Virtuality's Influence on the Process of Performing Information Systems Development: A case of a software organization

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By

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Abstract

Organizations in all sectors have been utilizing virtual teams and virtual technologies for projects, making use of geographically dispersed human capital. Other forms of virtual working such as work-from-home, remote-work and telecommuting have also been implemented by organizations, often to a few employees usually over a small period of time and not applicable to the full organization. The transitioning from a collocated environment to a virtual context induced by the coronavirus disease (COVID-19) influenced the process of performing Information Systems Development (ISD). The objectives of the study are:

RO1: Explain how virtuality influences the process of doing ISD projects inside the IS Industry.

RO1a: Explain how virtuality influences the execution of ISD activities inside the IS Industry.

RO1 b: Explain how virtuality influences the assessment of ISD projects inside the IS Industry.

RO2: Identify how organizations can improve ISD when working in a virtual context.

This study employed a single case study of a technology company that recently transitioned from a collocated context to a full remote context. Data was collected through seventeen semi-structured interviews and secondary documents. Thematic analysis was employed to explain virtuality's influence on performing ISD and assessing ISD outcomes. A modified Systems Development as Performing (sd-as-p) conceptual model was utilized as a guide for this study's data collection process. A literature-derived sd-as-p conceptual model was developed made up of the following processes of performing ISD, namely leading; communicating; collaborating; knowing; developing with agility; dealing with challenges; trusting; assessing achievements and the enactment of virtuality. The study explained how virtuality influences the processes of performing ISD. Subthemes of the processes of performing ISD were identified resulting in the modification of the initial literature-derived sd-as-p model. Components that enhance the performing of ISD in a virtual context were found to be people, tools, processes, and virtual culture.

Keywords: virtuality, virtual teams, remote work, fully remote mode, remote first, work from home, information systems development, software development, agile software development, software engineering

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CHAPTER 1: INTRODUCTION

1.1 Research Background and Context

The novel Coronavirus disease-19 (COVID-19) pandemic forced most countries to adopt social distancing measures that restricted the movement and activities of people in their territories (Bodenstein et al., 2020). These measures and policies were aimed at slowing the spread of the coronavirus and involved keeping people physically apart from each other and confining them to their homes (Greenstone & Nigam, 2020). Most businesses, even though they were not prepared, were compelled to implement virtual ways of working such as work-from-home strategies (O Connor et al., 2022).

Virtuality is defined as *"*the movement of physical or in-person processes to online platforms or tools which mimic or replace traditional processes*"* (Tijunaitis et al., 2019, p. 359). Shameem et al. (2017) refer to a virtual team as a geographically distributed group of people who work towards accomplishing a task or project collaboratively using telecommunication technologies. The virtuality phenomena is not completely new to organizations. Most industries including the Information Technology (IT) sector make use of terms such as telecommuting (Sroka, 2018; Masuda et al., 2017), remote work (Althoff et al., 2022; Eddleston & Mulki, 2015), and work from home (Galanti et al., 2021; Jones et al., 2020).

Some of the factors which influence the rise of virtual working include globalization, changes in business environment, improvements in information communication technologies (ICTs) (Abarca et al., 2020). Virtual teams have limited face to face contact and work interdependently by utilising electronic communication technologies to achieve common goals (Dulebohn & Hoch, 2017). Virtuality is mostly practiced by virtual project teams and partly by a few individuals from collocated teams and not in a more continuous way (Hoegl & Muethel, 2016). Virtual teams operate across several boundaries which can be highlighted by coordinates of time, place, and organization (Weimann et al., 2013). Some organizations create and structure virtual teams deliberately based on the availability and skills of resources (Adewole, 2020). Saraiva et al. (2021) define remote work as "a form of virtual work performed virtually outside the conventional workplace where collaboration happens through computer-based technology" (p. 1).

Technological advancement has also led to the global emergence of business models and business organization strategies (Saura et al., 2022). One such business model that is increasing post the COVID-19 pandemic is the concept of fully remote mode (FRM) (Pashchenko, 2021). Elkordy (2022) describes a fully remote company as a company that operates without a collocated physical office but allows employees to work from anywhere including their homes, coworking spaces, and coffee shops. According to Saura et al. (2022), telework did not get much attention in academic studies before the outbreak of COVID-19 pandemic. These two factors, rapid technological advancement and the outbreak of COVID-19 pandemic pushed the increase of virtual working including in the Information Technology (IT) industry.

Information Systems Development (ISD) (Hummel, 2014; Kautz et al., 2007; Nilsson, 2005; Korpela et al., 2002) is strongly linked to other business development functions within the organization (Guinan et al., 2019) which work effectively and efficiently in a collocated environment. Collignon et al. (2022) highlight the need for intense collaboration and interactions between developers, users and other stakeholders when developing information systems. The development of software requires daily collaboration between software developers and other stakeholders from other business functions (Al-Saqqa et al., 2020). The performing of ISD has recently been conceptualised as a process involving both, 1) the execution of ISD activities by individuals when constructing information systems solutions, and 2) the assessment of ISD achievements (Geeling et al., 2019).

1.2 Problem statement

Although various studies relating to both virtuality and Information Systems Development phenomena have been extensively explored in academic research, these studies place focus on a narrow context of well-organized virtual teams created for specific temporary project tasks (Gallego et al., 2021; Zuofa & Ochienge, 2021; Morrison-Smith & Ruiz, 2020). These do not address the influence of virtuality on the process of information systems development in a broader context of an organization operating in a fully virtual mode (Hoegl & Muethel, 2016). Therefore, the goal of this study is to investigate virtuality's influence on the processes of performing of ISD within a fully virtual organisational context.

1.3 Primary Research Question

To achieve the purpose of the study, the following research questions and objectives are addressed. The primary research question for this study is formulated as (RQ1) below:

RQ1: *How does virtuality influence the processes of performing ISD in organizations operating within a virtual context?*

1.4 Secondary Research Questions

To answer the main research question (RQ1) above, the following sub-questions are going to be addressed:

RQ1a: How does virtuality influence the execution of ISD activities when operating in a virtual context?

RQ1b: How does virtuality influence the assessment of outcomes of ISD work?

RQ2: How can organizations improve the processes of performing ISD when operating within a virtual context?

1.5 Research Objectives

The research objectives of this study are as follows:

RO1: Explain how virtuality influences the process of doing ISD projects inside the IS Industry.

RO1a: Explain how virtuality influences the execution of ISD activities inside the IS Industry.

RO1 b: Explain how virtuality influences the assessment of ISD projects inside the IS Industry.

RO2: Identify how organizations can improve ISD when working in a virtual context.

1.6 Structure of the Dissertation

The following chapters will be covered in this study:

- Chapter one will cover the introduction, research background and context, research problem statement, research questions, and the research objectives;
- Chapter two introduces the literature review which present the previous background literature on the process of performing ISD comprising of processes such as leading,

communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements, and enacting virtuality. The literature review will lead to the development of the conceptual model which was utilised for collecting data and the chapter summary;

- Chapter three will present the research methodology;
- Chapter four will present the research findings, followed by;
- Chapter five which will discuss the research findings
- Chapter six presents the research conclusion and will cover the research contribution, recommendations for future research and limitations of the study. The study concludes with the reference list and supporting appendices.

CHAPTER 2: LITERATURE REVIEW

2.1 Background and Literature Review Approach

The preceding chapter provided the background to the study, outlining the purpose of the research study, the research questions, and objectives. This chapter provides the theoretical background which leads to the conceptual model that was used to collect research data.

The literature review process is an intrinsic iterative and natural interpretive process by which researchers expand and deepen their understanding of relevant literature (Baghizadeh et al., 2020). Due to the broadness of this study, sources of literature in this study were collected from various research disciplines including information systems development, software development, software engineering, humanities, and social sciences. A narrative literature review type was employed as it provides flexibility when mapping the current state of knowledge and identification of potential gaps in previous studies (Oosterwyk et al., 2019). The search for relevant literature was guided by the research questions (Bandara et al., 2015). The iterative review processes involved the seeking and clarification of information (Boell & Cecez-Kecmanovic, 2014) relating to the process of performing ISD, and virtual ways of working. It included searching, finding, selecting, reading, and revising of initial ideas (Baghizadeh et al., 2020). In searching sources of literature for this study, Google scholar, ScienceDirect and other various scholarly databases accessible under the UCT library were utilized and various key search terms such as virtuality, virtual teams, remote work, remote first, telecommuting, work from home, information systems development, software development, agile software development, software engineering, virtual communication, virtual leadership, and virtual collaboration. The period covered in this process encompasses studies that address both, well-established phenomena such as information systems development, software development, and software engineering as well as currently emerging business ideas such as full remote working mode which are relevant to this study. The literature review process involved two phases. The first phase focused on a broader view of the area of study and the result of analysis and synthesis of literature (Brown & Brown, 2019) assisted in identifying processes of performing ISD in relation to virtuality. The first phase resulted in a total of forty articles from the initial sixty-one articles. The second phase sought to deepen the understanding of the phase one review

outcomes and to ensure that current literature was sourced and included. The final articles from this phase were seventy-five. Appendix 11 shows the outcomes of the literature review process.

The rest of the chapter is organised as follows: first, the process of Performing ISD will be discussed in section 2.2, followed by the processes of performing ISD sections viz. Leading in section 2.2.1, Communicating in section 2.2.2, Collaborating in section 2.2.3, Trusting in section 2.2.4, Knowing in section 2.2.5, Dealing with challenges in section 2.2.6, Developing with agility in section 2.2.7. Section 2.3 will present Assessing achievements, and section 2.4 will discuss Enacting virtuality leading to the development of a conceptual model in section 2.5. The chapter concludes with a summary in section 2.6.

2.2 The Process of Performing ISD

Information systems development involves collaboration between information systems (IS) personnel such as product or project managers, researchers, UX designers, systems analysts, testers, systems developers, and users (Yang & Tang, 2004). Numerous and complex tasks that are necessary in the creation of software products are tied together in order to produce software products (Collignon et al., 2022). Kang et al. (2017) characterize ISD as an undertaking that involves different tasks, teams, and project complexities. Geeling et al. (2019) highlight that the process of performing ISD involves both, the doing (processes of performing) and the done (assessment of achievements). ISD performing involves i) the activities done by individuals in the process of construction of information system solutions and the reasons for doing them; and ii) how the results of ISD efforts are assessed (Geeling et al., 2019). According to the principles of agile software development, the main measure of progress in software development is working software (Beck et al., 2001). This highlights the need to assess the software output with various interested stakeholders. ISD involves people executing diverse activities by using a variety of methodologies, tools and techniques (Mangiza & Brown, 2020). Virtual teams perform differently from collocated teams (Zuofa & Ochieng, 2021) and the transition from collocated context to virtual context has an effect on the processes of performing ISD. Processes identified from literature include leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements and the enactment of virtuality which will be discussed next.

2.2.1 Leading

Geeling et al. (2019) conceptualize leading as "the behaviour and actions of leaders that shape the perceptions and feelings of followers" (p. 7). Leaders are responsible for defining and communicating the team's vision and aligning staff to support the vision (Newman & Ford, 2021). Leaders facilitate team coordination and collaboration in support of the business strategy (Kirkman & Stoverink, 2021). Supporting team tasks, emotional needs of virtual teams and leading dispersed teams is challenging as some members can view themselves as professional ISD personnel who are fully able to structure work roles without assistance from their leaders (Ford et al., 2017). Relationships among face-to-face teams grow organically but in cases of virtual teams, managers have to proactively guide relationship building processes (Liao, 2017). Virtuality makes it difficult for leaders to utilize physical observations making them rely on the use of alternative ways such as sensing when their team members are silent online (Malhotra et al., 2007). Leaders are most effective when they apply relational forms of leadership influence that are based on leader-follower attraction, interpersonal interactions and social bonds (Kozlowski et al., 2021). Some of the challenges faced by managers of virtual teams include poor communication; absence of team cohesion, the loss of team control and failure in project coordination (Castellano et al., 2021). Morrison-Smith & Ruiz (2020) point out that team effort management is one of the biggest challenge leaders face within virtual teams.

Shared leadership in virtual-based ISD can be implemented by strategies of encouraging leadership behaviours such as; accepting the new realities of virtual teamwork; become a true team member; loosening the reigns and avoiding the "responsibility trap" and respecting the competencies of team members (Hoegl & Muethel, 2016). The formation of shared leadership among team members increases team effectiveness, and leadership in ISD should be tailored to facilitating and encouraging this formation (Liao, 2017). Newman & Ford (2020) further highlight the need for shared leadership to improve team performance when operating virtually.

Effective project coordination and management is more difficult when operating virtually (Gilson et al., 2021). Leaders in virtual teams must show understanding and consideration on the different circumstances around virtual working (Serrat, 2017). Consideration of the complexities of virtuality such as technological issues of low internet bandwidth and environmental disruptions

are important in coordinating and timing of tasks thereby enabling ISD leaders to minimise chances of ISD project failures (Harris, 2018). Creating an environment that fosters creativity virtually is challenging for leaders but measures such as provision of training, coaching, and facilitation of relationship building activities is vital (Morrison-Smith & Ruiz, 2020). Leading virtual teams is more challenging than traditional collocated teams (Liao, 2017).

2.2.2 Communicating

Communication is vital to both collocated and virtual teams. Communication in virtual teams happens both synchronously and asynchronously (Jarvenpaa & Keating, 2021). However, virtuality hampers effective communication (Kirkman & Stoverink, 2021). In agile software development, the most effective method of passing information to and within development teams is through face-to-face communication (Beck et al., 2001). The unavailability of face-to-face communication among team members affects the team's engagement (Dulebohn & Hoch, 2017). Inadequate communication and misinterpretation of information are common challenges in virtual environments (Zuofa & Ochieng, 2017). Face-to-face interactions between virtual teams is carried out using technology tools on a day-to-day basis (Bundhun & Sungkur, 2021). The use of electronic communication and collaboration technologies is vital for communication and ISD project execution when operating virtually (Gallego et al., 2021). Technology enabled communication comes with challenges such as increased misunderstandings, incoherent messages, lags in information exchange and reduction in information seeking attempts (Gilson et al., 2015). Schulze & Krumm (2017) further state that the use of technology can be challenging with regard to effective communication among virtual team members.

