders *et al.*, 2011), distant learning (Kim, 2011), avatars in mobile communications (Kang and Watt, 2013), mobile instant messaging (Ogara *et al.*, 2014, Park *et al.*, 2014), Twitter (Han *et al.*, 2015), smartphone based social networking systems (Choi, 2016), smartphones (dis)connectedness and vacation recovery (Kirillova and Wang, 2016), social brand engagement (Osei-Frimpong and McLean, 2018), mobile learning (Alsadoon, 2018), social media brand page (Song *et al.*, 2019), online distance learning (Weidlich and Bastiaens, 2019), mobile instant messaging (Tseng *et al.*, 2019), online learning (Andel *et al.*, 2020), shadow IT (Mallmann and Maçada, 2021), tourism (Xu *et al.*, 2021), the cohesion of classroom community (Wang *et al.*, 2022), and Internet of Things (Kang and Kim, 2022). Our literature review also revealed that social presence has not been investigated in the context of off-the-shelf consumer VC apps. We, therefore, use social process theory to determine the social dimensions that influence professionals' use of VC apps.

## 2.4 Ubiquity

The concept of ubiquity was first introduced by Watson *et al.* (2002), who described it as synonymous with omnipresence: "The ubiquity or omnipresence of computer chips means not only that they are everywhere but also that they are, in a sense, 'nowhere' for they become invisible as we no longer notice them" (Watson *et al.*, 2002). Based on the definition by Watson *et al.* (2002), Junglas and Watson (2006) proposed ubiquity as a U-commerce construct consisting of portability, reachability, and accessibility. Junglas and Watson (2006, p.578) defined ubiquity as "the drive to have access to information unconstrained by time and space."

Based on the review of prior literature, Okazaki *et al.* (2012) conceptualized ubiquity as the interconnected dimension of time savings and spatial flexibility. Time savings relate to the mental calculation the user performs regarding the time saved when using a mobile service. Spatial flexibility relates to the perceived mobility that a mobile service provides to the users by releasing them from geographical constraints and enabling them to use the services anytime, anywhere (Okazaki *et al.*, 2012).

Later, Okazaki and Mendez (2013) reconceptualized ubiquity as a multifaceted construct that includes: immediacy, continuity, portability, and searchability (Okazaki and Mendez, 2013). Immediacy relates to the speed or quickness of an action. It denotes the extent to which a mobile service enables users to have quick, rapid, and instant communication with their peers. Portability relates to the physical characteristics of mobile devices. It refers to the quality or state of being light enough or mobile and specifically pertains to something that can be utilized while in transit. Continuity is the capability of being always connected and represents the extent to which mobile services can be used without interrupting ongoing tasks. Searchability refers to the capability of mobile services to enable users to search for information or data without the restrictions of time and space (Okazaki and Mendez, 2013).

Ubiquity has been investigated in the context of a wide variety of mobile services and technologies. Examples include mobile wireless technology (Kim and Garrison, 2009) and mobile services such as advertising (Okazaki *et al.*, 2009), web-browsing services (Yun *et al.*, 2011), cloud storage services (Arpaci, 2016), mobile commerce (Roy and Moorthi, 2017, Kaatz, 2020, Sarkar *et al.*, 2020, Chopdar and Balakrishnan, 2020, Ltifi, 2018), mobile TV and mobile banking (Tojib and Tsarenko, 2012, Zhou, 2012), social networking (Choi, 2016), mobile learning (Arain *et al.*, 2019), and mobile wallet adoption (Shaw *et al.*, 2022).

Our study conceptualized ubiquity as a second-order construct comprising portability, continuity, immediacy, spatial flexibility, and time-saving. Since VC apps are not used to search for information or data, searchability was not included in our conceptual research model.

## 3. Conceptual Research Model and Hypotheses

To unfold the usage patterns of VC apps in the professional context, we developed a conceptual research model that combines MST (Dennis *et al.*, 2008, Dennis *et al.*, 1998), social presence theory (Short *et al.*, 1976), ubiquity (Okazaki and Mendez, 2013, Okazaki *et al.*, 2012), technicality (Kim *et al.*, 2007), and perceived fees (Kim *et al.*, 2007) with two constructs from UTAUT2: performance expectancy and facilitating conditions (Venkatesh *et al.*, 2012).

Integrating key factors from MST theory and Social Presence theory with the key factors from UTAUT2 is necessary to develop a comprehensive understanding of VC apps' usage for two reasons. First, as noted in prior studies, technology adoption models such as UTAUT (Brown *et al.*, 2010, Chan *et al.*, 2010), Technology Acceptance Model (Min *et al.*, 2019), Innovation Diffusion Theory, and UTAUT2 (Morosan and DeFranco, 2016) are deficient in accounting for the use characteristics of specific technologies. In other words, they do not account for factors such as the characteristics of the use situation and the context in which the technology is used. For example, in examining VC apps, UTAUT2 is useful to assess individuals' perceptions about the

effectiveness and efficiency of the technology in completing work-related tasks. However, UTAUT2 on its own does not provide insights on how specific characteristics of VC apps and the context in which it is used influence individuals' decisions to adopt and use the technology.

Second, factors such as social presence and synchronicity from collaborative theories do not directly influence the adoption and use of VC apps. Instead, research argues the need to start with the factors from collaborative theories and then link them to key factors from UTAUT to gain a holistic understanding of the adoption and use of specific collaborative technologies (Brown *et al.*, 2010). For instance, in a study on the adoption of Mindomo, a cloud-based collaborative tool, Huang (2020) started by assessing the influence of synchronicity on social influence and social support and then evaluated the adoption and use of the technology. Similarly, Brown *et al.* (2010) first evaluated the effect of situational characteristics such as social presence and immediacy on UTAUT factors in studying proprietary collaborative technologies and then assessed their adoption and use. In another study on e-government technology, Chan *et al.* (2010) studied convenience, a feature of the technology, as an antecedent of the UTAUT factors.

Thus, following prior practices, in our study, we start with the characteristics of VC apps and the context in which they are used (convergence process), with UTAUT2 as the mediating mechanism that influences the professional's adoption and use of VC apps.

It is to be noted that while constructs such as ubiquity, perceived fees, and technicality are not part of the theories that we used in the conceptual research model, they play a vital role in individuals' perceptions of VC apps' usage. For example, in a study by Karis et al. (2016) on remote collaborations, the participants explicitly stated that the ubiquity of VC apps is key to the success of remote collaborations. Hacker et al. (2020) noted that in professional settings, the use of ubiquitous video conferencing facilitates knowledge sharing and trust building among distant collaborators. Elsden et al. (2022) found that the ubiquity of video conferencing facilitates not only remote work and learning but also enables social and personal interactions. Suciu et al., 2018 noted that the ubiquity and accessibility of video conferencing can save time and money across various business processes, due to which VC apps are now viewed as a necessity, not just a nicety. The studies are a few examples depicting ubiquity as a most important characteristic of VC apps.

Similarly, perceived fees are crucial when selecting a specific telecommunications media (Lin *et al.*, 2012). Lin *et al.* (2012) noted that a small variation in fees directly influences the amount of use and the adoption decision to use a specific technology. With regards to technicality, Lin *et al.* (2012) further argued that technical excellence enabled by a specific technology enables consumers to obtain a better usage experience and, consequently, enhances their intentions to adopt or use a technology.

The conceptual research model is shown in Figure 1. Synchronicity is a second-order formative construct based on transmission velocity, reprocessability, and parallelism. Ubiquity is the other second-order formative construct based on portability, continuity, immediacy, spatial flexibility, and time savings. The second-order formative constructs are depicted using the double-lined boxes in Figure 1.

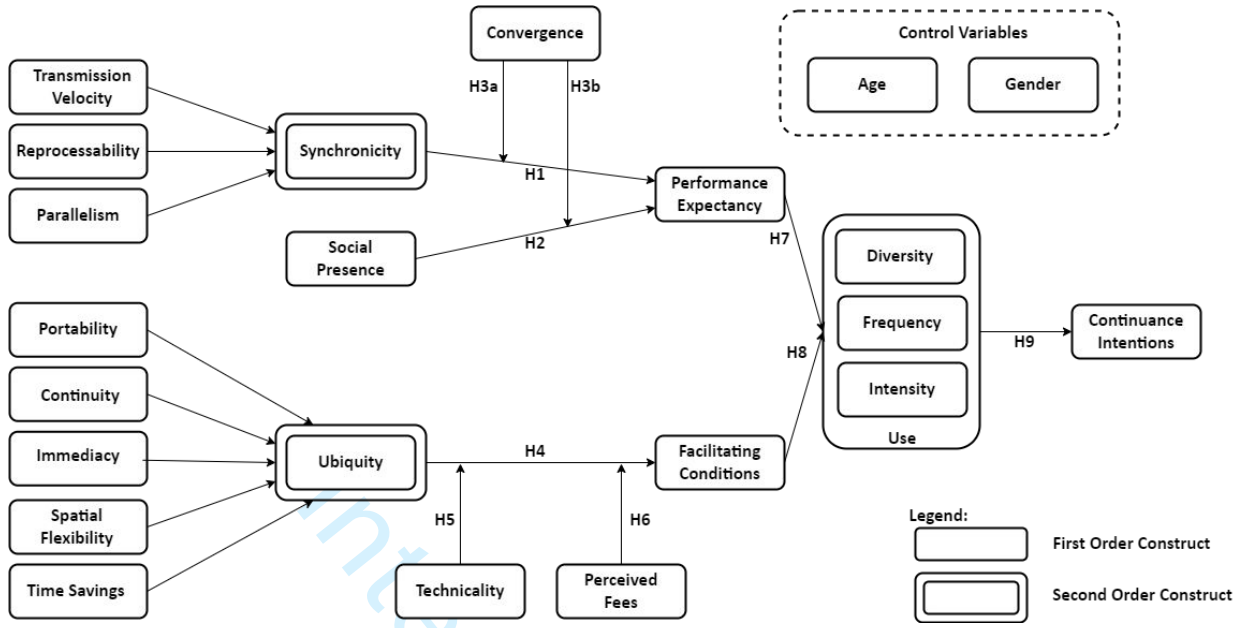



**Figure 1. Conceptual Research Model**

### 3.1 Effect of Synchronicity on Performance Expectancy

Synchronicity represents the extent to which VC apps support individuals working together simultaneously with the shared pattern of coordinated behavior and focus (Dennis *et al.*, 2008). Prior research has found that teams that use media with high synchronicity perform better than teams that use media with low synchronicity (Davison *et al.*, 2006). VC apps are high in transmission velocity as the VC platform communication occurs in real time. Real-time communications enable the messages to reach the recipient as soon as they are sent and facilitate instant responses. Video conferencing enables multiple participants to communicate simultaneously, thus facilitating high parallelism (Maruping and Agarwal, 2004). VC apps support concurrent conversations, thus facilitating consensus building. The advanced features in VC apps, such as the recording of communications, enable participants to reexamine and reprocess prior interactions (Gonzales-Zamora *et al.*, 2020), thereby enabling reprocessability. Taken together, synchronicity appropriated by VC apps allows participants to effectively hold discussions, interpret messages, obtain an understanding of jobs, consider options, and take decisions. Synchronicity of VC apps enhances the productivity of professionals and enables them to accomplish work-related tasks. Therefore, we hypothesize