The adoption of innovative communication technologies that provide rich channels of communication and collaboration to facilitate the coordination of tasks among team members is paramount in performing ISD (Schaubroeck & Yu, 2017). Advanced communication technologies play an integral part in ensuring adequate communication among virtual members, but leaders must find ways to compensate for the lack of non-verbal communication cues to ensure success when operating virtually (Newman & Ford, 2021). Connelly & Turel (2016) point out that rich innovative technologies that facilitate communication and collaboration such as video and audio-conferencing capabilities, collaborative tools that enable visual task sharing and project

coordination enhance the team's productivity as compared to the use of lean communication media that do not have capabilities of members seeing face to face such as email and instant messaging. Training of virtual team members on what, how and when to use different communication medium (Schulze & Krumm, 2017) improves team performance. Despite the implementation of these trainings, Newman & Ford (2021) highlight that it is still difficult to communicate effectively without non-verbal cues.

According to Beck et al. (2001), the transmission of information within a software development team is most effective through face-to-face interactions therefore making collaboration easier for collocated teams over virtual teams. ISD also requires tacit knowledge sharing among the software engineering teams which is mostly gained via face-to-face interactions (Fowler & Highsmith, 2001). Virtuality takes away that immediate view resulting in communication interruptions that will in turn have an impact on the team's productivity.

2.2.3 Collaborating

Software development requires high collaboration between stakeholders such as project sponsors and software developers (Collignon et al., 2022). Morrison-Smith & Ruiz (2020) define collaboration as "synchronous and asynchronous interactions and tasks to achieve common goals" (p. 1). Cross-team collaboration is essential in agile software development (Beck et al., 2001). Virtual collaboration contributes to the performance of the virtual team (Liao, 2017). For virtual teams to function effectively, collaborative tools must be provided to virtual team members (Bundhun & Sungkur, 2021). Dulebohn & Hoch (2017) point out that virtual collaborative sessions are not as impactful as face-to-face interactions. Morrison-Smith & Ruiz (2020) highlight that as the number of team grows, collaboration on projects become difficult to manage virtually.

2.2.4 Trusting

An environment of trust is crucial in the process of performing ISD (Beck et al., 2001). High-performing teams are characterised by high levels of team cohesion and trust among members (Kozlowski et al., 2021). Trust is one of the important aspects of team collaboration (Zaitsev et al., 2020). Team leaders can cultivate trust in virtual teams by implementing norms for teamwork and maintaining a knowledgebase for a team's taskwork (Kozlowski et al., 2021). Team members' trust is impacted by their ability to directly observe what others are working on (Ford et al., 2017).

In virtual teams, continuous communication, and timely responses influence trust (Yu et al., 2022; Gilson et al., 2015). Virtuality makes it difficult for team members to observe each other in informal interactions and non-verbal communications are lost in technological based communications (Newman & Ford, 2021). Team participation regarding communicating feedback timely is difficulty especially with a sizeable group of people relying on technological tools which might be ineffective or poorly designed (Meluso et al., 2020). Due to these communication challenges in virtual environments, trust among ISD team members becomes an issue IS managers must deal with (Shameem et al., 2017). When performing ISD virtually, trust can be developed through knowledge sharing and knowledge exchange (Tyagi et al., 2022) Alsharo et al., 2017). Information repositories and online platforms that enable and enhance knowledge sharing can be utilised to improve trust within virtual teams (Morrison-Smith & Ruiz, 2020). Virtual ISD teams need to have skills to develop interpersonal trust-related qualities such as active and frequent participation, responsiveness, and dependability (Schulze & Krumm, 2017).

Trust relies on the behaviours of virtual team members, the feedback virtual members receive from each other and is also built on past interactions, experiences, and trust-building cues (Connelly & Turel, 2016). Within virtual teams, trust is based more on ability and delivery of tasks at hand and is built by measures such as generating clear and concise objectives; asking effective questions; enablement of free flow of data and information for constant, consistent, concerned, and concrete interactions; the development of communication and meeting protocols; development of an environment that makes, shares, and celebrates good news and early diagnosis and solving of problems (Serrat, 2017). Due to challenges in virtual working caused by technological factors, ISD managers must be mindful on task allocation to their virtual team members to minimise over burdening their teams resulting in low delivery that will affect team trust.

Interpersonal trust that comprises of frequent and active participation, dependability and responsiveness should be fostered to improve ISD performance within virtual teams (Liao, 2017; Schulze & Krumm, 2017). In collocated teams, trust bonds are usually developed informally over chats, after-work gatherings, and other social ways but in virtual contexts, trust can be cultivated by performance and fulfilment of team roles (Kozlowski et al., 2021).

2.2.5 Knowing

Hung et al. (2021) point out that knowledge is a significant resource to any organization and must be managed effectively. Performing ISD is a team effort and software developers rely on each other's abilities and knowledge. Sharing of knowledge is critical for ISD success (Tyagi et al., 2022). Knowledge can be acquired through online training and collaboration via the use of online technological resources (Hao et al., 2019). Knowledge on the use and application of different communication medium is essential in ensuring team performance (Schulze & Krumm, 2017). It is crucial to know about technological factors such as when, why, and for what purpose a certain tool is selected and used (or why it is not used) in virtual project team (Weimann et al., 2013). Skills capabilities and knowledge required for effective virtual working are important in performing ISD virtually (Kozlowski et al., 2021). The level of virtual team member's competence in executing tasks is another concern when ISD teams are working virtually (Morrison-Smith & Ruiz, 2020). Improvement in knowledge sharing within virtual teams can be fostered using online platforms and repositories (Morrison-Smith & Ruiz, 2020). Knowledge comes in forms such as tacit and explicit (Alsharo et al., 2017) and virtual environments makes it difficult for teams to share tacit knowledge (Hung et al., 2021).

2.2.6 Dealing with challenges

Dealing with challenges involve taking actions to prevent or remove impediments when performing ISD (Geeling et al., 2019). Some of the challenges encountered by virtual teams include availability of technology resources, trust, communication, dealing with uncertainty of roles caused by multiple participation of members on various virtual teams and leading (Levasseur, 2012). Due to challenges posed by virtuality, performing ISD in a virtual context requires virtual teams to embrace empathy (Meluso et al., 2020). According to Hinds & Bailey (2003), the three types of conflicts that affect virtual teams comprise of process conflicts, task conflicts and relational conflicts. Conflicts can emanate from virtuality related challenges such as technological challenges (Dulebohn & Hoch, 2017), lack of trust (Shameem et al., 2017), ineffective communication (Zuofa & Ochieng, 2017). Virtual leaders thus need to be skilled in dealing with areas such as coordination of teamwork, effective communication, collaboration, and dealing with social challenges (Kozlowski et al., 2021). Characteristics of individuals pertaining to knowledge, skills, and abilities (KSAs) should be considered and addressed in a virtual context to ensure

individuals will not become bottlenecks for work outcomes (Wang & Haggerty, 2011). Schulze & Krumm (2017) highlight that knowledge and skills are crucial components in addressing technological use challenges.

2.2.7 Developing with agility

Collignon et al. (2022) define ISD as a complex undertaking that requires cooperation between developers and other stakeholders such as users, clients, and other business functions. Performing ISD employs the principles of agile development involving; early and continuous delivery of valuable software; frequent software delivery; change of requirements; daily collaboration between business, people, and software developers; provision of right environment, support and trust to software developers; face to face communication; self-organization of teams. (Kumar & Bhatia, 2012; Beck et al., 2001; Fowler & Highsmith, 2001). Successful implementation of these agile principles provide a better way of developing software products (Fowler & Highsmith, 2001), and organizational agility is essential for successful ISD in a virtual context (Uludağ et al., 2022).

2.3 Assessing achievements

Outputs from the process of performing ISD must be assessed including in a virtual context, and the process of assessing those outcomes also involve the criteria used to make the assessment (Geeling et al., 2019). Agile practices enable companies and software development teams achieve faster results in a wise way (Tam et al., 2020) and the delivery of working software in a continuous way (Fowler & Highsmith, 2001). During the ISD process, the quality of the output is measured through an agreed-upon definition of done put in place by the software development team that is building the software (Schwaber & Sutherland, 2011). According to Fowler & Highsmith (2001), the primary measure of progress in software development is working software, and this can be achieved by iterative development.

2.4 Enacting Virtuality

Geeling et al. (2019) made representation of enactment of culture and agency. In a similar manner, the concept of enacting virtuality encapsulates the use of Information Communication Technologies (ICTs) and Information Technology (IT) infrastructure to support the process of performing ISD. IT infrastructure comprising of software, hardware, and internet connectivity is

critical in supporting teams including ISD virtual teams do their tasks (Elkordy, 2022). Virtual working hinges on the availability of technological infrastructure to enable virtual team members to work together over time and distance in combining effort to achieve common goals (Meluso et al., 2020; Dulebohn & Hoch, 2017). Standard sets of communication and collaboration technologies should be provided to team members for virtual teams to function effectively (Kirkman & Stoverink, 2021; Choi & Cho, 2019; Serrat, 2017). The lack of appropriate IT infrastructure affects effective communication and collaboration among virtual teams. Technology use, and support are other factors that influence performance of ISD virtual work (Großer & Baumöl, 2017). Failure or unavailability of technology will affect team's performance for instance if some business applications are only available via the company's Virtual Private Network (VPN), there is a high need for the VPN to be available otherwise day to day operations will be affected. The technology infrastructure has to support and facilitate collaboration, integration of virtual team members, and enable processes such as communication and documentation (Großer & Baumöl, 2017).

Training of virtual teams on the use of technological resources enhances team effectiveness (Liao, 2017). Virtual team performance and process improvement can be enhanced by team empowerment in the form of training of staff on how to utilise technology and the availability of excellent technical support (Morrison-Smith & Ruiz, 2020). Measures such as weekly online training sessions on technology use and basic troubleshooting techniques can be implemented to facilitate user training, and the use of how-to guides can be useful to virtual team members as they do not have face to face technical support.

2.5 Development of a conceptual model

The processes of performing ISD that are discussed above created the variables used in the modification of the theory of Systems Development as Performing (sd-as-p) by Geeling et al. (2019). The modified sd-as-p theory was then adopted as a conceptual model for the purposes of this study. The modified sd-as-p conceptual model is shown in Figure 1 below:

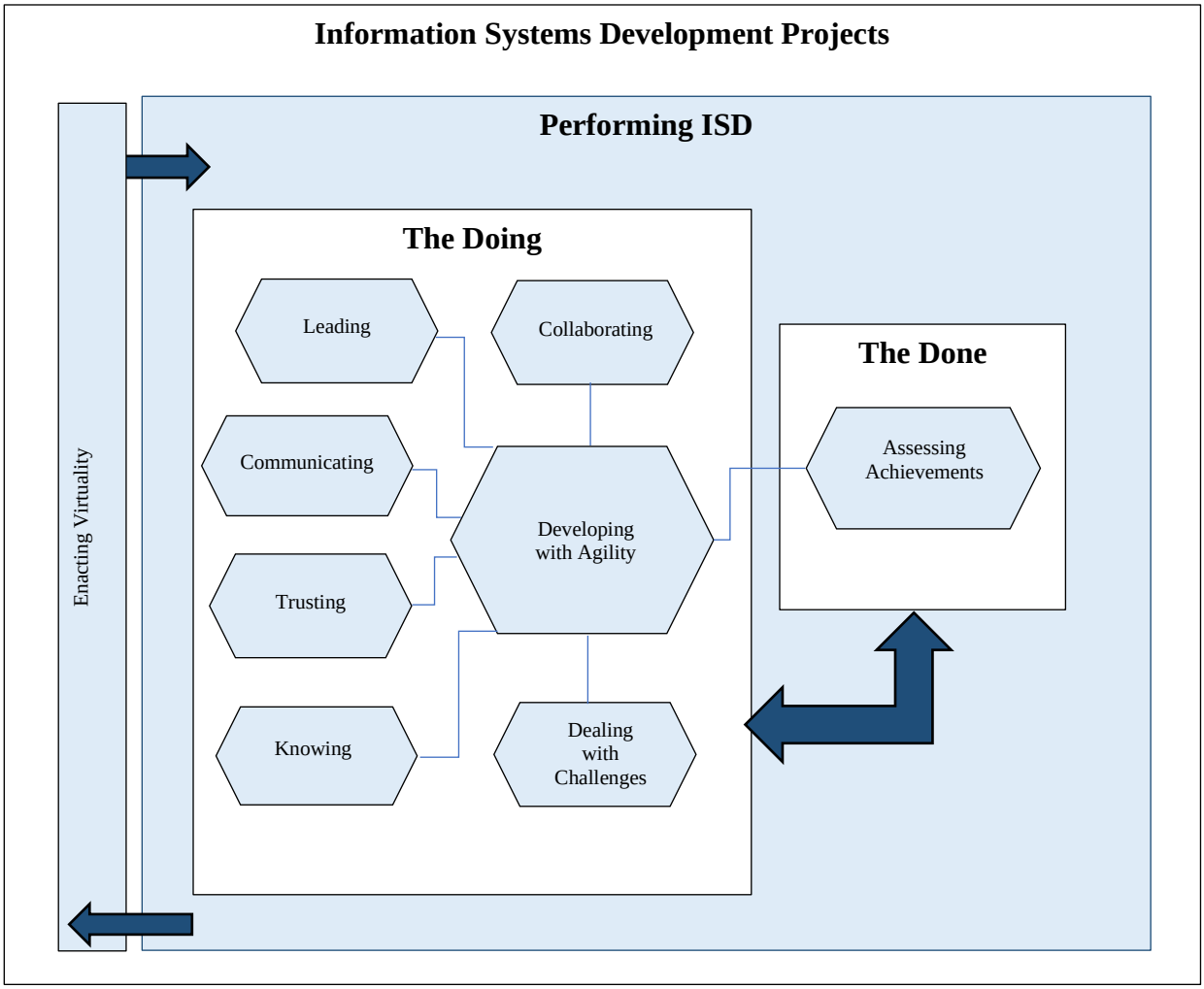

Figure 1: Modified theory of Systems Development as Performing (sd-as-p) (adapted from Geeling et al., 2019)

The processes of performing ISD and the assessment of ISD outcomes shown in the modified sd-as-p theory above are explained and summarized in Table 1 below.

Processes of Performing	Explanation	References
Leading	Is defined as "the behaviour and actions of leaders that shape the perceptions and feelings of followers". Leading involves defining and communicating the team's vision and aligning staff to support the vision. Leaders support their team members and cultivate a healthy environment for team cohesion and remove barriers that impact their team's productiveness. Leading virtual teams is more challenging than traditional collocated teams and some of the challenges faced by leaders of virtual teams include poor communication; absence of team cohesion, the loss of team control, failure in project coordination, and team effort management.	(Castellano et al., 2021 ; Ford et al., 2017; Gilson et al., 2021; Kirkman & Stoverink, 2021; Kozlowski et al., 2021; Newman & Ford, 2021; Morrison-Smith & Ruiz 2020; Geeling et al., 2019. p. 7; Liao, 2017)
Communicating	Is a multimodal process involving both nonverbal and verbal components. Synchronous and asynchronous communication is vital to team functioning whether the team is collocated or virtual. The unavailability of face-to-face interactions of team members negatively affects engagement of team members on collaborative efforts.	(Kirkman & Stoverink, 2021; Bundhun & Sungkur, 2021; Gallego et al., 2021; Jarvenpaa & Keating, 2021; Newman & Ford, 2021; Dulebohn & Hoch, 2017)
Collaborating	Involves synchronous and asynchronous interactions and tasks to accomplish common goals. ISD requires daily collaboration among various stakeholders. Collaborative technological tools enable ISD teams to conduct their tasks. Managing collaboration virtually is challenging.	(Bundhun & Sungkur, 2021; Collignon et al., 2022; Morrison-Smith & Ruiz, 2020; Dulebohn & Hoch, 2017; Liao, 2017; Beck et al., 2001)
Trusting	An environment of trust is crucial in software development teams. Trust comes from visible actions demonstrated by team members facilitating goal attainment of the team. Virtual working on ISD projects requires high levels of trust among team members. Virtuality	(Tyagi et al., 2022 ; Yu et al., 2022; ; Kozlowski et al., 2021 ; Newman & Ford, 2021 ; Meluso et al., 2020

Processes of Performing	Explanation	References
	makes it difficult for team members to observe each other in informal interactions and also non-verbal communications are lost in technological-based communications. Trust impacts leadership, and is also built by knowledge transfer, knowledge sharing and knowledge exchange.	; Morrison-Smith & Ruiz, 2020; Zaitsev et al., 2020 ; Alsharo et al., 2017)
Knowing	ISD is a team effort that requires software developers to rely on each other's abilities and knowledge. Knowledge sharing is a key component that can be used by virtual teams to build trust. Improvement in knowledge sharing within virtual teams can be fostered using online platforms and repositories. Knowledge transfer that is gained from face-to-face environments includes learning by observing and face to face team building exercises which is hard to gain virtually when performing ISD.	(Tyagi et al., 2022; Hung et al., 2021; Kozlowski et al., 2021; Morrison-Smith & Ruiz, 2020; Hao et al., 2019 Alsharo et al., 2017; Weimann et al., 2013)
Dealing with challenges	Challenges in virtual teams include technology resources, trust, communication, dealing with uncertainty of roles caused by multiple participation of members on various virtual teams, leading, factors such as geographic distance, social, cultural, technical, experiential differences, emotional factors, and conflicts.	(Meluso et al., 2020; Geeling et al., 2019; Dulebohn & Hoch, 2017; Shameem et al., 2017; Schulze & Krumm, 2017; Zuofa & Ochieng, 2017; Levasseur, 2012; Wang & Haggerty, 2011)
Developing with agility	ISD is a complex undertaking that requires cooperation between developers and other stakeholders such as users, clients, and other business functions. ISD involves early and continuous delivery of valuable software; frequent software delivery; change of requirements; daily collaboration between business, people and software developers; provision of right environment, support and	(Collignon et al., 2022; Harris, 2018; Kumar & Bhatia, 2012; Beck et al., 2001; Fowler & Highsmith, 2001)

Processes of Performing	Explanation	References
	trust to software developers; face to face communication; self-organization of teams.	
Assessing achievements	Involves the assessment of the outcomes of ISD work and the criteria used to make the assessment. The primary measure of progress in software development is working software. ISD output quality is measured through an agreed-upon definition of done.	(Tam et al., 2020; Geeling et al., 2019; Schwaber & Sutherland, 2011; Fowler & Highsmith, 2001)
Enacting virtuality	Is the reliance of technology-based tools and infrastructure such as hardware, software, internet connectivity and cloud computing platforms when performing ISD.	(Elkordy, 2022; Meluso et al., 2020; Morrison-Smith & Ruiz, 2020; Choi & Cho, 2019; Geeling et al., 2019; Dulebohn & Hoch, 2017)

Table 1: Summary of the processes of performing ISD

2.6 Summary

The principles of agile software development point out the need for strong collaborative relationships between software development teams, and other business functions (Beck et al., 2001; Fowler & Highsmith, 2001). The processes of performing ISD identified in literature includes leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements, and enacting virtuality. In this chapter, previous studies pertaining to these processes were reviewed and summarised as shown in Table 1, resulting in the development of the sd-as-p conceptual model shown in Figure 1. The next chapter will discuss the research methodology adopted for the purposes of answering the research questions.

CHAPTER 3: METHODOLOGY

This chapter sets out the research methodology that guided the study. The methodology provides procedures that were used to collect, select, and analyse data. The philosophical considerations will be covered in section 3.1 followed by research purpose in section 3.2. Next, the approach to theory development is presented in section 3.3. Section 3.4 will cover the study's timeframe, followed by research strategy in section 3.5. Data collection procedures will be discussed in section 3.6 followed by data analysis in section 3.7. Lastly, section 3.8 will present the ethical considerations for the study.

3.1 Philosophical Considerations

An interpretive paradigm was adopted in this study. The aim of this research was to make sense of the subjective and socially constructed meanings expressed about the phenomenon being studied (Saunders et al., 2016, p.168). The interpretive paradigm bases its assumption on social reality being not singular or objective but rather shaped by the experiences of humans and social contexts (ontology) (Bhattacherjee, 2012; Klein & Myers, 1999). Walsham (2006) highlights that our knowledge of reality is socially constructed by human actors. The experiences, views, and interpretations of ISD professionals working in a virtual context was investigated in this study therefore, the interpretive paradigm was chosen as the best fit for the study.

3.1.1 Philosophical Assumptions

Table 2 below summarizes philosophical assumptions that was adopted in this study.

Assumption	Definition	Question	Characteristics	Implications for Practice
Ontological	relates to the reality's nature and characteristics (Saunders et al., 2016, p.127; Creswell, 2012, p.20)	What the nature of reality will be?	Subjective and multiple realities as seen by the participants of this study.	Themes and quotes from the participants were employed when reporting as evidence of the different perspectives that were supplied.
Epistemological	relates to knowledge assumptions, what comprises legitimate, valid, and acceptable knowledge and how knowledge can be communicated to others (Saunders et al., 2016, p.127; Creswell, 2012, p.20)	What constitutes knowledge? How will knowledge claims be justified? What relationship is there between the researcher and the study?	The distance between the researcher and what is being studied	The researcher was closer to the participants of the case study to acquire knowledge and effectively communicate knowledge.
Axiological	deals with the role of ethics and values (Saunders et al., 2016, p.127)	The acknowledgement of research bias	The acknowledgement of bias in a research study and that the research being undertaken is value-laden	Values that will shape the study were discussed including the researcher's own interpretations together with the participants' interpretations

Table 2: Philosophical assumptions of this study

3.2 Research Purpose

The research aimed at explaining the phenomena (Yin, 1981) of virtuality's influence on the process of performing ISD. According to Bhattacherjee (2012), explanatory research looks for explanations of observed problems, phenomena, or behaviours and they can be used for doing causal investigations (Tellis, 1997). This study was investigating how virtuality influences the process of performing ISD and assessment of the outcomes, therefore, explanatory research was best suited for the study.

3.3 Approach to Theory

An inductive approach as shown in Figure 2 was applied in this study. The inductive approach "involves working exclusively from the participant experiences that drive the analysis entirely"

(Azungah, 2018, p. 391). While a literature-derived sd-as-p conceptual model was utilised as a guide for data collection, this approach allowed the identification of emerging themes, subthemes, and the modification of the sd-as-p model based on the case data from participants' interviews and company documents. According to Sarker (2000), "virtual teams need to be studied, not deductively, based on propositions existing in the teams/group/traditional organization behaviour literature" (p. 39). Subthemes pertaining to the processes of performing ISD were identified inductively as described by studies by Mitchell (2018) and Dudovskiy (2016).

	Deduction	Induction	Abduction
Logic	In a deductive inference, when the premises are true, the conclusion must also be true.	In an inductive inference, known premises are used to generate untested conclusions.	In an abductive inference, known premises are used to generate testable conclusions.
From/To	Generalise from the general to the specific.	Generalise from the specific to the general.	Generalise from the interactions between the specific and the general.
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory.	Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection and so forth.
Theory	Theory falsification or verification.	Theory generation and building.	.Theory generation or modification; incorporating existing theory where appropriate, to build new theory or modify existing theory.

Figure 2: Comparative approaches (Mitchell, 2018, p105)

3.4 Timeframe

This research is part of requirement for completing Master's degree studies at the University of Cape Town (UCT) thereby had to be completed at a fixed time span and the views and explanations of the research participants were at a particular point in time. The time horizon for this research study was cross-sectional.

3.5 Research Strategy

As the aim of this research was to investigate the influence of virtuality on ISD in an organization that has transitioned to a virtual context, a case study was deemed as the best strategy. A case study is defined as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 1994, p. 13). In case studies, in-depth analysis of an individual unit such as an

organization or community is undertaken (Baskarada, 2014). They are also used for holistic, in-depth investigations when a phenomenon cannot be studied outside the context in which it occurs (Dubé & Pare, 2003) and allow close examination of data within a specific context (Zainal, 2007). An interpretive case study allows for the emergence of the constructs of interest from data, the ability to change the research questions during the research, and the deriving of rich, contextualized, and authentic phenomenon interpretations (Bhattacherjee, 2012). Perspectives, views, and experiences from a range of participants involved in the processes of performing ISD working within different business units of the organization were obtained.

3.5.1 Case Selection

Case study research may be single-case or multiple-case depending on the issue being investigated (Zainal, 2007). A single case design can be employed when the phenomenon under study is unique, extreme, or critical (Saunders et al., 2016, p.186; Yin, 2003, p.40). Seawright & Geering (2008) define a typical case study as a representative case that exemplifies a stable, cross-case relationship. This study focused on a typical case of an ISD organization that has transitioned from a collocated context to a virtual context.

3.5.2 Unit of Analysis

A holistic case study with embedded units (Baxter & Jack, 2008; Yin, 2003, p.40) was adopted. Case studies facilitate the examination groups of individuals participating in an event or activity or an organization and can be either single unit of analysis or multiple units of analysis (Creswell & Poth, 2016, p.196). A full software development organization that transitioned to a virtual context was the unit of analysis.

3.5.3 Target Population

In research, target population refers to a manageable subset of an entire population (Saunders et al., 2016, p.275). The target population within the case were the individuals employed by the organization.

3.5.4 Within case Sampling

Sampling involves the study of a population representative instead of the whole population (Acharya et al., 2013). It is not always practical to study the entire population (Bhattacherjee, 2012,

p.65) of every employee in the organization under study, therefore, purposive sampling (Saunders et al., 2016, p.301) was used. The selection of participants who were most likely to give important perspective on the phenomenon of performing ISD in a virtual context due to their roles and business divisions they belong as prescribed by Robinson (2014) was done purposively and the type of the purposive sampling method was typical (Baskarada, 2014).

3.6 Data Collection

Qualitative data was collected using semi structured face-to-face interviews and secondary data from the organization that was being studied. Interviews allowed the interviewer to work directly with each participant asking questions and recording responses (Bhattacherjee, 2012, p.78). Researchers can collect rich and detailed qualitative data for understanding experiences of participants, how they describe those experiences, and the meaning they make of those experiences (Castillo-Montoya, 2016). The people involved in the process of performing ISD within a virtual context gave their input for the purposes of this study. The duration of the interviews ranged from between thirty minutes to an hour per interview as most participants were utilising the standard lunch time allocated to workers by the organization. Consideration of participants' time availabilities were considered. Rowley (2012) confirms that the duration of an interview can range from thirty minutes. As the organization under study is completely operating virtually, all interviews were conducted virtually using Microsoft Teams as the tool has recording and transcription capabilities which were vital to the flow and collection of data. The recorded video/audio data and transcription files were stored in Microsoft OneDrive which is a password-protected cloud-based storage platform provided by UCT. A total of seventeen participants were interviewed. In qualitative research methods, there is no exact number for the sample size as focus is on in-depth understanding of a phenomenon, but most scholarly articles recommend a range between five to fifty interviews (Dworkin, 2012). Saturation, which is the point at which additional data collection does not yield any new and relevant data or insight into the phenomenon of interest (Alam, 2020; Bhattacherjee, 2012, p.106; Dworkin, 2012) was considered during the data collection process to determine the number of participants as well as the cut off of the interview process. In addition to interview data, secondary data in the form of remote working guide (RWG) and the company values document (CVD) were collected from the case and were treated as participants in the data analysis process.

The participants from the key business divisions namely technology, business development, data production, data engineering and product were selected and interviewed. They were selected based on their roles and the key business divisions they work in as shown in Table 3 below.