*H1: Synchronicity of VC apps positively influences performance expectancy*

### 3.2 Effect of Social presence on Performance Expectancy

Social presence is the degree to which individuals perceive interactions over VC apps as personal, warm, sociable, and humanizing (Short *et al.*, 1976). Prior research has demonstrated a positive relationship between social presence and performance expectancy (Brown *et al.*, 2010, Karahanna and Straub, 1999). VC apps enable social presence due to their ability to convey a variety of social

cues, including audio, video, text, and emotive icons (Yoo and Alavi, 2001). The combination of cues enables participants to judge the facial expressions of participants and determine whether messages exchanged through VC apps are comprehended (Niinimäki *et al.*, 2010). Social cues in VC apps enable professionals to perceive psychological closeness, despite being in different locations. Higher social presence enhances the perceived usefulness of mobile technology in providing good-quality information (Hassanein and Head, 2007). When individuals experience a higher social presence in the media, they tend to be involved, absorbed, and engaged in the communication (Jin *et al.*, 2017). As immersive interactions through VC apps help professionals accomplish work-related tasks, we hypothesize

*H2: Social presence positively influences performance expectancy.*

### 3.3 Moderating Effect of Convergence on Synchronicity, Performance Expectancy, and Social Presence

According to MST, convergence is when individuals work together at the same time to develop a shared understanding of the pre-processed information and mutually agree on a possible course of action (Dennis *et al.*, 2008). The convergence process, where all the interacting partners mutually confirm the meaning of the communicated information, will need synchronicity more than the conveyance process (Park and Lee, 2019). Prior research has found that media with greater synchronicity leads to greater performance on tasks requiring convergence (Davison *et al.*, 2006). As stated earlier, synchronicity in VC apps positively influences performance expectancy. For professionals relying on VC apps for communication tasks involving convergence, this relationship will be stronger.

Similarly, in tasks such as negotiation and decision-making, where the desired outcome results from a high level of shared understanding (a convergence process), the need for social presence will be greater (Yoo and Alavi, 2001). In the virtual work environment, professionals routinely use VC apps to engage in interactions and reach a mutual agreement (Dennis *et al.*, 2008), and a higher social presence is more conducive to convergence (Brown *et al.*, 2010). Hence, we hypothesize

*H3(a): Convergence moderates the relationship between synchronicity and performance expectancy such that the effect of synchronicity on performance expectancy will be higher for convergence processes.*

*H3(b): Convergence moderates the relationship between social presence and performance expectancy such that the effect of social presence on performance expectancy will be higher for convergence processes.*

### 3.4 Effect of Ubiquity on Facilitating Conditions

Ubiquity allows users to have an uninterrupted connection and access to VC app services anytime and anywhere (Johnson *et al.*, 2018). Advancements in mobile devices and networks enable VC app users to have an instant and continuous connection with peers. Mobile device continuity and portability characteristics (Okazaki and Mendez, 2013) enable professionals to use VC apps

independent of their location. This trend has been widely popular during the COVID-19 pandemic. The ability to use VC apps through mobile phones or utilize mobile data to connect laptops and other portable devices to the Internet gives professionals an always-available link to peers without spatial and temporal barriers (Boateng and Tutu, 2018, Armfield *et al.*, 2015). This convenience contributes positively to the perceptions of facilitating conditions (Chan *et al.*, 2010). Therefore, we hypothesize

*H4: Ubiquity positively influences facilitating conditions*

### 3.5 Moderating effect of Technicality on the relationship between Ubiquity and Facilitating Conditions

Technicality is the degree to which VC apps are perceived to be technically excellent in the process of delivering services (Kim *et al.*, 2007). Technicality is determined by the consumers' perceptions of the system's ease of use, reliability, connectivity, and efficiency (Kim *et al.*, 2007). Lower technicality in a system can result in individuals experiencing discomfort, anxiety, tension, annoyance, and mental fatigue, thus negatively influencing individuals' attitudes or behavior (Kim *et al.*, 2007). In the context of VC apps, lower technicality is attributable to a wide range of factors, such as unfriendly user interfaces and connectivity difficulties (Archibald *et al.*, 2019). In this study, we assess the moderating effect of technicality on the relationship between ubiquity and facilitating conditions. We argue that when professionals experience significant psychological discomfort in using VC apps, the perception of ubiquity is lower and consequently its influence as facilitating conditions to use VC apps. Thus,

H5: *Technicality moderates the relationship between ubiquity and facilitating conditions such that the effect of ubiquity on facilitating conditions will be lower in case of lower technicality.*

### 3.6 Moderating effect of Perceived Fees on Ubiquity and Facilitating Conditions

Perceived fees refer to encoding and internalizing the monetary transaction cost of mobile internet (Kim *et al.*, 2007). Kim *et al.* (2007) note that without experience, consumers cannot judge whether the fees quoted for new technologies are reasonable. In such cases, consumers make judgments by comparing the value of new stimuli to an internal reference price or anchor points (Grewal *et al.*, 1998). When the consumer is presented with any item of new information (e.g., price, quality, or quantity) that is congruent to one's internal reference point and falls within one's latitude of acceptance, assimilation occurs (the process of accepting and integrating new belief into existing beliefs and attitudes). On the contrary, if the comparison falls within the consumers' latitude of rejection (new stimuli being discrepant from one's internal reference point), the item is rejected (the new stimuli fail to influence consumers' judgment or behavior) (Sherif and Hovland, 1961). Prior literature (Venkatesh *et al.*, 2012, Kim *et al.*, 2007, Wang and Wang, 2010) suggests that price is a key factor for consumers choosing to use a service or technology.

Although many mobile VC apps, such as Microsoft Team and Zoom, are free to use, some require the users to pay subscription fees to activate advanced features and capabilities. The paid accounts enable professionals to access robust features and extended customer support, whereas free accounts limit the availability of features and customer support. Hence, the paid accounts enable

higher ubiquity and better conditions that facilitate the use of VC apps. Therefore, we posit that the effect of ubiquity on facilitating conditions is higher when the perceived fees of VC apps are higher.

*H6: Perceived fees moderate the relationship between ubiquity and facilitating conditions such that the effect of ubiquity on facilitating conditions will be higher when perceived fees of using VC apps is higher.*

### 3.7 Effect of Performance Expectancy on Use

Performance expectancy represents the degree to which an individual believes that technology will help achieve better performance in work-related tasks (Venkatesh *et al.*, 2012). Performance expectancy has been studied as an antecedent to use intentions, and few studies (Al-Qeisi *et al.*, 2014, Anderson *et al.*, 2006, Isaac *et al.*, 2019, Lallmahomed *et al.*, 2013) have investigated its influence on system use. As indicated by these studies, when performance expectancy increases, individuals' actual use of the system also increases. As professionals explore different ways to enhance their operational performance, they will be more motivated to use mobile VC apps if they realize their usefulness in enhancing the efficiency and effectiveness of completing work-related tasks. Hence, we hypothesize

*H7: Performance expectancy positively influences the actual usage of mobile VC apps.*

### 3.8 Effect of Facilitating Conditions on Use

Facilitating conditions can be defined as the degree to which an individual believes that an appropriate environment and technical infrastructure exists to use the technology (Venkatesh *et al.*, 2003). Facilitating conditions "can be anything that acts supportively toward the implementation of the assessment procedure such as administrative, organizational or technical support, knowledge, and other resources" (Nikou and Economides, 2017). Based on the review of prior literature, Isaac *et al.* (2019) identified hardware, software, knowledge, training, compatibility with other technologies, and top management support as facilitating conditions that influence an individual's actual system use. The compatibility of VC apps across a wide variety of mobile devices makes them readily accessible and available to professionals. Online documentation and knowledge bases enable professionals to learn how to use VC apps and configure options to their liking. Intuitive user experience and feature-rich interfaces further facilitate professionals' use of VC apps. Therefore, we hypothesize

*H8: Facilitating conditions positively influence the usage of mobile VC apps.*

### 3.9 Effect of Use on Continuance Intentions

System use refers to the actual usage of an information system. The relevant measure and dimensions of system use vary across different contexts (Burton-Jones and Straub Jr, 2006). Several studies have studied system usage through users' assessments of the diversity, frequency, and intensity of use (Hou, 2012, Isaac *et al.*, 2019, Lallmahomed *et al.*, 2013, Mohammadi, 2015, Šumak and Šorgo, 2016, Venkatesh *et al.*, 2008). Diversity is the use of different features in a

system; frequency represents how often an individual uses the system, and intensity is the extent of system use. Many studies have investigated the effect of system usage on IS-related success factors such as knowledge acquisition, communication quality, decision quality (Isaac *et al.*, 2019), performance (Hou, 2012, Norzaidi *et al.*, 2009), satisfaction (Hou, 2012, Isaac *et al.*, 2019), and net benefits (Makokha and Ochieng, 2014). However, only a few studies (Martins *et al.*, 2019) have investigated the effect of system usage on continued intentions to use a system. Martins *et al.* (2019) demonstrated a positive relationship between actual system use and continuance intentions. Similarly, we argue that actual usage of VC apps enables professionals to experience different features and realize the full potential of VC apps, thus motivating them to continue using VC apps in the future. Therefore, we hypothesize

*H9: Actual usage of VC apps positively influences continuance intentions to use VC apps.*

# 4. Research Methodology

## 4.1. Measurement

A questionnaire to test the theoretical constructs was developed and made available on a survey website in two languages, English and Portuguese. The questionnaire was initially developed in English based on published literature and then translated into Portuguese. It was then reverse-translated into English to ensure translation equivalence and conformity (Brislin, 1970). Measurement items for most questions were based on a seven-point Likert scale, ranging from 'strongly disagree' (1) to 'strongly agree' (7). Diversity and frequency of use were based on a seven-point scale from 'never' (1) to 'many times per week' (7). The survey asked for an absolute number indicating average hours per week to evaluate the intensity of use. The survey also included demographic questions related to gender, age, industry, firm size, residency, education, and occupation. Measurement items used in the questionnaire are shown in the Appendix in Table A1.