Participant	Organizational Role	Business Division
TT	Software Developer and Team Lead	Technology
RP	Software Delivery Manager	Technology
TH	Scrum Master	Technology
KCM	Data Quality Assurance Specialist	Data Production
TKM	Junior Software Developer	Technology
LR	Country manager, Mexico	Business Development
NN	Scrum Master and Line Manager	Technology
TM	Head of Software Engineering	Technology
JP	Head of Data Production	Data Production
CL	Head of Research	Product, Research
IS	Lead Product Manager	Product
SJN	Product Manager	Product
SM	QA Automation Specialist	Product, Technology
RK	Operations Manager	Product, Operations
CW	Head of Data Processing	Data Production
JS	Senior Software Engineer	Technology
EK	Head of Data Engineering	Data Engineering
RWG	Remote working guide	All Divisions
CVD	Company values document	All Divisions

Table 3: Participants' profiles and business divisions

3.6.1 Protocol for Data Collection

To effectively collect data from the participants, a semi structured research protocol (Castillo-Montoya, 2016) was developed and used as a guide for the data collection process during interviews. The interview protocol comprised of semi structured open ended questions derived from the modified sd-as-p (Geeling et al., 2019) conceptual model shown in Figure 1. These open-ended questions were aligned to the research questions and objectives as prescribed by Yeong et al. (2018). The research protocol is shown in Appendix 5.

3.6.2 Research Validation

The process of verifying, interpreting, and analysing research data to establish its authenticity, credibility and validity is called validation (Saunders et al., 2016, p.206). Data validation can be achieved through triangulation of chains of evidence, use of multiple sources of evidence and member checking and through the implementation of case study protocols (Yazan, 2015). In this study, research validation was achieved using multiple sources of evidence such as interviews, and secondary documents which included the company's remote working guide (RWG) and the company values document (CVD).

3.7 Data Analysis

Data analysis is described as "the process of systematically searching and arranging the interview transcripts, observation notes, or other non-textual materials accumulated to increase the understanding of the phenomenon" (Wong, 2008). Thematic analysis of the qualitative data was employed in this case study. The development and testing of theories and explanations based on apparent thematic patterns or relationships can be achieved through thematic analysis (Saunders et al., 2016, p.579). Thematic analysis involves the identification of patterns and themes within qualitative data (Maguire and Delahunt, 2017). Qualitative data collected from the interviews was exported to Microsoft Word for cleaning and uploaded to NVivo 12 software analysis. NVivo 12 software was utilized in the data analysis process. The use of software tools enables researchers to effectively store organize, and manage qualitative data (Wong, 2008). The data analysis procedure conducted in this study followed a step-by-step thematic analysis guide as prescribed by Braun & Clarke (2006). This procedure enabled to researcher to thoroughly analyze the qualitative data. The stages of the thematic analysis followed in this study are shown in Figure 3 below.

PHASE	DESCRIPTION
1. Familiarizing with data	• Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas
2. Generating initial codes	• Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code
3. Searching for themes	• Collating codes into potential themes, gathering all data relevant to each potential theme
4. Reviewing themes	• Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis
5. Defining and naming themes	• Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	• The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis

Figure 3: Thematic Analysis Stages (Braun & Clarke, 2006, p.87)

3.7.1 Phase 1: Familiarizing with data

The initial transcription of the interviews was done automatically using the transcription functionality of Microsoft Teams. The transcription file was downloaded from Microsoft Teams as a Microsoft Word document and uploaded to NVivo 12 for cleaning, editing, and error checking (Kothari, 2004, p.122). The recorded video files were played back during this process for the purpose of finding and rectifying errors. This process of reading, re-reading, and listening the recorded data files allowed the researcher to get more familiarized with the data and to check the transcription for accuracy. Initial ideas and nodes were noted and recorded in NVivo during this phase. According to Braun & Clarke (2006), there are no hard rules on producing a transcript and the authors further point out the need for thorough and rigorous orthographic transcripts. High

importance is also placed on transcript's ability to retain the needed information that is true to its original sense (Braun & Clarke, 2006). These guidelines were applied through reading and re-reading of the transcripts against the video playbacks.

3.7.2 Phase 2: Generating initial codes

Coding or categorizing data is vital during analysis and includes subdividing of data and allocating it to relevant categories (Basit, 2003). According to Wong (2008), coding involves assigning identified themes or topics from the research's data files to related categories. The next stage was to code the data features from the data files systematically into the relevant categories. Secondary documents collected from the organization were also uploaded to NVivo 12 and utilized together with the data from interview transcriptions in this stage. Careful and equal attention was given to each data file during this process. Appendix 6 contains the initial nodes of the coding process. Data was initially coded in the initial nodes. The initial nodes in this phase were guided by the research interview protocol questions and data was initially coded around these questions. Emerging codes from data extracts were also created and relevant data from the files was coded accordingly.

3.7.3 Phase 3: Searching for themes

Themes capture important things about data in related to research questions and shows patterns within data sets (Braun & Clarke, 2006). After all data was collated and coded into the nodes, a long list of nodes and sub nodes was generated as shown in Appendix 7. In this phase, the related codes were analyzed, combined, and sorted into potential themes.

3.7.4 Phase 4: Reviewing themes

Initial themes identified in phase 3 were further reviewed and refined. The process of reviewing the themes involved merging related themes, removal of the initial themes that did not have enough supporting data, and creation of new themes and sub themes. Cycles of checking and re-checking of themes against each other and back to the data files with the aim of attaining a level of internal coherence, consistence, and distinctiveness (Braun & Clarke, 2006) were conducted. As highlighted by Geeling et al., (2019), the "process of constant comparison checks the distinctiveness of emerging themes or possible alignment with other themes in the data or with concepts from related theory". As coding is an ongoing organic process (Braun & Clarke, 2006), further coding was done with carefully considerations on themes that are relevant and of interest

to this study thus avoiding endless coding. This phase resulted in the development of an initial thematic map in Appendix 8.

3.7.5 Phase 5: Defining and naming themes

According to Vaismoradi et al. (2016), a theme is used as a descriptor or an attribute and contains codes that have a common point of reference and has a high degree of generality that unifies ideas regarding the subject of inquiry. According to Braun & Clarke (2006) the researcher can determine what a theme is as themes are not qualified based on size or number of occurrences within data sets. In this phase, further refinement of themes was conducted by removing candidate themes that were not relevant or did not have enough supporting data as well as separating unrelated themes, combining related themes, and renaming themes as prescribed by Braun & Clarke (2006). This process went through several cycles, utilizing NVivo 12 and whiteboards for better visualization and sense making as shown in Figure 4 below. The final themes and subthemes are shown in Appendix 9.

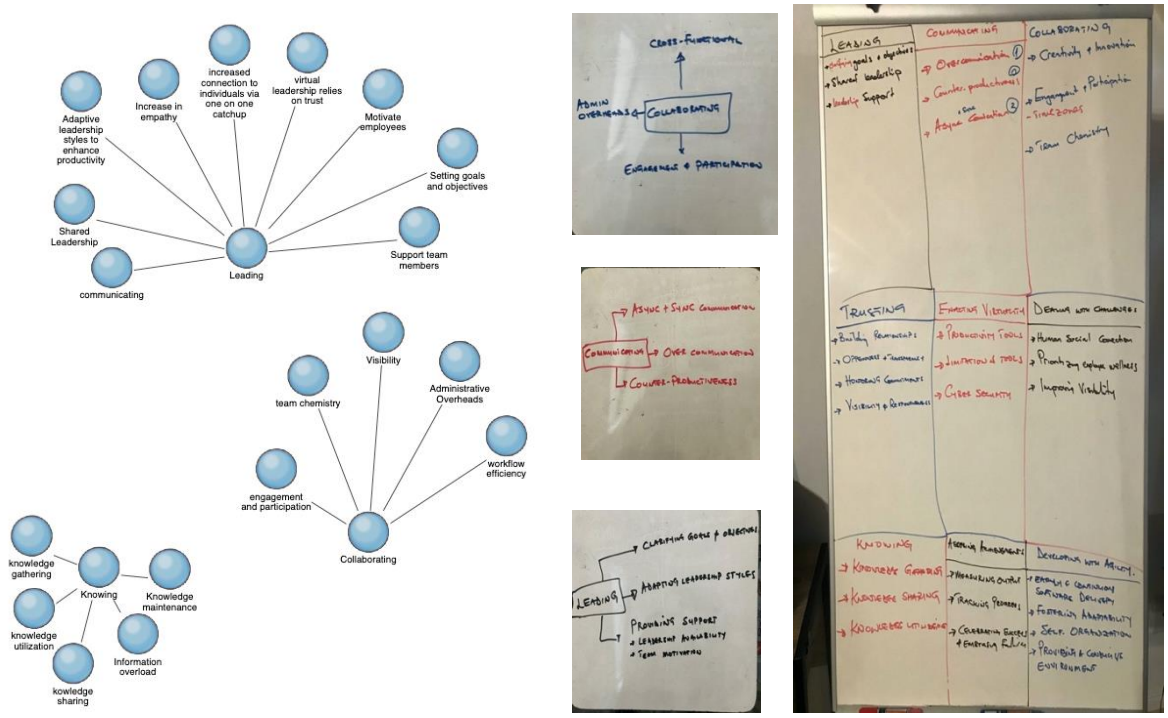

Figure 4: Defining and naming themes and sub-themes

3.7.6 Phase 6 Producing the report

The findings of the thematic analysis were reported in chapter 4. Data extracts that easily identified examples of themes and subthemes were embedded within the analytic narrative of the research question as prescribed by Braun & Clarke (2006). An example of themes, subthemes and data extracts as shown in Figure 5 below:

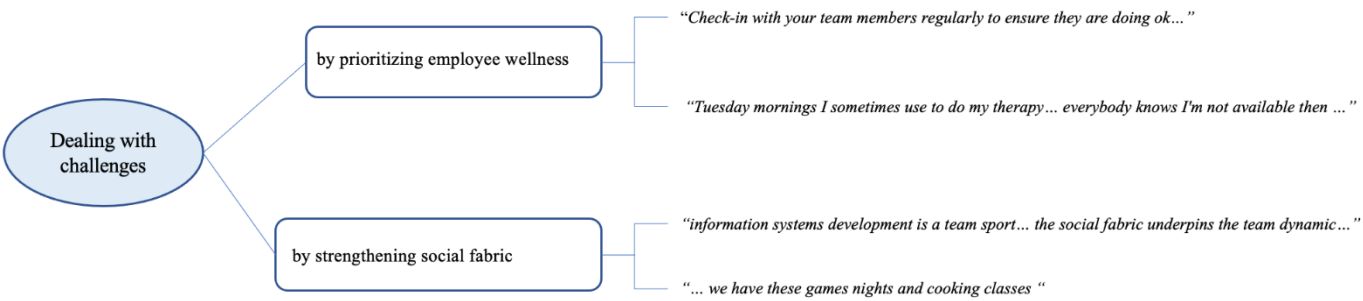

Figure 5: Illustration of the Dealing with challenges theme, sub-themes, and data extracts

3.8 Ethical Considerations

Ethics clearance was granted from the University of Cape Town, upon providing a cover letter and completing the required Commerce Faculty Ethics Form, to the university's Ethics Committee. The researcher was employed by the organization where the study was conducted. Permission to conduct the study was obtained from management of the organization. The management of the organization and the research participants were informed of their right to voluntarily participate, and all parties agreed with confidentiality and anonymity of their data by signing consent forms. The participants gave verbal consent to record the interviews before the start of each interview session. To guarantee participant's anonymity, the collected data was anonymized using codes. The ethical principles in scientific research as prescribed in the social science research handbook (Bhattacherjee, 2012, p.137) were adhered to in this study. The evidence for the Ethics Approval process followed in this study is shown on Appendix 1 to 4.

CHAPTER 4: FINDINGS

4.1 Introduction

The purpose of this research study was to investigate virtuality's influence on the performing of Information Systems Development. To achieve this, semi structured interviews were conducted with seventeen participants and secondary data comprising of the company's remote working guide and company values document. This section will discuss the research findings from the thematic analysis conducted using NVivo 12 as described in the Data Analysis section above.

4.2 Case Study Background

Company X is an industry-leading technology company and central source of high-quality mobility and location data for emerging markets. The quality of the company's data offering is underpinned by a combination of data products, applications, and people. The company's product offerings for clients include mobility Transit data, Point of interest (POI) data, Real-Time Alerts, and journey planning and GPS tracking applications. The company internally develops and maintains software systems that collect, validate, and process public transport network data and software tools that process and publish alerts to other external platforms. The company previously operated from an office location in Cape Town, South Africa for over six years employing fifty full time employees and in 2020, it transitioned to become a fully remote company and is now comprised of a team size of more than one hundred staff working virtually. The company's operational internal structure is made up of five main divisions namely Technology, Data Production, Product, Business Development and Data Engineering. The technology division includes software engineering, IT, and geo-informatics; data production department focuses on data processing; the product division deals with research, design, and product management; Business development division deals with market operations, marketing, clients, and revenue; and the business's day to day operations. The data engineering creates and maintains systems relating to data collecting, data storage, data analysing and data reporting.

4.3 Performing ISD Virtually

The below section will discuss the themes and subthemes that emerged from the data analysis pertaining to the processes of performing ISD virtually. Table 4 below shows the most occurring subthemes derived from NVivo 12 analysis.

Theme	Sub-themes	Occurrence	Participants
Leading	• Clarifying goals and objectives	8	4
	• Adapting leadership styles	12	10
	• Providing leadership support	39	19
Communicating	• Asynchronous and synchronous communication	18	8
	• Overcommunication	22	7
Collaborating	• Cross-functional collaboration	6	5
	• Engagement and participation	23	9
	• Administrative overheads	15	8
Trusting	• Relationship building	17	10
	• Honouring commitments	8	7
	• Active involvement	6	4
Knowing	• Knowledge gathering	41	14
	• Knowledge sharing	33	10
	• Knowledge utilization	19	10
Dealing with challenges	• Strengthening social fabric	28	12
	• Prioritising employee wellness	12	9
Developing with agility	• Championing early and continuous software delivery	30	10
	• Encouraging self-organization	18	8
	• Providing a conducive environment	42	9
Assessing achievements	• Quality assurance	7	5
	• Progress tracking	5	4
	• Celebrating outcomes	4	4
Enacting Virtuality	• Virtual culture	20	10
	• Technology infrastructure	21	11
	• Online productivity tools	83	17

Table 4: Occurrence of subthemes derived from NVivo.