## 4.2. Data

A pilot survey was conducted with 30 respondents in May 2020 to improve the questionnaire and gain additional feedback on the content and structure. The acceptance and feedback were positive; therefore, no changes were made to the survey. This aspect also enabled the inclusion of data from the pilot with the main survey results. A link to the questionnaire was shared via email with 956 participants across the European Union to collect the data required for the primary survey. Most respondents were from Portugal (95%), where the study was initiated, and the remaining 5% were from 11 other nations in the European Union. Survey respondents were identified through corporate mailing lists, university connections, and personal contacts.

Several actions were taken to boost the response rate. First, to help determine the most suitable respondents, we applied the "key informant" approach (Oliveira *et al.*, 2019, Pinsonneault and Kraemer, 1993). A detailed explanation of the study, along with examples of professionals utilizing VC apps to complete work-related tasks, were provided to single out respondents that act as key informants. Second, the survey respondents were allowed to share the study results. Third, a follow-up email was sent to non-respondents after two weeks. A total of 252 valid responses

(171 initial respondents and 81 late respondents) were received after 12 weeks. This translated to a 26% response rate. Initial and late respondent groups were compared using the Kolmogorov-Smirnov (K-S) test and showed the absence of non-response bias (Ryans, 1974). Common method bias was not present as the majority of variance was not explained solely by any of the factors, thus passing Harman's one-factor test (Podsakoff *et al.*, 2003). The absence of the common bias method was confirmed by applying the marker variable approach (Lindell and Whitney, 2001), which involves adding a theoretically irrelevant marker variable to the research model to assess the maximum shared variance. The value of .059 (5.9%) obtained can be considered low (Johnson *et al.*, 2011), thus confirming the absence of common method bias.

Table II. Demographic Characteristics below shows the demographic characteristics of the sample. With regard to industry sectors, several industries were represented, with services constituting the largest group (47.2%) of the sample. Regarding firm size, micro and medium-sized firms (24.6% each) represented almost half the sample, and nearly half of the respondents (42.1%) worked for a large firm. Also noticeable is that the vast majority of respondents (91.7%) lived in an urban context, while only 8.3% resided in a rural area. The sample comprised mainly individuals with a bachelor's degree or higher (85.3%), and only 0.8% had no formal education.

**Table II.** Demographic Characteristics

Sample characteristics (n=252)

| | | | | | |
|---|---|---|---|---|---|
| **Gender** | | | **Firm size (number of employees)** | | |
| Female | 120 | 47.6% | Micro (=<10) | 62 | 24.6% |
| Male | 127 | 50.4% | Small (11-50) | 22 | 8.7% |
| Prefer not to answer | 5 | 2.0% | Medium (51-250) | 62 | 24.6% |
| **Age (years)** | | | Large (>250) | 106 | 42.1% |
| < 18 | 1 | 0.4% | **Residency** | | |
| 18 – 24 | 34 | 13.5% | Urban | 231 | 91.7% |
| 25 – 34 | 91 | 36.1% | Rural | 21 | 8.3% |
| 35 – 44 | 52 | 20.6% | **Education** | | |
| 45 – 54 | 27 | 10.7% | No school degree completed | 2 | 0.8% |
| 55 – 64 | 34 | 13.5% | High school degree | 35 | 13.9% |
| 64 > | 13 | 5.2% | Bachelor's degree | 111 | 44.0% |
| **Industry** | | | Master's degree | 96 | 38.1% |
| Commerce | 4 | 1.6% | Doctoral degree | 8 | 3.2% |
| Health | 5 | 2.0% | **Occupation** | | |
| Information and communication | 40 | 15.9% | Student | 32 | 12.7% |
| Manufacturing | 44 | 17.5% | Employed worker | 171 | 67.8% |
| Services | 119 | 47.2% | Self-employed | 25 | 9.9% |
| Other | 40 | 15.9% | Unemployed/Retired | 24 | 9.5% |

## 5. Data Analysis

The research model was assessed empirically using structural equation modeling (SEM). SEM comprises two distinct techniques - covariance-based and variance-based (Henseler *et al.*, 2009). A model with low theoretical information and maximum complexity needs a variance-based technique such as partial least squares (PLS) to assess the data (Henseler *et al.*, 2009). A normal distribution of the data is not required when applying PLS (Chin *et al.*, 2003). The PLS approach averts restrictive distributional assumptions when asserting path coefficients considerably different from zero (Fornell and Bookstein, 1982; Gefen and Straub, 2005).

Furthermore, for analyzing previously untested subjects, PLS proves to be an advantageous technique (Ke *et al.*, 2009, Teo *et al.*, 2003), as one of its perks is allowing formative indicators to model latent constructs (Goo *et al.*, 2009). Since our research model has not been tested before, the variable distributions are not normal, and formative constructs are included in the model, PLS is the most fitting method for this study (Henseler *et al.*, 2009). SmartPLS 3.3.2 was used to assess the measurement model's reliability and validity and to perform an analysis of the structural model. We used a proportional stratified sampling technique based on age and gender. Age and gender were used as control variables in order to capture the heterogeneous nature of the population that the research model would not otherwise capture.

### 5.1. Measurement model

Table III, Table IV, Table V, Table VI, and Table VII present the measurement model. The composite reliability of all reflective constructs is higher than 0.7, confirming internal consistency (see Table III) (Henseler *et al.*, 2009, Straub, 1989). The convergent validity of the measurement model was tested with average variance extracted (AVE). AVE should be higher than 0.5 so that more than half of the variance of the indicators is explained by the latent variables (Fornell and Larcker, 1981, Hair *et al.*, 2012). As seen in Table III, all constructs satisfy this criterion. To evaluate indicator reliability, the loading (in bold) should ideally be greater than 0.70 (Churchill Jr, 1979, Henseler *et al.*, 2009). With the exception of TV4 and C3, all loadings are greater than 0.70. TV4 was dropped, and C3 was maintained because it was greater than 0.40. As seen in Table IV, the model presents good indicator reliability.

Three criteria were applied to assess the constructs' discriminant validity: the Fornell-Larcker criterion, cross-loadings, and the heterotrait-monotrait ratio (HTMT) (Henseler *et al.*, 2015). The Fornell-Larcker criterion requires that the correlations between the constructs must be lower than the square root of AVE (Fornell and Larcker, 1981). These correlations are satisfied by the measurement model (Table III). The second criterion is that the loadings (in bold) must be greater than all cross-loadings (Chin, 1998). This criterion is also satisfied (Table IV) except for items I4 and IT1, which were eliminated. With regard to HTMT, none of the values are higher than the threshold of 0.9, as observed in Table V. Thus, the discriminant validity of the scales is satisfied.

We performed a similar analysis of the formative construct, diversity of use. As observed in Table VI, the variance inflation factor (VIF) ranges between 1.337 (lowest) and 1.973 (highest) and is below the 3.3 threshold (Lee and Xia, 2010). The weights of the items DV1, DV2, and DV3 are statistically significant ($p < 0.01$). The weights for the other items, DV4, DV5, DV6, and DV7, are not statistically significant. Hence, we computed the loadings for all items and concluded that all items are statistically significant. Thus, we determined that diversity of use can be used to test the structural model.

**Table III.** Descriptive Statistics, Average Variance Extracted, Composite Reliability and Correlations

| | Mean | SD | AVE | CR | TV | R | PL | SP | CG | P | C | I | SF | TS | T | PF | PE | FC | DV | FQ | IT | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV | **5.14** | **1.15** | **0.83** | **0.94** | **0.91** | | | | | | | | | | | | | | | | | |
| R | **4.69** | **1.60** | **0.83** | **0.95** | 0.38 | **0.91** | | | | | | | | | | | | | | | | |
| PL | **5.96** | **1.04** | **0.72** | **0.91** | 0.58 | 0.42 | **0.85** | | | | | | | | | | | | | | | |
| SP | **4.65** | **1.36** | **0.84** | **0.96** | 0.61 | 0.40 | 0.53 | **0.92** | | | | | | | | | | | | | | |
| CG | **5.62** | **1.11** | **0.80** | **0.94** | 0.61 | 0.41 | 0.63 | 0.52 | **0.90** | | | | | | | | | | | | | |
| P | **5.28** | **1.40** | **0.75** | **0.90** | 0.58 | 0.38 | 0.47 | 0.50 | 0.45 | **0.86** | | | | | | | | | | | | |
| C | **4.80** | **1.20** | **0.66** | **0.85** | 0.50 | 0.42 | 0.46 | 0.45 | 0.46 | 0.49 | **0.81** | | | | | | | | | | | |
| I | **5.51** | **1.12** | **0.74** | **0.90** | 0.72 | 0.35 | 0.51 | 0.54 | 0.60 | 0.53 | 0.58 | **0.86** | | | | | | | | | | |
| SF | **5.18** | **1.23** | **0.70** | **0.90** | 0.60 | 0.44 | 0.49 | 0.56 | 0.56 | 0.73 | 0.61 | 0.63 | **0.84** | | | | | | | | | |
| TS | **5.25** | **1.24** | **0.77** | **0.91** | 0.57 | 0.34 | 0.48 | 0.45 | 0.56 | 0.67 | 0.59 | 0.58 | 0.67 | **0.88** | | | | | | | | |
| T | **5.51** | **1.12** | **0.74** | **0.92** | 0.55 | 0.46 | 0.62 | 0.50 | 0.61 | 0.58 | 0.56 | 0.53 | 0.57 | 0.56 | **0.86** | | | | | | | |
| PF | **2.64** | **1.66** | **0.88** | **0.95** | -0.16 | -0.04 | -0.18 | -0.08 | -0.17 | -0.13 | -0.15 | -0.17 | -0.11 | -0.14 | -0.23 | **0.94** | | | | | | |
| PE | **5.00** | **1.40** | **0.82** | **0.95** | 0.61 | 0.44 | 0.55 | 0.54 | 0.72 | 0.56 | 0.63 | 0.61 | 0.67 | 0.71 | 0.63 | -0.09 | **0.91** | | | | | |
| FC | **5.81** | **1.13** | **0.74** | **0.92** | 0.55 | 0.32 | 0.53 | 0.39 | 0.70 | 0.47 | 0.42 | 0.50 | 0.52 | 0.51 | 0.66 | -0.31 | 0.51 | **0.86** | | | | |
| DV | **5.20** | **1.46** | **NA** | **NA** | 0.35 | 0.28 | 0.40 | 0.36 | 0.46 | 0.30 | 0.33 | 0.44 | 0.36 | 0.34 | 0.44 | -0.12 | 0.50 | 0.41 | **NA** | | | |
| FQ | **5.16** | **1.71** | **0.82** | **0.93** | 0.42 | 0.26 | 0.42 | 0.38 | 0.51 | 0.37 | 0.37 | 0.45 | 0.40 | 0.38 | 0.47 | -0.27 | 0.53 | 0.47 | 0.59 | **0.90** | | |
| IT | **5.23** | **1.65** | **0.94** | **0.97** | 0.37 | 0.22 | 0.35 | 0.37 | 0.39 | 0.27 | 0.32 | 0.41 | 0.33 | 0.31 | 0.40 | -0.21 | 0.42 | 0.38 | 0.64 | 0.74 | **0.97** | |
| CI | **5.82** | **1.42** | **0.95** | **0.98** | 0.47 | 0.29 | 0.47 | 0.47 | 0.62 | 0.46 | 0.35 | 0.49 | 0.43 | 0.47 | 0.49 | -0.21 | 0.59 | 0.52 | 0.58 | 0.60 | 0.59 | **0.98** |

**Note:** Standard deviation (SD); Average variance extracted (AVE); Composite reliability (CR); Transmission velocity (TV); Reprocessability (R); Parallelism (PL); Social presence (SP); Convergence (CG); Portability (P); Continuity (C); Immediacy (I); Spatial flexibility (SF); Time savings (TS); Technicality (T); Perceived fees (PF); Performance expectancy (PE); Facilitating conditions (FC); Diversity of use (DV); Frequency of use (FQ); Intensity of use (IT); Continuance intentions (CI); Non-applicable (NA).
All loadings have an absolute value greater than 0.5.
The diagonal elements (bold) are the square root of AVE.

**Table IV.** Factor Analysis

| **Construct** | **Item** | TV | R | PL | SP | CG | P | C | I | SF | TS | T | PF | PE | FC | FQ | IT | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV | **TV1** | **0.86** | 0.31 | 0.51 | 0.60 | 0.59 | 0.52 | 0.40 | 0.63 | 0.56 | 0.52 | 0.50 | -0.15 | 0.54 | 0.54 | 0.37 | 0.29 | 0.45 |
| | **TV2** | **0.95** | 0.40 | 0.57 | 0.57 | 0.59 | 0.56 | 0.49 | 0.69 | 0.57 | 0.52 | 0.55 | -0.17 | 0.58 | 0.55 | 0.41 | 0.37 | 0.45 |
| | **TV3** | **0.92** | 0.32 | 0.51 | 0.52 | 0.50 | 0.53 | 0.48 | 0.66 | 0.52 | 0.53 | 0.47 | -0.12 | 0.55 | 0.43 | 0.38 | 0.35 | 0.38 |
| R | **R1** | 0.43 | **0.82** | 0.42 | 0.43 | 0.44 | 0.43 | 0.38 | 0.39 | 0.41 | 0.36 | 0.47 | -0.06 | 0.43 | 0.38 | 0.21 | 0.21 | 0.30 |
| | **R2** | 0.31 | **0.94** | 0.38 | 0.34 | 0.34 | 0.34 | 0.38 | 0.28 | 0.40 | 0.31 | 0.40 | -0.04 | 0.38 | 0.27 | 0.25 | 0.22 | 0.25 |
| | **R3** | 0.32 | **0.96** | 0.37 | 0.32 | 0.35 | 0.30 | 0.40 | 0.30 | 0.40 | 0.29 | 0.40 | -0.04 | 0.41 | 0.27 | 0.24 | 0.19 | 0.24 |
| | **R4** | 0.31 | **0.91** | 0.36 | 0.35 | 0.36 | 0.31 | 0.36 | 0.30 | 0.38 | 0.27 | 0.38 | -0.01 | 0.39 | 0.24 | 0.25 | 0.17 | 0.26 |
| PL | **PL1** | 0.56 | 0.37 | **0.90** | 0.46 | 0.60 | 0.43 | 0.43 | 0.51 | 0.43 | 0.44 | 0.57 | -0.22 | 0.45 | 0.55 | 0.36 | 0.31 | 0.45 |
| | **PL2** | 0.52 | 0.39 | **0.91** | 0.46 | 0.58 | 0.43 | 0.46 | 0.46 | 0.47 | 0.48 | 0.58 | -0.16 | 0.54 | 0.51 | 0.39 | 0.33 | 0.42 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PL3** | 0.41 | 0.36 | **0.76** | 0.45 | 0.39 | 0.40 | 0.30 | 0.37 | 0.36 | 0.35 | 0.47 | -0.06 | 0.39 | 0.33 | 0.31 | 0.23 | 0.32 |
| | **PL4** | 0.47 | 0.31 | **0.81** | 0.43 | 0.54 | 0.31 | 0.34 | 0.38 | 0.37 | 0.36 | 0.48 | -0.17 | 0.47 | 0.37 | 0.35 | 0.32 | 0.40 |
| | **SP1** | 0.56 | 0.32 | 0.47 | **0.89** | 0.47 | 0.51 | 0.45 | 0.55 | 0.59 | 0.51 | 0.45 | -0.10 | 0.55 | 0.35 | 0.36 | 0.31 | 0.44 |
| SP | **SP2** | 0.55 | 0.40 | 0.48 | **0.92** | 0.47 | 0.46 | 0.44 | 0.50 | 0.48 | 0.41 | 0.47 | -0.04 | 0.46 | 0.34 | 0.33 | 0.32 | 0.43 |
| | **SP3** | 0.57 | 0.39 | 0.50 | **0.95** | 0.47 | 0.43 | 0.39 | 0.46 | 0.48 | 0.35 | 0.44 | -0.05 | 0.48 | 0.35 | 0.34 | 0.34 | 0.42 |
| | **SP4** | 0.58 | 0.35 | 0.50 | **0.91** | 0.48 | 0.41 | 0.38 | 0.47 | 0.47 | 0.38 | 0.47 | -0.10 | 0.48 | 0.40 | 0.35 | 0.39 | 0.44 |
| | **CG1** | 0.49 | 0.39 | 0.53 | 0.39 | **0.86** | 0.34 | 0.34 | 0.49 | 0.43 | 0.48 | 0.47 | -0.10 | 0.61 | 0.58 | 0.40 | 0.32 | 0.52 |
| CG | **CG2** | 0.60 | 0.38 | 0.57 | 0.51 | **0.92** | 0.46 | 0.47 | 0.58 | 0.57 | 0.55 | 0.59 | -0.18 | 0.67 | 0.68 | 0.51 | 0.39 | 0.61 |
| | **CG3** | 0.56 | 0.39 | 0.62 | 0.52 | **0.92** | 0.44 | 0.43 | 0.57 | 0.52 | 0.48 | 0.62 | -0.19 | 0.64 | 0.69 | 0.48 | 0.36 | 0.58 |
| | **CG4** | 0.55 | 0.31 | 0.54 | 0.42 | **0.87** | 0.38 | 0.42 | 0.51 | 0.47 | 0.50 | 0.51 | -0.15 | 0.67 | 0.55 | 0.42 | 0.34 | 0.50 |
| | **P1** | 0.52 | 0.31 | 0.38 | 0.40 | 0.43 | **0.87** | 0.41 | 0.50 | 0.65 | 0.61 | 0.51 | -0.13 | 0.48 | 0.45 | 0.30 | 0.20 | 0.36 |
| P | **P2** | 0.50 | 0.34 | 0.42 | 0.43 | 0.37 | **0.88** | 0.39 | 0.45 | 0.65 | 0.51 | 0.47 | -0.09 | 0.48 | 0.40 | 0.34 | 0.27 | 0.40 |
| | **P3** | 0.49 | 0.34 | 0.40 | 0.47 | 0.37 | **0.84** | 0.47 | 0.42 | 0.59 | 0.61 | 0.52 | -0.12 | 0.50 | 0.37 | 0.31 | 0.24 | 0.42 |
| | **C1** | 0.37 | 0.34 | 0.35 | 0.33 | 0.32 | 0.37 | **0.86** | 0.45 | 0.49 | 0.47 | 0.46 | -0.07 | 0.46 | 0.32 | 0.28 | 0.21 | 0.22 |
| C | **C2** | 0.51 | 0.36 | 0.43 | 0.41 | 0.51 | 0.43 | **0.88** | 0.57 | 0.54 | 0.54 | 0.52 | -0.19 | 0.62 | 0.41 | 0.34 | 0.28 | 0.38 |
| | **C3** | 0.34 | 0.33 | 0.33 | 0.37 | 0.28 | 0.39 | **0.69** | 0.37 | 0.46 | 0.42 | 0.38 | -0.09 | 0.44 | 0.28 | 0.27 | 0.29 | 0.23 |
| | **I1** | 0.58 | 0.29 | 0.42 | 0.49 | 0.54 | 0.45 | 0.54 | **0.87** | 0.59 | 0.53 | 0.47 | -0.13 | 0.59 | 0.39 | 0.42 | 0.42 | 0.40 |
| I | **I2** | 0.70 | 0.28 | 0.43 | 0.45 | 0.51 | 0.46 | 0.55 | **0.90** | 0.55 | 0.52 | 0.47 | -0.14 | 0.55 | 0.43 | 0.39 | 0.33 | 0.41 |
| | **I3** | 0.60 | 0.34 | 0.49 | 0.48 | 0.50 | 0.46 | 0.39 | **0.81** | 0.49 | 0.45 | 0.44 | -0.18 | 0.44 | 0.49 | 0.35 | 0.31 | 0.45 |
| | **SF1** | 0.46 | 0.49 | 0.39 | 0.41 | 0.38 | 0.56 | 0.59 | 0.50 | **0.81** | 0.56 | 0.44 | -0.01 | 0.58 | 0.30 | 0.25 | 0.20 | 0.25 |
| SF | **SF2** | 0.51 | 0.30 | 0.39 | 0.44 | 0.54 | 0.51 | 0.44 | 0.57 | **0.79** | 0.62 | 0.44 | -0.16 | 0.58 | 0.48 | 0.39 | 0.30 | 0.41 |
| | **SF3** | 0.49 | 0.33 | 0.37 | 0.47 | 0.40 | 0.70 | 0.52 | 0.48 | **0.88** | 0.56 | 0.48 | -0.05 | 0.54 | 0.39 | 0.34 | 0.28 | 0.36 |
| | **SF4** | 0.56 | 0.36 | 0.48 | 0.54 | 0.56 | 0.68 | 0.51 | 0.58 | **0.87** | 0.53 | 0.56 | -0.14 | 0.56 | 0.56 | 0.36 | 0.32 | 0.43 |
| | **TS1** | 0.42 | 0.34 | 0.39 | 0.34 | 0.42 | 0.57 | 0.54 | 0.42 | 0.54 | **0.86** | 0.42 | -0.05 | 0.57 | 0.33 | 0.22 | 0.18 | 0.32 |
| TS | **TS2** | 0.58 | 0.35 | 0.49 | 0.44 | 0.56 | 0.61 | 0.57 | 0.56 | 0.65 | **0.92** | 0.55 | -0.11 | 0.68 | 0.49 | 0.39 | 0.31 | 0.48 |
| | **TS3** | 0.51 | 0.21 | 0.40 | 0.40 | 0.49 | 0.58 | 0.46 | 0.54 | 0.58 | **0.86** | 0.49 | -0.20 | 0.62 | 0.52 | 0.38 | 0.32 | 0.44 |
| | **T1** | 0.45 | 0.37 | 0.48 | 0.38 | 0.52 | 0.50 | 0.45 | 0.43 | 0.44 | 0.47 | **0.88** | -0.19 | 0.51 | 0.62 | 0.39 | 0.34 | 0.42 |