4.3.1 Leading

This section will outline how virtuality influences leading when performing ISD in a virtual context. Three main subthemes emerged from the data set under leading viz clarifying goals and objectives, adapting leadership styles, providing leadership support.

Clarifying goals and objectives

The company's remote working guide stated that in order for the business to be able to successfully function as a remote fully business and achieve its goals, their ISD workers and leaders had to spend more time and effort communicating and clarifying the expected outcomes:

> ***"Spend more time clarifying objectives and direction. Communication is often harder over text. Double-check that you've understood deliverables correctly, align with your team and/or line manager on what success looks like."*** **(RWG)**

Most participants pointed out that clarification of goals and objectives is a challenge for leaders due to virtuality's asynchronous way of working. One leader stated that: ***"… some of the team members do struggle in writing out or typing out in slack their progress or what they're trying to say or questions…"*** **(CW)**

Another participant further highlighted that writing things down is not enough to clarify goals and objectives so leaders in a virtual context must do more to ensure their reports (those that report to them) understand goals and objectives to ensure successful ISD outcomes:

> ***"Even though you would definitely think that in writing things will be clearer because it's written, black on white…but I think we do take for granted how much people rely on visual cues and be able to draw for each other and kind of talk through things to create a greater kind of joint understanding. So I think adapting the way you communicate is one thing that impacts leaders in a virtual setting."*** **(JP)**

Virtuality might cause team members to over-promise and under-deliver on objectives which will in turn will have a negative effect on the ISD process. Leaders therefore should look out for such challenges when clarifying goals and objectives and assigning responsibilities. Another participant stated:

> ***"People like to over-promise things and it's easier to spot that if you're face-to-face. So when you have somebody sitting in front of you, they're less likely to over promise…It's***

easier to say yes to something that you don't quite intend to follow up when you don't see the person and exaggerate a little bit, I think the whole social pressure is a bit stronger if you don't see the person to kind of fake accommodation and fake compromises are a bit more likely to happen in an online setting." **(EK)**

Adapting leadership styles

Most participants highlighted that for remote businesses to achieve ISD goals and objectives, virtual teams need to adapt the way they conduct leadership.

***"I do adapt my leadership style to the person and to the context that I'm speaking to and the relationship I have with that person, which is of course impacted by virtuality.*"** **(RK)**

"*I think that another aspect that changes is, you're kind of changing your scope of leadership to a smaller team space… it feels like it's easier to focus on few individuals."* **(JS)**

It was pointed out that virtuality provides an opportunity for recognition of underrepresented leaders such as females. One participant stated:

"What I hear and what my impression is that in a collocated space other attributes makes you a leader, it's very common that especially tall men become leaders in a collocated space because they stand out, they are "more impressive" and they feel more physically confident whereas in virtual space, and there has been research on this actually, women and underrepresented groups are more likely to be leaders because some of these are these attributes that we consider to be unnatural leader is different." **(EK)**

Leading is based on relationships, thus requiring ISD leaders to invest more on relationship-building within their teams to achieve their goals. Building relationships virtually is a complex undertaking as compared to a collocated environment. This is evidenced by the participants' responses below.

> ***"Leadership to me is all about the relationship… and a relationship doesn't happen overnight… it takes time in-person as it is and remotely it's really incredibly challenging."*** **(CW)**

> ***"… I think maybe just an acknowledgement that this is difficult, this is harder and I acknowledge that I don't actually know you properly and our relationship is through Zoom screen."*** **(RK)**

Accountability on the handling of the team and individuals' duties and responsibilities is of great importance when performing ISD virtually. Due to lack of much visibility in a virtual context, team members and individuals are accountable to each other and to their own individual work. Some participants pointed out the following:

> ***"one thing that helped in that regard is the team kept people accountable. It wasn't necessarily your team lead, tech lead, managers or people saying we need to document, the team was like I have absolutely no idea what you did in this code base, can you explain it to me?"*** **(RP)**

> ***" I think yeah before in the office, people constantly had to check up on you physically but now within the team as well there is that autonomy like you know I'm responsible for this, this person is responsible for this and they are certain people who depend on my work."*** **(KCM)**

ISD success in a virtual context, requires an adaptation to upward leadership styles where team members bring solutions, suggestions and guidance to the team including their leaders. As stated by one participant: ***"I think that a lot of people lead up, you know, they they're managing us, they definitely manages me…"*** **(CL)**. Leaders, therefore, need to create a safe space to allow upward leadership style. In the organization's remote working guide, it was stated that team members agreed to:

***"communicate with our team leads if there's anything to do with remote work that we're struggling with or anything that could help us to be more productive while working remotely."* (RWG)**

Providing leadership Support

Provision of leadership support in a virtual setting is one of the most critical responsibilities of ISD leaders. One participant stated that: ***"… in leading software engineering teams, one of the main focus areas for the leadership of such teams is to try and remove too many distractions."* (TM)**

By ensuring leadership availability

Due to virtuality's complex nature, ISD team leads must increase their availability times in order to accommodate team members including those working in different time zones and remove any sudden impediments that arise while performing ISD, thus increasing leadership scope and workload.

***"my job is to respond to notifications. As a manager, that's my job to talk to people and if somebody wants to talk to me usually it's urgent, and if they really want to address something with me and then it's worth talking to them."* (EK)**

***"for me as a team lead, in my Slack like as soon as I see a red badge or something like unread notification to me it's like high priority, so I have to jump on it. That's like the way I feel, I can't be holding somebody else up. I feel like if things aren't flowing nicely then I'm not doing my job. I know I have a lot of things on my plate as well, but I really try to be responsive on Slack."* (TT)**

***"For me as a leader, one big aspect is how do you treat people fairly across your team, despite them being in totally different time zones, how do you also make sure that you are offering your team the right work life balance that they deserve across different time zones? Because that's come up before in my team, concerns about messages being exchanged or certain meetings taking place when it's outside of their normal working hours."* (JP)**

Other important aspects of leadership support are relationship building and the ability of ISD leaders to support their reports by practical demonstrations. It was reported that the lack of visibility when using technological tools complicates leadership support.

> ***"as a leader, one thing I always want to do is to lead by example and when you're leading by example, you need to be visible for people to see what you are doing. So sometimes it takes a little bit of effort to think, for example how am I going to make what I'm trying to do here visible and I think that can be frustrating sometimes."*** **(JS)**

> **"** ***Not being able to build a real relationship with your direct reports and or other people you lead, whether directly or indirectly is a big thing. So, the only relationship, especially with people in our company is that a relationship through zoom screen and there's only so much of a person you can get to know through zoom screen, and I think that makes building trust, which is obviously a central for leadership really difficult."*** **(RK)**

ISD leaders, therefore, must make space for one-on-one touch points with individual reports, as stated by one participant: **"*"besides stand-ups I do have check-ins with every team member and "coffee chats" only on a weekly basis."*** **(NN)**, thereby increasing the leadership scope.

By motivating the team

Leading entails motivating teams to deliver on goals and objectives. ISD as a highly collaborative teamwork mandates leaders with the responsibility of encouraging teams to adapt and grow productive virtual ways of working as stated by some participants:

"*virtuality is encouraged by leadership, but they should also be the aspect of leadership forcing the growth in a healthy way."* **(TH)**.

"leadership is now the one thing, the pillar of strength that has to help people navigate uncertainty, you want to have your teams feeling that their world has not been turned upside down." **(TM)**

Keeping team morale high and ensuring that everyone remains engaged virtually is a challenge stated by many participants:

> **"*probably one of our biggest challenges with leadership is maintaining morale in the absence of social interaction.*" (IS)**

> ***"What has been a bit of a challenge in some cases is people losing drive. There are some people who are able to perform better because they are in a work setting and offer traditional office work setting and without it they struggle with focus. They struggle with motivation to get the work done, but that's been very isolated cases and I mean we are dealing with those cases as and when they come up."*** **(TM)**

> ***"…keeping that energy up in meetings and collaborative sessions and so on can be difficult." (JP)***

> **"*You can send something out in the email or you can put something out on a Slack message but then there's just no response to some initiative and that can get a little bit demotivating or it can just mean that you don't reach the leadership that you're trying to because there would be no engagement.*" (JS)**

4.3.2 Communicating

This section outlines the findings on virtuality's influence on communication while performing ISD. It covers asynchronously and synchronously communication, and overcommunication.

Communication plays an integral part in performing ISD in a virtual context, one participant stated that: ***"I do feel that compared to in the past, more time is spent communicating than it was when we were not virtual."*** **(IS)**

Asynchronous and synchronous communication

ISD processes hinges on both synchronous and asynchronous ways of communication. As one participant stated***: "the communication I have is synchronous… a lot of regular calls with a lot***

of people, one on ones and team ceremonies, team calls... then work asynchronously…I send them a question and they respond whenever they have time." **(EK)**

It emerged that asynchronous communication increases significantly when working virtually, one participant stated, **"*a lot of meetings that would have happened in a face-to-face conversation they've been happening in sort of asynchronously."* (TKM)**

It was stated that by interacting asynchronously, ISD engineers can think through their answers and give valuable input which in turn results in quality solutions.

> **"*when you talking about asynchronous communication, what you're basically saying is that I can post a message for you to digest and reflect and respond to later. I'm able to share the information that informs what you need to do, or ask the question that I need input on and continue with something else, knowing that you will eventually respond to me at some point in time."* (TM)**

> ***"I prefer to communicate via text. So even when we were in the office I would communicate a lot on Slack. The reasons that I love it is that writing on the text means that you can think very carefully about what you're going to say before you say it, and then also that you know it can be asynchronous, you don't have to disturb someone in the middle of what they're doing."* (IS)**

Many participants pointed out that asynchronous interactions reduce communication-related disruptions when performing ISD and enables developers to focus on developing software.

> ***" An engineer is forced to shift their focus or their concentration from one thing to a bunch of other things every time they stop coding, It's harder to find where they were and pick up where they left off. So that's why asynchronous communication is always preferred over synchronous communication when it comes to software engineering"* (TM)**

"… unless the thing is very urgent, then you'd send a meeting invite, but I think a lot of non-urgent, non-pressing matters have been pushed to that sort of asynchronous communication and I think that it's made work easy because it actually allows me to focus, or if there's something that I'm focused on I can see messages come through on Slack but I don't need to remove myself from what I'm doing in the moment. I can continue with what I'm doing until I'm finished and then give that other matter attention." **(TKM)**

"If you go and you ask somebody like in in-person, you have to interrupt their flow and then they will tell you something and then you have to kind of remember it and you have to make sure you remember it correctly, whereas if they've written something in text you've kind of got it written down, I find that misunderstandings are a lot less common…" **(IS)**

Some participants highlighted that some of the challenges that are posed by increased asynchronous communication includes time wastage, noise caused by a lot of messaging on various platforms and the loss of interpersonal relations and nonverbal cues which enhances team chemistry in ISD.

"… English is not everybody's first language, and that's 100% normal, the challenge is it takes up a lot of time sometimes to read, interpret, and really figure out what they're trying to say and that back and forth afterwards, it takes up time, takes energy and it's not conducive." **(CW)**

"*… Slack in our case as an instant messaging has existed for a long time, even when teams were still working physically in the same space, but I feel as though now inevitably it becomes even noisier, there's a lot more messaging happening through instant messaging, which can become quite noisy and distracting. Then on top of that, you've got, emails, then on top of that you might have tools or platforms being used for asynchronous communications, such as adding comments to document in the G suite or*

our project management tool ClickUp and prompting comments and messaging through there." **(JP)**

"*… we've lost that interpersonal thing, we sort of lose our tone and you say messages jokey things come off a bit more sarcastic and harsh, so you tend to stray away from them and keep things as professional as you can."* **(TH)**

"we're also missing a lot of nonverbal communication that kind of deters trust." **(EK)**

Overcommunication

Virtuality removes teams from organic information flows that collocated environment provides resulting in the need to communicate more when operating virtually. The company's adopted remote working guide stated:

"Your team members will be cut off from organic information flows they used to have through others in the office, so you need to make time to communicate more … pass on the information you learn from other teams… spend more time clarifying objectives and direction." **(RWG)**

Many participants further agreed the need for virtual ISD teams to communicate more than they usually did in a collocated environment.

"I think the first thing when it comes to virtuality is you need to be as clear as possible, so a lot of times you will need to overcommunicate." **(RP)**

"we've also had to shuffle, to a much more asynchronous way of communicating. So overcommunication is important…Uhm, following up with, "we had a meeting, here's the recording, here's the document, please comment" that was never a way we used to do things before, everyone was in the room." **(RK)**

Overcommunicating when performing ISD is counterproductive. As stated by one participant: **"*meetings and software engineering don't really go well together…*" (TM)**. Most participants pointed out that more time is spent in meetings than performing ISD tasks when working virtually.

> **"*For me personally for example, it gets too much, you end up feeling like you are not doing much because you are in a meeting after a meeting.*" (KCM)**

> ***"they are quite a lot of meetings, when I joined there was an overload of meetings and that was the main complaint that there's too many meetings."* (NN)**

Many participants further noted that the overcommunication happens on various digital platforms, increases work pressure, and forces developers to context-switch thus making ISD process ineffective. It was also reported that context-switching increases working hours as developers must make up for the loss of time caused by overcommunication.