| T | **T2** | 0.50 | 0.40 | 0.57 | 0.45 | 0.52 | 0.55 | 0.52 | 0.47 | 0.55 | 0.48 | **0.89** | -0.20 | 0.52 | 0.59 | 0.39 | 0.31 | 0.42 |
| | **T3** | 0.39 | 0.33 | 0.46 | 0.39 | 0.45 | 0.41 | 0.43 | 0.39 | 0.45 | 0.41 | **0.77** | -0.13 | 0.49 | 0.44 | 0.34 | 0.28 | 0.35 |
| | **T4** | 0.56 | 0.46 | 0.61 | 0.50 | 0.61 | 0.52 | 0.53 | 0.53 | 0.53 | 0.54 | **0.88** | -0.24 | 0.62 | 0.60 | 0.49 | 0.41 | 0.49 |
| PF | **PF1** | -0.15 | -0.01 | -0.16 | -0.06 | -0.17 | -0.14 | -0.16 | -0.17 | -0.10 | -0.13 | -0.21 | **0.94** | -0.09 | -0.29 | -0.27 | -0.24 | -0.19 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PF2** | -0.17 | -0.05 | -0.18 | -0.08 | -0.18 | -0.14 | -0.15 | -0.18 | -0.11 | -0.15 | -0.21 | **0.95** | -0.10 | -0.31 | -0.28 | -0.21 | -0.24 |
| | **PF3** | -0.13 | -0.05 | -0.17 | -0.08 | -0.14 | -0.09 | -0.10 | -0.13 | -0.09 | -0.09 | -0.22 | **0.92** | -0.05 | -0.28 | -0.22 | -0.15 | -0.15 |
| PE | **PE1** | 0.58 | 0.40 | 0.55 | 0.49 | 0.69 | 0.54 | 0.59 | 0.58 | 0.63 | 0.67 | 0.64 | -0.18 | **0.88** | 0.55 | 0.60 | 0.48 | 0.61 |
| | **PE2** | 0.56 | 0.41 | 0.52 | 0.53 | 0.66 | 0.52 | 0.57 | 0.58 | 0.66 | 0.62 | 0.55 | -0.09 | **0.94** | 0.45 | 0.49 | 0.39 | 0.52 |
| | **PE3** | 0.55 | 0.43 | 0.48 | 0.48 | 0.64 | 0.50 | 0.60 | 0.55 | 0.61 | 0.66 | 0.55 | -0.02 | **0.92** | 0.45 | 0.42 | 0.32 | 0.48 |
| | **PE4** | 0.51 | 0.37 | 0.42 | 0.46 | 0.63 | 0.45 | 0.53 | 0.51 | 0.53 | 0.62 | 0.51 | -0.02 | **0.90** | 0.40 | 0.40 | 0.30 | 0.50 |
| FC | **FC1** | 0.49 | 0.32 | 0.50 | 0.35 | 0.59 | 0.48 | 0.34 | 0.46 | 0.49 | 0.50 | 0.62 | -0.34 | 0.45 | **0.89** | 0.44 | 0.35 | 0.48 |
| | **FC2** | 0.46 | 0.22 | 0.46 | 0.30 | 0.59 | 0.40 | 0.37 | 0.43 | 0.43 | 0.44 | 0.58 | -0.28 | 0.44 | **0.88** | 0.49 | 0.41 | 0.48 |
| | **FC3** | 0.49 | 0.22 | 0.40 | 0.34 | 0.64 | 0.37 | 0.36 | 0.44 | 0.44 | 0.42 | 0.57 | -0.21 | 0.46 | **0.88** | 0.36 | 0.28 | 0.46 |
| | **FC4** | 0.47 | 0.38 | 0.45 | 0.38 | 0.59 | 0.35 | 0.37 | 0.41 | 0.42 | 0.39 | 0.49 | -0.25 | 0.42 | **0.79** | 0.28 | 0.22 | 0.34 |
| | **FQ1** | 0.41 | 0.28 | 0.42 | 0.38 | 0.49 | 0.37 | 0.36 | 0.40 | 0.42 | 0.35 | 0.48 | -0.24 | 0.53 | 0.46 | **0.94** | 0.69 | 0.56 |
| FQ | **FQ2** | 0.37 | 0.26 | 0.33 | 0.35 | 0.41 | 0.30 | 0.36 | 0.44 | 0.34 | 0.33 | 0.37 | -0.23 | 0.44 | 0.37 | **0.85** | 0.62 | 0.47 |
| | **FQ3** | 0.37 | 0.17 | 0.38 | 0.30 | 0.46 | 0.32 | 0.29 | 0.39 | 0.33 | 0.35 | 0.42 | -0.27 | 0.47 | 0.42 | **0.92** | 0.69 | 0.59 |
| IT | **IT2** | 0.35 | 0.20 | 0.35 | 0.36 | 0.38 | 0.26 | 0.30 | 0.40 | 0.30 | 0.30 | 0.36 | -0.20 | 0.39 | 0.35 | 0.71 | **0.97** | 0.58 |
| | **IT3** | 0.37 | 0.23 | 0.34 | 0.36 | 0.39 | 0.28 | 0.32 | 0.40 | 0.34 | 0.30 | 0.41 | -0.22 | 0.42 | 0.38 | 0.72 | **0.97** | 0.57 |
| | **CI1** | 0.47 | 0.27 | 0.47 | 0.48 | 0.61 | 0.48 | 0.35 | 0.50 | 0.45 | 0.46 | 0.49 | -0.21 | 0.58 | 0.51 | 0.58 | 0.57 | **0.98** |
| CI | **CI2** | 0.45 | 0.30 | 0.48 | 0.48 | 0.60 | 0.45 | 0.34 | 0.49 | 0.43 | 0.47 | 0.47 | -0.21 | 0.56 | 0.50 | 0.57 | 0.55 | **0.98** |
| | **CI3** | 0.45 | 0.28 | 0.43 | 0.43 | 0.60 | 0.41 | 0.33 | 0.44 | 0.39 | 0.46 | 0.48 | -0.20 | 0.57 | 0.51 | 0.60 | 0.60 | **0.97** |

**Note:** Transmission velocity (TV); Reprocessability (R); Parallelism (PL); Social presence (SP); Convergence (CG); Portability (P); Continuity (C); Immediacy (I); Spatial flexibility (SF); Time savings (TS); Technicality (T); Perceived fees (PF); Performance expectancy (PE); Facilitating conditions (FC); Frequency of use (FQ); Intensity of use (IT); Continuance intentions (CI).
All loadings have an absolute value greater than 0.5.

**Table V.** Heterotrait-Monotrait Ratio (HTMT)

| Construct | TV | R | PL | SP | CG | P | C | I | SF | TS | T | PF | PE | FC | FQ | IT | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV | | | | | | | | | | | | | | | | | |
| R | 0.413 | | | | | | | | | | | | | | | | |
| PL | 0.657 | 0.474 | | | | | | | | | | | | | | | |
| SP | 0.669 | 0.425 | 0.591 | | | | | | | | | | | | | | |
| CG | 0.676 | 0.446 | 0.705 | 0.555 | | | | | | | | | | | | | |
| P | 0.675 | 0.434 | 0.550 | 0.561 | 0.516 | | | | | | | | | | | | |
| C | 0.610 | 0.507 | 0.566 | 0.544 | 0.551 | 0.628 | | | | | | | | | | | |
| I | 0.841 | 0.402 | 0.607 | 0.617 | 0.687 | 0.641 | 0.726 | | | | | | | | | | |
| SF | 0.685 | 0.493 | 0.561 | 0.614 | 0.629 | 0.866 | 0.771 | 0.750 | | | | | | | | | |
| TS | 0.654 | 0.382 | 0.557 | 0.499 | 0.633 | 0.793 | 0.745 | 0.685 | 0.786 | | | | | | | | |
| T | 0.619 | 0.502 | 0.707 | 0.551 | 0.680 | 0.676 | 0.696 | 0.623 | 0.659 | 0.636 | | | | | | | |
| PF | 0.176 | 0.044 | 0.203 | 0.083 | 0.187 | 0.152 | 0.172 | 0.198 | 0.120 | 0.150 | 0.247 | | | | | | |
| PE | 0.664 | 0.478 | 0.605 | 0.573 | 0.779 | 0.635 | 0.755 | 0.692 | 0.750 | 0.792 | 0.686 | 0.091 | | | | | |
| FC | 0.624 | 0.364 | 0.596 | 0.437 | 0.780 | 0.545 | 0.517 | 0.595 | 0.593 | 0.579 | 0.739 | 0.343 | 0.563 | | | | |
| FQ | 0.475 | 0.290 | 0.473 | 0.415 | 0.559 | 0.429 | 0.457 | 0.527 | 0.460 | 0.431 | 0.528 | 0.301 | 0.578 | 0.513 | | | |
| IT | 0.404 | 0.235 | 0.391 | 0.394 | 0.424 | 0.311 | 0.387 | 0.466 | 0.366 | 0.338 | 0.432 | 0.228 | 0.439 | 0.403 | 0.806 | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CI | 0.502 | 0.304 | 0.510 | 0.494 | 0.653 | 0.510 | 0.402 | 0.546 | 0.473 | 0.515 | 0.528 | 0.218 | 0.610 | 0.550 | 0.641 | 0.613 |

**Note:** Transmission velocity (TV); Reprocessability (R); Parallelism (PL); Social presence (SP); Convergence (CG); Portability (P); Continuity (C); Immediacy (I); Spatial flexibility (SF); Time savings (TS); Technicality (T); Perceived fees (PF); Performance expectancy (PE); Facilitating conditions (FC); Frequency of use (FQ); Intensity of use (IT); Continuance intentions (CI).

**Table VI.** Formative Construct

| Formative Construct | Item | Weights | Loadings | VIF |
|---|---|---|---|---|
| Diversity of use | DV1 | 0.293*** | 0.716*** | 1.527 |
| | DV2 | 0.482*** | 0.704*** | 1.337 |
| | DV3 | 0.495*** | 0.753*** | 1.973 |
| | DV4 | -0.086 | 0.478*** | 1.717 |
| | DV5 | 0.168* | 0.637*** | 1.448 |
| | DV6 | 0.070 | 0.409*** | 1.868 |
| | DV7 | -0.112 | 0.147* | 1.555 |

**Note:** Standardized coefficients, *p<0.10; ** p<0.05; *** p<0.01

**Table VII.** Second-order Constructs

| Formative Construct (second-order construct, reflective formative type) | Constructs (first-order reflective) | Weights | VIF |
|---|---|---|---|
| Synchronicity | Transmission Velocity | 0.378*** | 1.564 |
| | Reprocessability | 0.438*** | 1.261 |
| | Parallelism | 0.433*** | 1.632 |
| Ubiquity | Portability | 0.217*** | 2.466 |
| | Continuity | 0.170*** | 1.888 |
| | Immediacy | 0.214*** | 1.913 |
| | Spatial Flexibility | 0.296*** | 2.979 |
| | Time Savings | 0.297*** | 2.353 |

**Note:** Standardized coefficients, *p<0.10; ** p<0.05; *** p<0.01

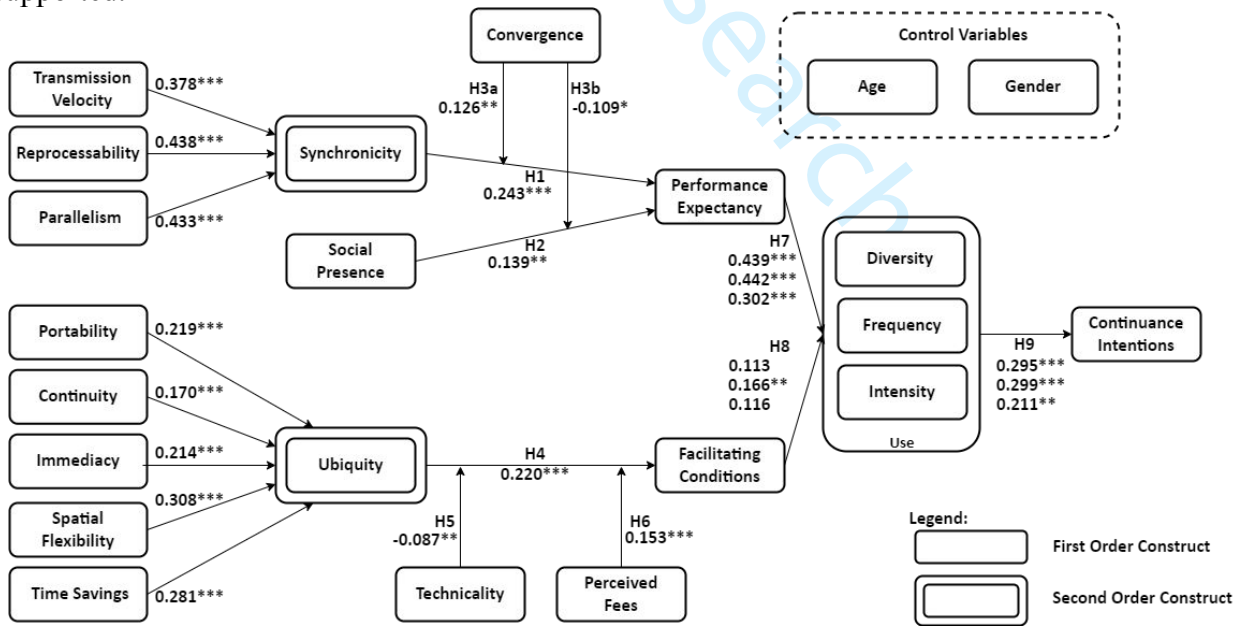
The measurement model was then analyzed to evaluate the significance levels, weights, and multicollinearity of the two second-order formative constructs, synchronicity and ubiquity. The VIF statistic was performed to assess multicollinearity (Table VII), which ranges between 1.261 (lowest) to 2.979 (highest). Variable multicollinearity is not an issue in the measurement model as the values are lower than the 3.3 threshold (Lee and Xia, 2010). Moreover, all the weights are statistically significant ($p < 0.01$) and hold a positive sign, thereby confirming that both second-order formative constructs can be used to test the measurement model.

### 5.2. Structural model

The structural model (Figure 2) shows the PLS results along with the path coefficients and the variations explained. The significance levels of path coefficients in the structural model were assessed by bootstrapping with 5000 subsamples (Hair *et al.*, 2011, Henseler *et al.*, 2009).

The model explains 60.7% of variation in performance expectancy (PE) and confirms the positive effect of synchronicity ($\hat{\beta}$=0.243; p<0.01), and social presence ($\hat{\beta}$=0.139; p<0.05) on PE. In addition, the moderating effect of convergence ($\hat{\beta}$=0.126; p<0.05) on the relationship between synchronicity and PE is confirmed. The moderating role of convergence ($\hat{\beta}$=-0.109; p>0.10) on the relationship between social presence and PE was not found to be statistically significant. Therefore, H1, H2, and H3a are supported, while H3b is not supported.

The model explains 56.8% of variation in facilitating conditions (FC), confirms the positive effect of ubiquity ($\hat{\beta}$=0.220; p<0.01), and the negative moderating effect of technicality ($\hat{\beta}$=-0.087; p<0.05) on the relationship between ubiquity and FC. The moderating effect of perceived fees ($\hat{\beta}$ =0.153; p<0.01) on ubiquity, and FC is also confirmed. Consequently, H4, H5, and H6 are supported.




**Note:** Standardized coefficients, * p<0.10; ** p<0.05; *** p<0.01

**Figure 1. Structural Model**

The model explains 35.3% of variation in diversity of use, 41.5% of variation in frequency of use, and 30.7% of variation in intensity of use. The effect of PE on use (diversity - $\hat{\beta}$=0.439; p<0.01; frequency - $\hat{\beta}$=0.442; p<0.01; intensity - $\hat{\beta}$=0.302; p<0.01) is statistically significant, thus confirming H7. The effect of FC on use (diversity - $\hat{\beta}$=0.113; p>0.10; frequency - $\hat{\beta}$=0.166; p<0.05; intensity - $\hat{\beta}$=0.116; p>0.10) is only statistically significant for frequency, thereby partially confirming H8.

Finally, the model explains 46.0% of variation in continuance intentions. The positive influence of diversity of use ($\hat{\beta}$=0.295; p<0.01), frequency of use ($\hat{\beta}$=0.299; p<0.01), and intensity of use ($\hat{\beta}$ =0.211; p<0.05) on continuance intentions are also supported, thus confirming H9.

## 6. Discussion

The objective of our study was to investigate how media characteristics, i.e., technological and socially derived characteristics of VC apps, shape professionals' perceptions toward VC apps. The study also aimed to examine how professionals' perceptions toward VC apps influence their use and continued use in the professional context. Drawing upon prior research, we proposed and tested a conceptual model to assess the technological and socially derived characteristics of VC apps. The antecedents of attitudinal constructs were empirically tested using survey data collected from professionals in the European Union. The findings provide support for our conceptual research model and are discussed below.

The study revealed that synchronicity in VC apps positively influences performance expectancy. The survey results show that when professionals perceive higher synchronicity in VC apps, they perceive VC apps to be useful in enhancing productivity and effectiveness in completing work-related tasks. The findings align with prior literature on virtual collaborations (Davison *et al.*, 2006). Our study also found that social presence enabled by VC apps supports the development of warm, close, and personal relationships among peers. Thus, it is noteworthy that the socially derived characteristics of VC apps enhance interactions, make communication easy, and consequently increase performance expectancy. These findings correspond with prior literature on the role of social presence in online platforms (Hassanein and Head, 2007, Joksimović *et al.*, 2015, Walter *et al.*, 2015).

The study found that the convergence process positively moderates the relationship between synchronicity and performance expectancy. As seen in Figure 3a, the effect of synchronicity on performance expectancy is higher when convergence is higher. This aspect suggests that higher synchronicity enabled by VC apps results in the professionals fostering a higher sense of usefulness of VC apps for tasks that require more interactions and coordination, such as group decision-making and negotiation. However, our findings indicate that convergence is not significant in moderating the relationship between social presence and performance expectancy. This suggests that synchronicity enabled by VC apps is more important than social presence for communication tasks where the desired outcome is a high level of shared understanding.

The study's findings also suggest that ubiquity positively influences the facilitating conditions to use VC apps. The survey results indicate that VC apps enable professionals to have a seamless and constant connection with their peers regardless of time and space. It enables scheduling flexibility

and effective time management. However, our findings indicate that the influence of ubiquity on facilitating conditions is negatively moderated by technicality. This facet implies that when professionals experience higher cognitive effort (meaning lower technicality), their perceptions of ubiquity as a facilitating condition for VC app use decrease. The survey found that difficulties in using and connecting VC calls also lowered the technicality of VC apps. In other words, the importance of ubiquity in facilitating conditions is lower when technicality is lower, as can be seen in Figure 3b.