> **"*one of the things also that comes from working remotely when especially in terms of digital platforms, there are just so many different spaces where you can interact with people and it can create quite a lot of noise and potential again a different form of distraction.*" (JP)**

> ***"context-switching is the most important thing because imagine you were a developer working on quite a complex problem and at some point you just see five pings, you see that little red icon pop up for Slack, and so from a developer, going from a complex task need to stop to read the slack messages, and then you need think what is the problem, then you need to come back to where you were because we have the challenge of it's not supposed to be instant, but it became at a point where people like if I Slack, you need to respond immediately. So that's the first very important issue that we see with developers is like context-switching is expensive and it's extremely frustrating."* (RP)**

> ***"I try to reply very timeously to stuff so I'm available to anybody who needs anything so for me, my flow can be interrupted between the Zoom meetings and replying to Slack***

messages, you end up with like your eight hour work day kind of just gets subdivided so much that you have like meeting and a short break, a meeting and then a short break and the actual solid focus times disappear, then I feel that pressure like ah, I know like I just need like an hour to like focus on this thing and get it done and make a pull request that I can never quite find like the solid focus to do that. I definitely do make the time eventually but you know it is a bit of an additional stress or pressure." **(TT)**

Even though context-switching was reported as a challenge by many participants, another participant pointed out that virtuality enables her to multitask and get more work done by effectively using time:

"There's an interesting thing that I've noticed has happened is a dual use of time, so we've got some really busy people in this company and when you're in a meeting in a traditional office, you can't be doing anything else. You are 100% in that meeting and it's incredibly rude to be on your phone to be texting someone else to be talking to someone else, whereas working virtually, I often, am doing two things at once, I'm listening in on a meeting and I'm working on a document or I'm replying or I'm sending some messages on Slack…, so in that way I'm maximizing time…" **(RK)**

4.3.3 Collaborating

This section outlines the research findings pertaining to the influence of virtuality on collaborating while performing ISD. The following sections will be discussed, 1) Cross functional collaboration; 2) Engagement and participation; 3) Administration overheads.

Cross functional collaboration

Cross-functional collaboration has been a feature of both collocated teams and remote teams, but most participants stated that virtuality increases cross-functional collaboration between ISD teams and other business functions thus ensuring successful ISD delivery and quality outcomes. One participant noted:

"I think that the idea of cross functional collaboration was always there. It's not new, but I think there's a heightened awareness that because we now doing remote work and it's not optional for most people, the need for cross functional collaboration has been emphasized and there's an increased awareness for the need for cross functional collaboration. That has proven to be the only way to work. What used to happen before is that you'd have your marketing, your product, your research teams, and things they were doing was siloed and maybe sometimes when it eventually gets handed over to software engineering teams there's a lot of back and forth now to kind of clarify what the actual objective is, what is the requirement? Now we are all more immersed in each other's worlds than we were before, … we really are walking in stride with design, walking in stride with product research..." **(TM)**

"there's also collaboration from the team externally… I worked with the Scrum Master to create rituals within the team, so we have a planning session, we have an open-door session every day." **(CL)**

It was further stated that due to the transition to virtual context, other business functions gained more access to collaborative tools and ways of working that were previously utilized mostly by software development teams only. Due to this influence, cross-functional collaboration increased and enhanced the process of ISD.

"In terms of mass collaboration, we've got more sustainable tools than ever before at our disposal…that has been easier. It used to be just the development team that had access to all of this and now it's the entire company who has access to all of this, so it's getting everybody's hand in or getting everybody feedback has been easier than ever getting design feedback or finances feedback on the projection costs of this amazing project we would totally going to develop and going, 'yeah, but maybe that's not realistic' and that's in a matter of seconds just because we had the open end of this is free for anyone to join in the company, 'here's the tools, please go, have look and give feedback', So it has allowed us to have more faculties involved and that could help all of us." **(TH)**

Engagement and participation

Some participants find engagement and participation difficult virtually especially when dealing with complex concepts. Lack of visibility on non-verbal cues has been identified as part of the challenges in performing ISD virtually. One participant stated:

> **"*Collaboration can be really tricky when you're trying to do complex things or get concepts across and being able to get valuable input in those complex concepts is really difficult over a Zoom screen, especially when people turn videos off or when they've got mute on all those sorts of things. You can't see people nodding or shaking, or confused faces or anything like that. If I compare this to sitting in a room with someone with a white board, I can very quickly tell if you're resonating with what I'm saying and if you're getting it, whereas if I'm sitting with someone with a Miro board and I'm trying to take him through a complicated concept, it's very hard for me to tell if my audience is resonating, and if they're not resonating, they're not going to contribute, they're not going to get involved, so yeah, I think it definitely adds a layer that makes collaborative work much trickier, particularly when it's more complex topics."* (RK)**

On the contrary, most participants reported that the collaboration tools utilised within virtual environments makes collaborations easier and improves participation when performing ISD:

> ***"my developers on my team they're more likely to have these Zoom calls to discuss something or do a code review or something like that, or pair together."* (EK)**

> ***"I found that a lot of collaboration is much more visual which works a lot better for me because we have tools like Miro, it makes it a lot easier to represent like workflows and collaborate in real time on how information flows and that kind of thing in a visual way"* (SJN)**

> **"*there are tools that make it seamless, but I think without those tools it will be quite difficult to have like a collaborative environment. I think because you get everybody's input rather than having one individual sitting and writing down all the stickies,***

everybody contributes, and everybody has the ability to edit the sticky whenever they want, so it makes collaboration quite seamless." **(SM)**

It was also noted that virtuality makes collaboration across different time zones difficult, affecting the ISD process. One participant stated that:

"in my team I try to encourage a lot of high touch collaborations when I encourage people to pair and I encourage people to have calls to discuss issues. So which is why for instance, we have everybody in roughly the same time zone and I've never hired anyone who was very far away because I noticed that makes things a lot harder. If you work in settings where cross teams split from anywhere from Malaysia to Colombia, and that was really hard if you only can communicate through asynchronous means and text that is much harder." **(EK)**

On the contrary, most participants stated that virtuality enabled teams in different time zones to collaborate when performing ISD. Some participants stated:

" ***I feel like collaboration can be helped by it because it means that it could be asynchronous and what it means is that you can collaborate with people who are in different time zones or who are busy, so being able to like collaborate with people asynchronously is really a big advantage."*** **(IS)**

"the one big positive with collaboration is you're able to collaborate now with someone that sits in Berlin, you are able to collaborate with someone that's even in Joburg and where if you had people that worked in one office that might have been a voice that you lost completely and because people have a conscious mind to say oh, we're remote first, like we need to make sure that we're still inclusive with everybody else to be involved in collaboration." **(RP)**

Some participants pointed out that collaborating virtually makes it difficult to get immediate input or feedback thus affecting the ISD process:

> ***"…the only part that I find difficult is communicating urgency sometimes. It's difficult to work asynchronously, especially when you've got people in different time zones and things. It's sometimes hard to communicate that something needs to be done quickly while respecting that people have their own working hours and their own ways of working."*** **(SJN)**

> ***"…because people schedules kind of come full and people also have their own day-to-day activities, somebody needs to pick up the kids from school or whatever, you don't have that same kind of commitment to office time sometimes, so you can have an important conversation that gets pushed out a week, which eventually leads to development's delayed deliverables."*** **(JS)**

On the contrary, some participants argued that virtuality's asynchronous ways of working enables people to think solutions through and collaborate effectively to produce better ISD outcomes. One participant stated:

> ***"being remote has really helped me because I have the ability to take a moment, breathe, read something, articulated it, write it, whereas when you're in an office environment, it's like we've got to go and yeah, it's all of that too much."*** **(CL)**

It was stated that some measures that are being taken to address time zone-related matters in ISD includes setting out working hours, thus enabling team members to plan collaboration sessions in different time zones and cutting off unnecessary global meetings to have regional collaborative sessions thus ensuring ISD success.

> ***"Ensure availability via phone and Slack during our core hours (10 am to 4 pm in your local time zone). For anything urgent, we agree to phone each other, rather than sending a text message."*** **(RWG)**

> ***"certain meetings taking place when it's outside of their normal working hours. And so we're really trying as much as possible to move to what we've already limited as much as possible… so we've limited those global ones trying to rather have regional team***

meetings wherever it makes sense to, without completely losing that connection, though across the whole global team, because that would be a shame if we never engaged as a global team, but we just try to limit that and make sure it's quite targeted interactions." **(JP)**

Administrative overheads

It was noted by most participants that there are huge administrative overheads when collaborating virtually. Some of the participants stated that:

"I think in all senses it makes collaboration a little bit more difficult because it's more time consuming to set up meetings with someone and to organize time together." **(JS)**

"when you have to set up those meetings to collaborate with those people. It involves a lot of admin before you can actually get to the actual things that you want to talk to." **(KCM)**

" ***I think collaboration throughout the company is also very important and it's quite difficult because if you check someone's calendar and their calendars are filled with meetings, you don't really want to give people pressure, especially those outside of your team."*** **(NN)**

"for those that manage the calendars and things like that it is not easy. Generally, you are always stepping on toes because people always want their time." **(TH)**

It was also pointed out that some of the administrative overheads in virtual collaboration enable teams to work effectively and thus produce better ISD outcomes. One participant stated:

" ***Yes, it's just more time that goes into preparing things, but at the same time, it often means better outcomes, because if you have a meeting with an agenda or a deck that is talking through what you're doing and you're sending recordings in your follow ups, that has a very positive impact …"*** **(RK)**

4.3.4 Trusting

The below section will discuss the research findings on virtuality's influence on trust when performing ISD in a virtual context. Subthemes that emerged in the thematic analysis relating to trust will be outlined under the following sections: relationship building, honouring commitments, and active involvement.

Relationship building

It emerged that virtuality influences the process of building relationships thereby affecting trust as trust is strongly linked to team relationships. Almost all the participants reported that trust-building is longer in a virtual context as compared to collocated context and sometimes there is a false perception of availability of trust in a virtual context when in fact it is not there. Some participants stated:

> "***Virtuality slows down the process of building trust …"*** **(NN)**

> ***"Trust is built overtime and you will only go so far with me as far as you trust me and that takes time and I think the one thing with the virtual world is we think that trust is there when it isn't, we think that vulnerability is there when it isn't because we see into people's homes and we assume that because we have that we can suddenly be at a trust level that we're not."*** **(CL)**

Most participants further highlighted that the lack of visibility when operating virtually prolongs trust-building thereby affecting ISD. Some participants stated:

> ***"…when working in an in-person setting you can see that someone physically in the office […], you can see if they're busy, you can see that because you engage with them more directly, you get to know that person a lot faster based on the way that they communicate with you, engage with you, … you very quickly build up a relationship and as a result of that normally some sense of trust. When it comes to remote setting,***

obviously it takes longer to get to know someone because you're not interacting with them quite as much, and trust will naturally come through with the relationship…" **(JP)**

"I think maybe it's a little bit more difficult to learn about people when you're not in the same space as them, may be in an office you would walk and get coffee or have lunch with that person and learn about their life outside of work, and so I think that aspect maybe takes a bit more time when you're working remotely because you're not spending so much time in the same spot together. So, it I think it takes longer to build trust, It's not impossible though." **(SJN)**

"If you're working around people and if someone promised to do something… you always have the assurance because you can see what they're busy with, you can see that they are working on specifically what it is that they said they would be, or in some cases like that they are doing something about a certain issue at all. When it's done virtually, you don't know what a person is up to after the conversation is had." **(TKM)**

Another participant argued that virtuality improved trust by increasing a sense of blind trust: ***"I think it's improved. We now have a stronger sense of blind trust than we ever had before previously everything was taken with a 'Umm, I don't know, we'll see', now it's a Oh no, we trust you fully and if you prove us wrong then we will stop trusting you, but continuing to prove us right, we will keep our trust in you.' "*** **(TH)**

It was also noted that junior or new team members find it difficult to reach out for assistance virtually due to the difficulty in relationship-building which results in the development of trust. Some participants stated that:

"…some people are more shy to reach out to others especially if they're more junior and less experienced… It's probably easier to collocated space because there's a bit more trust going on if you see each other person to person." (**EK)**

> ***"I think there's always that bit of mistrust depending on whom you're dealing with. If it's somebody that you've dealt with before because you used to be in the office together and have interacted with certain people, I'm comfortable with those people because I know them but with the ones who are new, it sort of limits how much you say and what you say. So yeah, I think the trust part is not easy."*** **(KCM)**

As a result, ISD as a teamwork undertaking is negatively affected and there is great need for trust building to ensure ISD success as pointed out by another participant: ***"you need a new method of ensuring that the business outcomes are still achieved, and I think the pillars there for me are the trust, accountability..."*** **(TM)**

Ways of building trust within virtual ISD teams that emerged includes virtual agile practices such as daily scrum, retrospection sessions and regular online touchpoint meetings. One participant stated that:

> ***"The best way to build up trust is probably just through having regular touchpoints, having stand-ups to check in hopefully like if someone says they're going to get something done that they get it done. If they don't, they can let you know what the blockers were. The other things are definitely to have semi-regular like retrospection type sessions where you can kind of unpack issues over the last two weeks or the last sprint, those settings are generally more like informal and you kind of design to let off a bit of steam, so I think that's helpful and it does build some trust and it just fosters a good relationship."*** **(TT)**

Honouring commitments

In addition to relationship-building, most participants pointed out that honouring commitments when performing ISD is also important in fostering and earning trust when working in a virtual environment. It was stated that trust in a virtual setting is more based on delivering on agreed goals on time. Some participants stated that:

"There's this movement away from basing your trust on someone's presence, and it becomes much more outputs based ... it's rather about the outputs and are they achieving the goals that are necessary and within a reasonable timeline of expectation… If you're not seeing the results of somebody's work, it's difficult to start trusting them in a remote setting, I think." **(JP)**

"I think the work as well with the guys do speak for themselves, you know, because it can feel like you can get away with a lot of stuff but when it comes to delivering and you are not delivering, that's very evident. I guess trust is earned." **(SM)**

"If you're not hitting your goals, if you're not functioning at a high level, it's very quickly going to become obvious that you're a slacker, for instance. I think we're in a very interesting space.... So at the end of the day no matter where you are, it really does boil down to your outputs." **(RK)**

Virtuality therefore, pushes ISD professionals to be more responsible when performing their tasks and honouring their commitments to achieve goals thus ensuring ISD success. Some of the participants stated that:

"…the other point of building trust virtually is, if my pull request (PR) is open and you're a required reviewer and you haven't reviewed it for 3-4 hours, that's when you see this seems like where are you like? What're you doing? You know you have team members that are waiting on you. Can we chat about this? And that's also something that the team keeps each other accountable." **(RP)**

"…people constantly had to check up on you physically but now within the team as well there is that autonomy like you know I'm responsible for this, this person is responsible for this and they are certain people who depend on my work." **(KCM)**

> ***"Trust and reliability become more important. Let others know when you're going to get something done, and then stick to your word. Remote work falls apart when trust breaks down. If you can't deliver on time, communicate early and proactively."*** **(RWG)**

Active Involvement

Another trust-enhancing ingredient for successful ISD in a virtual context is active involvement. A few participants highlighted that virtuality increases the need for software developers to be actively involved in ISD activities such as brainstorming sessions and contributing in software development events such as pull requests in order for them to gain trust from their peers. One participant observed that:

> ***"…there's quite a few people that joined in the office for like two weeks and then they had to move virtually… it wasn't as easy as the people that already had settled relationships, they had to prove with PRs (Pull Request), they had to prove in sessions with their teams that they are there, they had to make a positive contribution and being responsive so this is a very big point that I saw within the engineering spaces so you don't have to keep your camera on in our brainstorming conversations, but voice your opinion, speak, add a sticky, use the tool that you were given, you don't have to speak the entire time, but just add a point that you'd like to make."*** **(RP)**

4.3.5 Knowing

This section will outline the research findings pertaining to knowledge gathering, sharing and utilization when performing ISD within a virtual context.

Knowledge gathering

Most participants stated that virtuality significantly improved knowledge gathering. Asynchronous ways of working forced all teams to improve knowledge documentation thus enhancing the process of ISD. Some participant stated:

> **"*I would say 80% of what we do is written down somewhere in one way, shape or form where there would be in a slack message and an email and that has to become just the way that we do things and this is really useful.*" (RK)**
>
> ***"…because we are remote first, we are forced to document a lot of things. Knowledge base is quite big at this company but everything is so well documented on Notion, our meetings have Google Docs attached to and it's quite elaborate."* (NN)**
>
> ***"…forces you to kind of commit things down to better formal documentation or recording or whatever. So you'd still be doing the same things, but there's a benefit that you might be able to pass on information that was disseminated in a meeting at a later point to others again."* (JS)**
>
> ***"virtually is quite good because there are certain things when you discover them you can make documents and then share those documents. So in terms of knowledge sharing and keeping up records it makes it easier so that a lot of people can have access."* (KCM)**

It was further noted that virtuality improved information organization and consistency as there is now an increase on reliance of documented knowledge. Some participants stated:

> **"*I do think that the way that we've organized information improved quite a lot in Notion. I feel like it was a bit sort of haphazard before, we didn't really have a very organized library of information."* (IS)**
>
> ***" in some instances because sometimes having to write something down like that helps really frame it and like drill down to what it is we're trying to do. It also creates consistency, which is helpful because everyone reading the same thing. If you think about our onboarding documentation, everyone reads the same thing."* (RK)**

Knowledge sharing

It has been noted that sudden creativity and innovation is affected by virtuality's influence on unplanned knowledge sharing. Some participants pointed out that:

> ***"You can't just over here somebody and say oh, they're doing something cool, I'm going to listen to them."*** **(IS)**

> ***"We don't have these moments of sudden creativity or accidental creativity because we're not bumping into each other at a water cooler, you know? So, our accidental innovation, 'Alright, I heard John say that, I should go over and talk to him, you know', that we don't have that anymore, I don't have that with the data team."*** **(CL)**

> ***"you can more easily refer to historical decisions and information and so on because it's recorded cause that's what ends up happening when you do, especially if you're moving towards more asynchronous working things are written down much more… I feel as though there is some impact on innovation and creativity."*** **(JP)**

Another participant argued that virtuality improves innovation and creativity. It was stated that:

> ***" this scenario working remote, having global team in a different part of the world forces us to think more creatively and be more efficient. In the office we became sort of accustomed to a certain way of working close each other and we got lazy in a way…. But now we are forced to think a bit further and come up with ways of working that will suit the global presence that we have but does not affect the quality… It's a challenge, but it brings up new ideas and new opportunities and new approaches, which is equally as important in the bigger scheme of things."*** **(CW)**

It emerged that virtuality enhances knowledge sharing by providing opportunities of knowledge sharing knowledge in both real time and non-real time via documentation. One participant stated that: **"*one thing that does help is all meetings are recorded and all of those meetings, then put on Google Drive so we can all revisit those meetings. If for me it helped a lot"*** **(TKM)**. Some

participants further noted that virtuality opens up access to knowledge sharing which essential to ISD:

> ***"if someone giving you a lunch and learn, all you have to do is turn on zoom and you're there. You don't have to like you know pack up your computer, close your work and walk over to a meeting room and sit down so it makes it a lot more accessible. And also the fact that we always record these things means that we can attend them virtually at a different time."*** **(IS)**

> ***"Systems and platforms and workflows need to be documented so that someone has ease of access. And I think that ease of access and being unblocked, you know without needing to go and speak to anyone else has kind of allowed us to improve to a much higher standard than it was before remote work."*** **(TM)**

> ***"We do have tea and learns very quickly; we have tech demos across the board that people can ask more technical specific questions…"*** **(RP)**

It emerged that knowledge sharing through training is difficult in virtual context. One participant stated that the virtual context: ***"makes more difficult to train, again in close contact it's easy and whether you sit in Bangkok or Gauteng…"*** **(CW)**

A few participants argued that virtuality enhances knowledge sharing through creation and sharing of training materials, and provides ISD team a platform to provide the right feedback on ISD processes:

> ***"…let's say you've got training for new collectors for example and then there's another group which is going to come, you can sort of create a video of the first meeting and then share that with the second group. So I think in a way it sort of speeds up the process and makes it easier in terms of knowledge sharing."*** **(KCM)**

> ***"… we're documenting only the important things and if you think about it, if someone new joins you're going to have to sit with that person anyway to show them the ropes and***

it would be easier so it takes work away, you are making that effort now but in the long run will take hours out of your day if you're going to have to go through an onboarding with someone and explain something to them if like something in the code that they don't understand and if it's already documented, it's easier for them to go and open a document and go through that document." **(NN)**

"…on the knowledge sharing we have RFC's (Request for comments) document, it's just a document confirming processes, the architecture, the possible designs, implications and you have reviewers of the document and people that need to sign up and say yes, we are in agreement on this or we need to update some of these things so it's a compiled way. It's a more structured way instead of just pasting things in a confluence document and never touching it again and so you're more persistent in getting the right feedback, and it's something that gets shared widely, it should not be shared between two people and they are quite a few rules that the team has for them." **(RP)**

Further, one participant pointed out that the capabilities in virtual communication tools remove language barriers during knowledge sharing thus encouraging teamwork within diverse ISD teams:

"… also the fact that we always record these things means that we can attend them virtually at a different time and a third thing that's actually been very useful when it comes to knowledge sharing is the translations function in Zoom, so something that we've been doing quite a lot because we're working in multiple languages ,one of the things that we do is we actually get translators and Zoom has a great function where you can have the translator translate in real time, and so if you speak English you can select English on zoom and you can listen to somebody in Spanish and hear English and so in a lot wouldn't be able to do that if **collocated." (IS)**

Knowledge utilization

Most participants agreed that regardless of the availability and easy access of knowledge, there is a major challenge in knowledge utilization when performing ISD virtually. One participant stated:

> ***"I would put utilization underneath 50% … utilization is poor, but the knowledgebase is there and the hunger for knowledge is there. It's just because we're trying to be all-inclusive and be in all our meetings and we just don't have the time to ingest and output as a normal developer and from a leadership standpoint, we don't."*** **(TH)**

Some of the factors that affect knowledge utilization relates to knowledge discoverability and knowledge maintenance. Some participants stated that:

> ***"I think discoverability of information can be hard… I don't really know a lot of the time where to find some information because I feel like there's so much information that I don't know where to go so in that sense, I think it is a bit harder."*** **(IS)**

> ***"and also that documentation is not always up to date, and that's also just another major struggle like are we giving people the right things to read. Is it still relevant? We as a company change things every two minutes, every quarter we are restructuring which is really hard to keep things up to date."*** **(RK)**

4.3.6 Dealing with Challenges

The section will outline research findings on ways of dealing with challenges when performing ISD in a virtual context. The identified ways of dealing with challenges include measures such as adding human social connections, and prioritising employee wellness.

By strengthening social fabric

The process of performing ISD requires teamwork and social fabric is essential when dealing with challenges as stated by one participant:

> ***"information systems development is a team sport… the social fabric underpins the team dynamic in the sense that when people have a sense of camaraderie, they see themselves as humans first, friends first, then colleagues later. It does kind of create a harmony and a way of dealing with challenges in a way that we are a collective, we as a collective need to succeed …"*** **(TM)**

Without the social fabric in virtual working, people will feel overwhelmed and challenges of working in silos can be observed thus impacting ISD. One participant stated: ***"I think at times you might feel like virtually you don't have communication with other teams, at times you might feel like you're working in silos, and it gets frustrating and at times you're not sure if there's help when you are being overwhelmed. So I think there's there need to be a bit of human feeling in everything as much as everything is virtual and we are using technology."*** **(KCM)**

Some of the ways that emerged in relation to building a social fabric virtually includes virtual social activities such as cooking classes, and game nights. When collocated, these activities were practically impossible to conduct, but because now, it's easily doable.

> ***"In a virtual setting we have to create those spaces where people could be comfortable just chatting otherwise there will be no connection made and we have these games nights and cooking classes …"*** **(EK)**

> ***"… we have focused on building a culture that is collaborative, communicative, fun, silly sometimes, you know, we do cooking classes. I love those sorts of things…"*** **(RK)**

Virtuality brings flexibility to how an organization functions that accommodates socializing such as coworking in coffee shops where team members or leaders can share challenges openly thereby providing opportunities to find ways of dealing with those issues to ensure successful ISD.

> ***"I work with a team member closely and we went for coffee the other day, we had like coworking day and at that coworking day when she spoke to me face-to-face she told me a whole lot of things about what she's struggling with… She never would have said it on a Zoom call."*** **(RK)**

> ***"…something that I'm very conscious as a manager in my team is to create this kind of a safer space where people feel that they can open up and share."*** **(EK)**

By prioritising employee wellness

Major challenges relating to employee wellness encountered by most participants when performing ISD virtually are of a physical and psychological nature such as fatigue, developer burn-out, etc. Some participants stated:

> ***"…people are already struggling with the cognitive load and the workload…"*** **(RP)**

> ***"There's a strong sense of meeting fatigue. I think that with agile development there's a lot of ceremonies, you know, you have stand-ups, you have retros, you have planning, you have backlog grooming, so you have all these ceremonies and I hear a lot from people like oh, do I really need to be there? I've been in like so many hours of meetings already today. So, I feel like that is a big problem. Online meetings are more tiring as you have to concentrate a lot more to hear what people are saying."*** **(IS)**

Wellness challenges are not easily identifiable in a virtual context thus requiring intentionalism on both company and individual front. Some participants stated:

> ***" one of the big challenges are while you're sitting across a person in an office, you can see where there are high tension conversations you can pick up if this person is not 100% ok, you don't spot fatigue, almost burn out as quickly as you do physically, as you do virtually."*** **(RP)**
>
> ***"…you kind of relying on people to report when they're not feeling good, you can't just see it…"*** **(IS)**

It emerged that virtuality pushes companies to focus more on employee wellness by being more understanding and not output-focused. One participant stated:

> ***"… Seniors are now more open to go "no you need time, you need to take some human time for yourself, we understand the delays" before it used to be, "but we have a deadline, we need to push our deadline. It's a very commutative effort where everybody is talking to each other."*** **(TH)**

Provision of time and space to address employee wellness related matters has also been incorporated into day-to-day ways of working because of virtuality as noted by many participants.

> **"*Check-in with your team members regularly to ensure they are doing ok. Remind them (and yourself) to make sure we're working in a way that is kind to your body - don't spend all day hunched over a stool at the kitchen counter, take regular breaks, and make sure to stretch!"* (RWG)**
>
> ***"…with intentionality in giving people that time, if people know, hey, I can quickly set this up with you for an hour to talk about a few things and you make them feel good or you make them feel safe. They can share openly and honestly about some of their frustrations, some of their concerns about systems, some of their concerns around the process itself. … this is something that I do, and the virtual space allows you to do that with a lot more people, and because you don't have that three hour gap, you don't have to drive somewhere to get someone, you don't have to be like I need to leave now."* (RP)**
>
> ***"…we do offer flexible working. I think that benefits a lot of people in terms of better supporting their wellness, it means that they can choose a time that suits them to spend time with family or they can dedicate time to outdoor activities and so on that it can lead to a healthier lifestyle…"* (JP)**
>
> ***"part of what we do now is we ask everybody in the morning just to give a rating or at least weekly. How is your week been? Just so we understand if you've had four really bad weeks, chances are you need a break. If you've had three really rough weeks, please take your leave. You need some time. You need to decompress."* (TH)**
>
> ***"… working remotely frees you up in so many different ways to be happier, healthier… I can manage my time myself if I need a break, I can go for a walk outside…"* (RK)**

Another participant highlighted that it can be a challenge and will take time for team members to open up virtually in those spaces: ***"…some people are more vulnerable in one-on-one and other***

people it's a different space but as you work with someone, you build empathy and overtime it becomes easier. So, I think it's more difficult with virtuality perhaps, but you still reach it." **(JS)** It was also stated that online therapy sessions have also been incorporated into workdays to ensure the wellness of employees.

> ***"… we try to do psychological therapy and it helps. Virtually you can say I'm taking a few minutes or few hours off so that you can sort of rest, find yourself and meditate if you want to, so being given that space as well does help instead of like sitting in front of a computer for the whole day."*** **(KCM)**

> ***"Tuesday mornings I sometimes use to do my therapy and that's fine, but everybody knows I'm not available then, so they don't really book meetings in there."*** **(CW)**

4.3.7 Developing with Agility

This section sets out the research findings pertaining to developing with agility in a virtual context. It will discuss championing early and continuous development, encouraging self- organization and providing a conducive environment.