Additionally, the moderating effect of perceived fees on the relationship between ubiquity and facilitating conditions was found to be significant. As can be seen in Figure 3c, the importance of ubiquity in facilitating conditions is higher when perceived fees are higher. Professionals believe that increased fees increase ubiquity features and facilitate improved conditions to use VC apps.

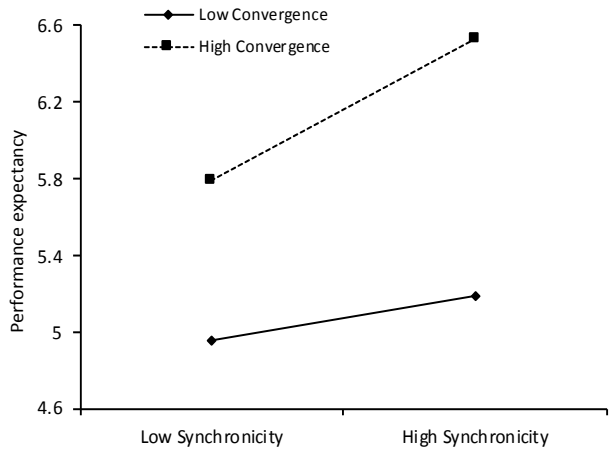



**Figure 2a.** Moderation effect of Convergence on the relationship between Synchronicity and Performance Expectancy

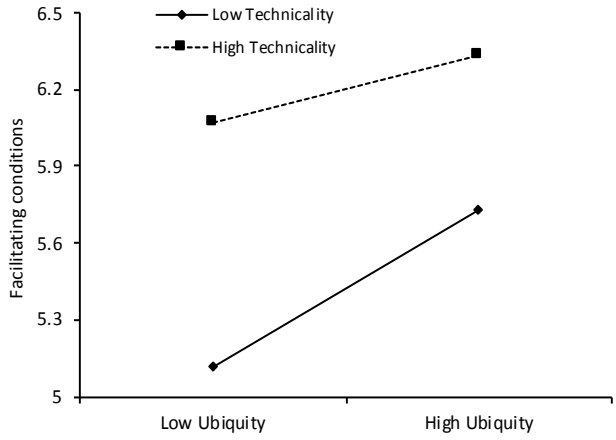



**Figure 3b.** Moderation effect of Technicality on the relationship between Ubiquity and Facilitating Conditions

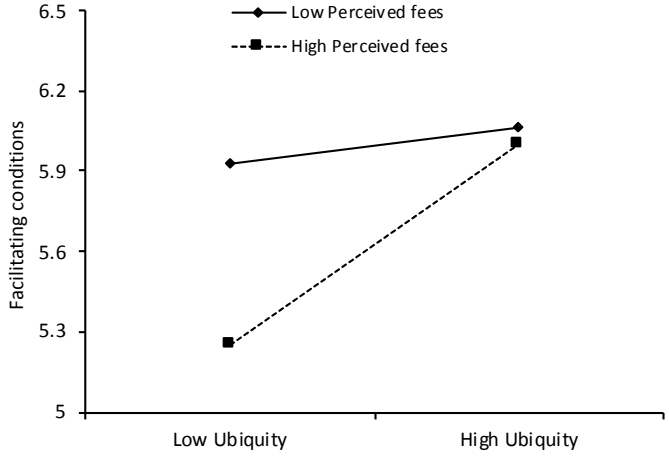



**Figure 3c**. Moderation effect of Perceived Fees on the relation between Ubiquity and Facilitating Conditions

The analysis of results indicated that performance expectancy positively influences VC app usage. The usefulness of VC apps in enhancing productivity and completing tasks results in increased diversity, frequency, and intensity of VC app use. These findings align with the results of prior studies (Al-Qeisi *et al.*, 2014, Isaac *et al.*, 2019, Lallmahomed *et al.*, 2013). However, facilitating conditions only explain the frequency of use. This is justifiable for two reasons. First, ubiquity, the antecedent of facilitating conditions, is about the interconnectedness of time savings and spatial flexibility. Second, a closer look at the survey results suggests that professionals' use of VC apps is more motivated by performance expectancy rather than the facilitating condition. This indicates that performance expectancy is more crucial for VC app use, whereas facilitating conditions only explain the periodicity of VC app use by professionals in the virtual environment. The study also found that actual use positively influenced the intention to continue using VC apps. Increased VC app usage thus serves as the basis for forming favorable judgments and intentions among professionals to continue using VC apps. Kim and Malhotra (2005) note that system usage is driven by conscious intentions when the relationship between stimuli and action is not fully developed. However, once information system use becomes a routine performed regularly in a stable environment, past use becomes a significant predictor of future use (Kim and Malhotra, 2005).

### 6.1 Theoretical Contributions

Our study examined the antecedents that influence professionals' perceptions toward VC app use, specifically two types of media characteristics, namely, technological characteristics and socially derived characteristics (Dennis *et al.*, 2008). The research paints a more comprehensive picture of how individuals' perceptions of VC apps influence their use and continued use in the professional context. The study thus adds to the body of literature on collaborative technologies and related practices in the professional context.

Prior research has investigated only the socially derived characteristics of collaborative solutions. To the best of our knowledge, the combination of technological and social characteristics of VC apps has not been investigated. A theoretical integration of the technological and socially derived characteristics is crucial to better understanding how contemporary VC app platforms are perceived and used in a professional context. Furthermore, our study separated the work context from the leisure context and investigated how the media richness of VC apps influences their continued use in the professional context. Thus, our study addresses the call by Brown *et al.* (2010) to evaluate collaborative technologies by separating the work context from the leisure context.

MST has been empirically examined for many collaborative technologies other than VC apps (see Appendix, Table A1). However, Dennis *et al.* (2008) and Dennis *et al.* (1998) only provided each construct's normative propositions and conceptual definitions. The operational measures for the constructs were not provided in related publications. This study contributes to the literature on MST by empirically investigating VC apps, a specific type of collaborative technology that has gained popularity in recent years. By developing the measurement items for convergence, our study addresses the call by Park and Lee (2019) for the development of measurement items for processes relevant to communication tasks, as well as testing their validity. The comprehensive instrument we tested and validated would be useful for researchers conducting similar studies. The

research also addresses the call by Maruping and Agarwal (2004) for studies that contribute to the generalizability of MST.

Our study investigated the role of ubiquity in the context of VC apps. To the best of our knowledge, no studies have examined ubiquity, a concept that is not just indicative of convenience but essential for remote work. In today's professional settings, the rise in hybrid work models and full-time remote work means that professionals can participate in remote work regardless of their location and time. The ubiquitous connectivity enabled by VC apps makes it possible for employees to send and/or receive unexpected and unscheduled messages outside of scheduled meeting times, make calls without pre-scheduling, and share files and notes in an asynchronous manner (e.g., Zoom and Google Hangout). Our study thus addresses the call by Okazaki and Mendez (2013) to utilize ubiquity as an antecedent in models that aim to explain the adoption, use, and continuing use of emerging technologies.

Additionally, our study addresses the call by Okazaki and Mendez (2013) to investigate what might moderate the impact of ubiquity on mobile service usage. Our study found that the effect of ubiquity as a facilitating condition is moderated by technicality and perceived fees (Figures 3b and 3c). Our findings suggest the decreased importance of ubiquity constructs (such as portability, continuity, and spatial flexibility) when technicality is lower (i.e., when the VC app is more difficult to use). Our research also found that ubiquity as facilitating conditions becomes stronger when professionals perceive VC apps to be of higher grade (higher fees). This suggests that professionals anticipate higher ubiquity and consequently increased facilitating conditions when paying higher fees for VC apps. An interesting direction for future research would be to investigate factors that moderate ubiquity in hedonic technologies that provide fun and pleasure.

Lastly, by integrating collaboration theories and several theoretical constructs from collaboration literature with UTAUT2, our study provides deeper insights into the professional use of VC apps which have previously not been provided by published literature. By doing so, our research reinforces the significance of integrative models for comprehensively assessing up-and-coming technologies. We argue that theories on their own may fall short in their utility to study the adoption and use of new technologies and that the integration with theoretical constructs from published literature is appropriate if the choice is sufficiently demonstrated and justified.

### 6.2 Implications for practice

Our research has implications for practice. First, as VC app use becomes a routine activity performed regularly in a stable environment, past experiences become a significant predictor of the intentions to continue its use. While it might seem that performance expectancy and facilitating conditions are fundamental to VC app use, our findings determined that these factors alone do not explain the professional's attitude toward its continuing use. Media richness that includes value-adding technological and socially derived characteristics is also equally important to professionals using VC apps in virtual work environments.

Although synchronicity is a cherished feature of VC apps, managers also need to recognize the impact it may bring to the workforce. As noted by Dennis *et al.* (2008), the use of multimedia simultaneously (for example, interacting with voice while engaging in instant messaging) may

lead to increased cognitive load, resulting in reduced information processing and reduced communication performance (Dennis *et al.*, 2008). While multi-tasking enhances efficacy and efficiency in completing job-related tasks, it also affects the ability of individuals to pay attention in virtual meetings (Lyons *et al.*, 2010). Advancements in VC apps have consistently targeted improvements in synchronicity, ubiquity, and media richness. However, it also results in employees spending more time in virtual meetings, over-depending on technologies, overcommitting to job tasks and increasing the likelihood of attempting to complete multiple tasks simultaneously (Johnson, 2021). Simultaneous talking, seeing, sending chat messages, sharing files, and managing sessions not only increase distraction (Sarkar *et al.*, 2021) but also result in heightened cognitive overload (Kear, 2011, Dennis *et al.*, 2008) and fatigue (Cao *et al.*, 2021, Bailenson, 2021). Reduced mobility and increased cognitive load from spending extended time in virtual meetings result in exhaustion and a subsequent decline in productivity (Bailenson, 2021). Changes to the VC interface design to include features that reduce distractions and cognitive overload can potentially increase productivity in the virtual environment. This could include features to block distractions (Karl *et al.*, 2022), alert users of multi-tasking behaviors (Cao *et al.*, 2021), and regular break reminders (Cao *et al.*, 2021). We, therefore, call for more research to assess the impact of continued and extended VC app use on the professional workforce.

The significance of social presence on performance expectancy suggests that developers and designers of VC apps should introduce visual and non-visual cues that are humanizing and warm and enable individuals to experience psychological closeness. However, the designers of VC apps should also be aware of the associated pitfalls. For instance, Bailenson (2021) noted that seeing self-image in VC apps causes self-evaluation and self-consciousness leading to distractions that affect performance. In addition, long stretches of direct and close-up eye gaze at the speaker during a meeting may also result in fatigue and a subsequent decline in productivity (Bailenson, 2021). Tomprou *et al.* (2021) found that visual cues in VC apps create greater inequality in speaking and hampers vocal synchrony, thereby reducing collective intelligence, countering prior beliefs about the role of media richness in facilitating collaborations (Tomprou *et al.*, 2021). Foundational literature on visual communications, such as Kozma (1986), noted that there is a short window of engagement when individuals attend to materials through video channels. After a point, individuals' attention wanders from conceptual content presented through the video channel (Kozma, 1986), and the lack of attention leads to a decrease in task completion and a decline in productivity (Huberman *et al.*, 2009). Hence, designers should find innovative ways to combat the potential pitfalls of rich social cues in VC apps. Currently, there are no established guidelines for productivity enhancements in the virtual workplace. Placing a limit on the profiles displayed, automatically hiding speakers a few seconds after they are framed (Bailenson, 2021), and introducing round-robin options (Kalia, 2020) to mitigate speaker inequality are best practices that could be standardized across all VC app platforms. Doing so would more closely match video conferencing to face-to-face meetings and help combat distractions and fatigue.

## 7. Conclusion

This study examined the antecedents that influence professionals' perceptions toward VC app use, specifically two types of media characteristics, namely, technological characteristics and socially derived characteristics (Dennis *et al.*, 2008). Furthermore, it investigated how individuals' perceptions toward VC apps influence their use and continued use in the professional context. The

study found that media characteristics that include value-adding technological and socially derived characteristics are crucial to professionals' perceptions of VC apps.

The study is not without limitations. One limitation of this research relates to the generalizability of the findings. The study was conducted in the European Union, and therefore the findings may not transfer to other geographic locations and cultural settings. However, the study provides the necessary foundations to test the research model in other settings, including non-European countries. Second, data for the study were collected during the COVID-19 pandemic. This period was characterized by an unprecedented reliance on VC apps in professional settings. Although the pandemic may have redefined the perception and use of VC apps, longitudinal studies are required to investigate media capabilities and communication processes appropriated by VC apps in a post-pandemic period. Our study lays the groundwork for future research in this direction.

Another limitation of our study is that it only considered three aspects of synchronicity, namely, transmission velocity, parallelism, and reprocessability. This study did not include other media capabilities, such as rehearsability and symbol sets. Rehearsability does not apply to VC apps because participants have little chance to rehearse their communication while engaging in virtual collaboration. The media richness of VC apps increasingly enables the conveyance of symbol sets in the form of social cues. As noted by Bailenson (2021), social cues present in VC apps influence individuals' perceptions during the real-time video and the consequent potential of VC apps to drive productivity. Similarly, we did not investigate the conveyance process (i.e., transmission, interpretation, and understanding of new information) as the primary purpose of VC app usage is convergence (i.e., back-and-forth transmission of pre-processed information for shared understanding). We encourage future studies to extend our study to explore the conveyance of new information and social cues via VC apps.

As workplaces increasingly adapt to a hybrid work model wherein professionals work remotely, and in person (Molla, 2020), VC apps are also likely to undergo matching transformations. For instance, at the time of this study, VC apps did not provide noise suppression features to remove background noise distractions. VC apps such as Google Meet introduced background noise suspension features in June 2020 (Amadeo, 2020), and Zoom introduced similar features in August 2020, giving participants a customizable way to control distractions at their home offices (Carter, 2020). Our study provides a foundation to continue the advancement and accumulation of knowledge in this topical area of research.

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## Appendix

**Table A1.** Survey Questionnaire

| Constructs | | | Items | Adapted from |
|---|---|---|---|---|
| Synchronicity (second-order construct) | Transmission Velocity | TV1 | When using video conferencing apps, I could get a quick response from peers. | Tang *et al.* (2013) |
| | | TV2 | When using video conferencing apps, my peers responded quickly. | |
| | | TV3 | When using video conferencing apps, I get immediate responses from my peers. | |
| | | TV4[a] | When using video conferencing apps, it took me a long time to get a response from my peers. | Dropped |
| | Reprocessability | R1 | If I missed a message, I could easily retrieve it using text chat, audio, or video recording. | Tang *et al.* (2013) |
| | | R2 | Video conferencing apps allow me to review prior messages. | |
| | | R3 | Video conferencing apps allow me to re-examine prior messages. | |
| | | R4 | Video conferencing apps allow me to reconsider prior messages. | Self-developed |
| | | | | Self-developed |
| | Parallelism | PL1 | When using video conferencing apps, I could transmit comments to multiple participants at the same time. | Self-developed |
| | | PL2 | When using video conferencing apps, I could receive multiple comments at the same time. | |
| | | PL3 | When using video conferencing apps, I could hear multiple participants at the same time. | |
| | | PL4 | When using video conferencing apps, I could see multiple participants at the same time. | |
| | Social presence | SP1 | When using video conferencing apps, the interaction with my peers is personal | Choi (2016) |
| | | SP2 | When using video conferencing apps, the interaction with my peers is warm. | |
| | | SP3 | When using video conferencing apps, the interaction with my peers is close. | |
| | | SP4 | When using video conferencing apps, the interaction with my peers is humanizing. | |
| Ubiquity (second-order construct) | Convergence | CG1 | Video conferencing apps enable me to verify information with my peers. | Self-developed |
| | | CG2 | Video conferencing apps enable rapid exchange of information relevant to the task. | |
| | | CG3 | I can use video conferencing apps to discuss tasks with my peers. | |
| | | CG4 | I can negotiate with my peers through video conferencing apps. | |
| | Portability | P1 | Video conferencing apps are practical because I can use them without difficulty wherever I am. | Okazaki and Mendez (2013) |
| | | P2 | Using video conferencing apps outside my home or my workplace is not a problem for me. | |
| | | P3 | I find it convenient to use video conferencing apps because they don't make me dependent on any fixed installation. | |
| | Continuity | C1 | Using video conferencing apps keeps me well-informed at all times. | Okazaki and Mendez (2013) |
| | | C2 | With video conferencing apps, I can always keep up with my peers. | |
| | | C3 | When I use video conferencing apps, I don't have to interrupt my current task. | |
| | Immediacy | I1 | Video conferencing apps enable me to quickly reach communication partners | Brown *et al.* (2010) |

| | | | | |
|---|---|---|---|---|
| | | I2 | When I communicate with peers using video conferencing apps, they usually respond quickly. | |
| | | I3 | When my peers communicate with me using video conferencing apps, I try to respond immediately. | |
| | | I4[b] | The use of video conferencing apps to communicate with peers provide a chance for social interaction. | |
| | Spatial flexibility | SF1 | Using video conferencing apps enables me to find information at any place. | Okazaki *et al.* (2012) |
| | | SF2 | Using video conferencing apps gives me the ability to overcome spatial limitations | |
| | | SF3 | Using video conferencing apps fit any location, wherever I go. | |
| | | SF4 | Using video conferencing apps enables me to interact with peers at any place. | |
| | Time savings | TS1 | Using video conferencing apps is an effective way to manage my time. | Okazaki *et al.* (2012) |
| | | TS2 | Using video conferencing apps makes my life easier. | |
| | | TS3 | Using video conferencing apps fit my schedule | |
| | Technicality | T1 | It is easy to use video conferencing apps. | Kim *et al.* (2007) |
| | | T2 | Video conferencing apps can be connected instantly. | |
| | | T3 | Video conferencing apps take a short time to respond. | |
| | | T4 | It is easy to get video conferencing apps to do what I want it to do. | |
| | Perceived fees | PF1 | The fee that I have to pay for the use of video conferencing apps is too high. | Kim *et al.* (2007) |
| | | PF2 | The fee that I have to pay for the use of video conferencing apps is unreasonable | |
| | | PF3 | Overall, I am displeased with the fee that I have to pay for the use of video conferencing apps. | |
| | Performance expectancy | PE1 | I find video conferencing apps useful in my daily life. | Venkatesh *et al. (*2012) |
| | | PE2 | Using video conferencing apps increase my chances of achieving tasks that are important to me. | |
| | | PE3 | Using video conferencing apps helps me accomplish tasks more quickly. | |
| | | PE4 | Using video conferencing apps increases my productivity. | |
| | Facilitating conditions | FC1 | I have the resources necessary to use video conferencing apps. | Venkatesh *et al. (*2012) |
| | | FC2 | I have the knowledge necessary to use video conferencing apps. | |
| | | FC3 | Video conferencing apps are compatible with other technologies. | |
| | | FC4 | I can get help from others when I have difficulties using video conferencing apps. | |
| | Diversity of use | | For the following tasks, please indicate whether you use video conferencing apps to perform each task | Venkatesh *et al. (*2012) |
| | | DV1 | Audio Calls | |
| | | DV2 | Video Calls | |
| | | DV3 | Chat | |
| | | DV4 | Sharing pictures, videos, documents, and audio files | |
| | | DV5 | Screen Sharing | |
| | | DV6 | Create Groups | |
| | | DV7 | Check Privacy Settings | |
| | Frequency of use | FQ1 | I often use video conferencing apps to share my work. | Zhou *et al.* (2010) |
| | | FQ2 | I often use video conferencing apps to meet with my peers. | |
| | | FQ3 | I often use video conferencing apps in my professional work. | |
| | Intensity of use | IT1[b] | On average, how many hours do you use video conferencing apps each week? | Venkatesh *et al.* (2012) |
| | | IT2 | How often do you use video conferencing apps | |
| | | IT3 | How do you consider the extent of your current video conferencing app use? | |

| | | | |
|---|---|---|---|
| Continuance intentions | CI1<br>CI2<br>CI3 | I intend to continue using video conferencing apps.<br>I plan to continue using video conferencing apps.<br>I will continue using video conferencing apps. | Venkatesh *et al.* (2011) |

**Note:** [a] Eliminated due to low loading; [b] Eliminated due to loadings being lower than cross-loadings.