Championing early and continuous software delivery

It emerged that virtuality cuts down software delivery times. Faster delivery times are due to factors such as cross-team collaboration, and faster adoption of productivity tools. One participant stated:

> ***"I think when I look at our company a year or two ago, we were shipping at a slower pace than we are today… I think the combination of heightened cross-functional collaboration, fewer distractions might be leading to us being able to ship faster […] there's probably been faster adoption now of agile tools than there was previously because we now don't have the benefit of having a physical stand up at 9:00 AM in the morning where we all stand around the board with our coffee and talk about what you did the day before and what you're going to do now. So, there's been an increased adoption of digital tools for Agile workflows…"*** **(TM)**

The increase in the adoption of asynchronous digital tools for agile workflows, therefore, improves faster delivery times as developers and other divisions can collaborate and deliver at any time outside the traditional office working hours as well as involve other stakeholders easily in some of the development processes virtually. Some participants stated:

> ***"I think that's Agile does work well with doing smaller and more asynchronous chunks of work where you have kind of continuous small changes that you're working on…"*** **(JS)**
>
> ***"…the main touch points or things like stakeholder reviews obviously is now online whereas before it was in-person, so I think that may be in some ways it's easier for people to join…"*** **(TT)**

> ***"I think we've become a lot more action-orientated than research was previously. You know prior to two years ago, because I think there's a shorter loop now because everything is virtual there's a shorter loop between doing the work and making decisions about the work because everyone just jumps on a call, makes a decision, and goes, which is really helpful."*** **(CL)**

On the contrary, some participants were of the view that there are inefficiencies in ISD in a virtual context due to the structuredness of asynchronous communication making developers shy away from asking for help.

> ***"I do think that there's a certain productivity inefficiency that comes from remote working because things are a bit more structured…"*** **(JP)**

> ***"I think maybe sometimes people take a little bit longer to ask for help. In some situations, especially for like developers, if they're stuck on a problem, I think sometimes they're a bit more hesitant to interrupt somebody else is work I've got a sense that when I was in an office it was easier to walk over to someone and say hey, do you have time to help me with this? Whereas I think because we're a little bit more isolated when we're working remotely when you when you need to ask for help, you feel a little bit like you're***

invading my personal space or time, or bubble and you know so, maybe there's a little bit more time spent trying to figure out problems by yourself when you could just ask for help." **(SJN)**

Another participant also added that agile software development in a virtual context can be slowed down by, for example, unavailability of a team member when needed due to the virtuality's flexibility nature. One participant stated:

"…you don't have that same kind of commitment to office time sometimes, so you can have an important conversation that gets pushed out a week, which eventually leads to development's delayed deliverables." **(JS)**

When it comes to teamwork, it was noted that the reduction of social fabric due to virtuality can cause negative results in the processes of performing ISD. It was stated that:

"…in the field of software development that is a traditional, a culture that was very dominant in previous times, where you've got hero developers, cowboy developers, guys and girls for that matter who feel like they can go it alone. So without the social aspect there's a tendency to kind of go back to such norms, and it obviously impacts the quality and speed that you can move that." **(TM)**

Another participant pointed out that agile roles assist in removing team-related impediments thereby enabling faster and continuous ISD delivery.

"Agile is helpful and the different roles that involved are helpful… there's Scrum Master roles are helpful, I think having those people to be the grease in the cogs keeping things going is very helpful, especially when there are challenges or like somebody is not able to contribute as much as they would like, you can kind of like bring in the like Scrum Masters to help and can definitely help with facilitating retrospective sessions." **(TT)**

A few of the participants were of the view that virtuality does not influence a lot in agile software development as all agile ceremonies can be conducted online. One participant stated: ***"I don't think it influences a lot, which was surprising to me because I always thought that agile***

processes really need to be in person, but you can transfer them pretty much one-on-one into Zoom calls and they were still work pretty well, including the obscure ones, even pairing works pretty well in my team…" **(EK).** Another participant further pointed out that there is a reduction of time wastage in some of those ceremonies due to virtuality: ***"…we still we do two-week sprints which is the same as I've used to come, we probably spend less time and something like backlog refinement because a lot of the work can be done asynchronously…"*** **(SJN)**

Encouraging Self-Organization

Encouraging self-organization is critical for agile software development in a virtual context where there is limited visibility. Virtuality encourages self-organization in teams and individuals.

It emerged that decision-making largely shifted from being driven by leaders, a tendency usually found in collocated environment to being made by the ISD team. This push was encouraged by virtuality as stated by some participants.

> ***"So we'll have a cycle zero or a first point of contact with the team members in the team, our product owners or managers at Scrum Masters, our stakeholders, and the first question be there is what do we want out of this? Are we boxing to a time frame? Or are we boxing to outcomes? And part of Agile it used to be one thing we've got a time box to achieve this outcome. Now it's no longer up to us to decide. It's up to team members to decide when is that outcome going to be delivered."*** **(TH)**

Another participant pointed out that the people performing ISD were empowered by virtuality to voice opinions, concerns and decide their preferred ways of working.

> ***"…the teams adapted because we had the right people that had enough gumption, enough drive to change the process, we became more iterative…we have people pushing back for the first time. People speaking up, saying, hey, I don't like this like this, change it and we changed it and even though some of the processes that we've changed, I didn't agree with it to be changed but the team needed to change…"*** **(RP)**

Furthermore, the company encourages self-organization as itself had been adaptable due to the shift to virtual operations. The company's values document states that: ***"I take ownership and I support ownership in others. I will never knowingly let my team down."*** **(CVD)** and some participants stated:

> ***"…we are working remote we're not that strict on the times and things like that of what time you log on and it's quite flexible, remote work does open up like working at the time that you are most productive."*** **(NN)**

> ***"we do offer flexible working…for example, one of the questions I asked most of my new team members once they join is, when do you when are you at your most productive? Are you someone who's better in the mornings and the evenings, what suits you? and then allowing them to take as much as possible work within that time frame so that flexible working that can come more often with remote working than in person working."*** **(JP)**

Almost all participants pointed out that individuals are also encouraged to self-organize when performing ISD virtually to ensure success as there is less micromanagement from team leads.

> ***"…one of the most major good thing of not going to an office is I can wake up early and plan my day accordingly before I can sort of proceed."*** **(KCM)**

> ***"Empower team leads and team members to say NO to meetings that they do not feel fits in with their responsibilities."*** **(RWG)**

> ***"…we are relying on people to manage their own time."*** **(IS)**

> ***"I'm pretty good at managing my time in that way, and I'm also pretty good at saying about 10:00 o'clock meeting tonight. I'm going to take a two hour lunch for instance, so there's a balance there."*** **(RK)**

> ***"So, if you don't adapt to virtuality, you won't become agile because you need to be adaptive, you need to change quickly you need to help your teams with change, the biggest thing there is. You as a person and then it's not just the process then you as the agile human being or representative of agile need to be agile. You need to be the one that's ready to jump in to support your team. Your team will only trust the process as if they can see it's worked at some points it might not fully be everywhere but the that we're ready to pivot when we need to pivot."*** **(RP)**

This self-organization encouraged growth in personal and team development within ISD. One participant stated: ***"…it has given them ownership of their pieces of work. It's also giving them the opportunity to grow where they need it and also stick their arm off for help."*** **(TH)**

Providing a conducive Environment

Some of the participants highlighted that the environment for agile development was already conducive: ***"We could work from home already because we had all of our development environment setup on our laptops, so the change is not that radical…"*** **(IS**). Another participant further pointed out that even though the tools are available, there is a need of providing training for successful agile development virtually: ***"… we had the tools, but we didn't know how to use them as yet…The big room still exist, Zoom is very accommodating, Skype is accommodating, Teams is accommodating to it…"*** **(TH)**

Another important component for successful agile development in a virtual context relates to trust and accountability.

> ***"you want to foster a culture of trust and accountability because those are the things that are going to ensure that work will still happen. If you don't have trust and accountability, then how are you going to prevent people waking up, picking up work items on Azure DevOps and then slacking off the rest of the day on Netflix, because now there are no safeguards."*** **(TM)**

***"I am accountable for my own work."* (CVD)**

***"…now within the team as well there is that autonomy like you know I'm responsible for this, this person is responsible for this and they are certain people who depend on my work."* (KCM)**

It emerged that conducive environment for agile software development in a virtual context also includes the right human capital. Most participants agreed that virtuality makes it possible to get the right ISD professionals for the job.

***"…for me, the big one is like interviewing people, we just got too much a wider range of people we can pull from."* (TT)**

***"for me one of the key benefits of going for the remote is the ability to tap into a much wider talent pool of people. Definitely one of the benefits is that you're no longer restricted to where someone is geographically based, and that means that you can really make a point of truth finding the right candidate for the role and getting the best out of the best candidate as possible."* (JP)**

***"Virtuality allows you to have people from a broader geographic area so there is more of that type of talent that you're looking for that's available."* (JS)**

Some participants pointed out that virtuality's flexibility provides a conducive environment for creativity in how agile software development is conducted that brings efficiency and effectiveness to software development. Some participants noted:

***"I think we are more creative in a lot of the ceremonies because we have a lot of tools at our disposal, we don't just go into the same meeting room every time and follow the same process, write things down on a whiteboard. We often do things more visually in Miro and so we have an opportunity to change things up a bit."* (SJN)**

> ***"…the idea was it was flexible, but the truth of the matter was everything taught wasn't. Now I can honestly say, and I feel like you feel the same way, it is flexible and it has to be flexible. Otherwise, it just doesn't work. There's no point in having this meeting for meeting's sake. What's the outcome?"*** **(TH)**

Another participant argued that virtuality takes team fun out of agile development ceremonies. Fun activities improve team cohesion thus affecting how agile software development plays out virtually:

> ***"…I think if we had to maybe do a retrospectives in person, it would be better because then you can in the same room with people do trust building activities like throwing a ball to someone and things like that during a retrospective session is just more fun, I think virtuality takes away the fun aspect of working, it's quite isolating if you are working alone."*** **(NN)**

4.3.8 Assessing Achievements

This section sets out the research findings on the assessment of ISD achievements within a virtual context. Subthemes that will be discussed are ensuring quality output, tracking ISD progress, and celebrating achievements.

Quality assurance

Some participants pointed out that ensuring quality conformance and maintenance is difficult in a virtual environment. One participant stated: ***"we need to work harder to ensure we maintain the data quality and the conformance to the standards that we set ourselves."*** **(CW)**

It emerged that in a virtual context, user experiences can be incorrectly curated or moderated by the user, and in some cases quality checks such as context can be omitted or missed thereby providing incorrect data to the ISD process and consequently resulting in incorrect ISD outcomes. Many participants stated that:

"… we would have had them in a physical workshop, and this has been both very opening for us. We get to be in people's homes every single time we talked to them, whereas before you might have seen them in a workshop space …, but on the other hand, it's quite difficult to really understand what's going on because they can moderate that experience, right? They can curate an experience for you, so what's been a challenge is how much of the experiences curated." **(CL)**

"in terms of quality checks certainly one thing that does make it challenging is if you're not physically in the same city and you don't get to learn about the context so much directly yourself, you are much more reliant on those in that city would be sharing with you that context so that you can better assess the quality of the data being produced and that's quite tricky, because for a lot of people who are from that city and based in that city, there are certain things that are just normal to them that they won't feel the need to raise, it doesn't even occur to them that this is something that's quite unique or specific to that city. Whereas it would be something incredibly valuable for those of us not based there to be aware of because it can influence the way that we look at the data." **(JP)**

"we're building a product that doesn't apply to anyone where any of our core development team lives, none of our development team lives in Mexico, none of our developments even lives in Bangkok, so we can't just go out and take bus and we don't just use it in our day-to-day life… if you can't experience your own app and it's in your own context, then you're not really going to understand it." **(IS)**

Another participant argued that due to virtuality, the overall quality of ISD outputs has significantly improved due to factors such as embracing delays, better testing lines, emerging quality assurance roles. The participant stated:

"…we've improved quality as a whole, output quality has been improved because we are willing to have the difficult conversation now of delaying things, it's fine to delay, it's fine to wait if it's not ready yet... Now we're getting feedback because we're pushing it internally and beta testing lines, we get everything we need to make sure quality is there.

We also have dedicated roles now, remote quality assurance, or external quality assurance where you just get an end-product and make sure you can try break it as much as you want then you tell us where it's broken. These roles didn't exist, they do now..." **(TH)**

Progress tracking

Tracking ISD progress and outcomes has always been happening via the utilisation of technology tools in both collocated and virtual contexts. A few participants pointed out that there are improvements in the tracking process due to enhanced visibility and measurement features in technological tools because of virtuality. Some participants stated:

"…in most of our development situations, we have some form of tracking tools, and we always have for the past I think ten years used some form of tools to track tasks, how we manage our progress, the burn down of work, things like that. All of these has been tracked through a tool. Now it's just been massively improved on, so it's easier to read, it's easier to manage." **(TH)**

"…we make use of a lot of technology, and everything is measured, even the workload that you have, is measured. There are deadlines which are set and then you do get reminders if you're sort of falling behind, or you can sort of create your own timeline based on the deadline that you've been given. I think in that part is there's been improvement because there is visibility and then you can sort of understand the workload that we have and other activities that are falling behind…" **(KCM)**

"You're able to build metrics clearly, you're able to improve on what you've seen, you're able to share dashboards a lot faster on some of the outcomes of what we've experienced or what we've achieved instantly." **(RP)**

A few participants argued that low adoption of these technological tracking tools when working virtually makes the progress tracking progress difficult in a virtual context. It was reported that team members do not give feedback efficiently even when they have those technological tools

available thereby requiring leaders to do extra person to person follow ups to get project updates. Some participants stated:

> ***"We can spend hours building ClickUP and Gantt charts and assigning tasks, and no one looks at it and you have to follow up with everyone individually and be like 'have you done this thing and go and tick it off and make sure it's done and make sure the project is moving forward' and these are real challenge around the feedback mechanism of getting things done and marking and also knowing when things are blocked and when things are stuck and we've tried a lot of different software, Personally, I haven't found a software that's actually helped us with that problem, my approach to it is talk to the people, follow them up."*** **(RK)**

> ***"if I'm in the same physical office as my team inevitably every day I'll be touching base with each of them, 'how's it going? what he's struggling with? How you're progressing with stuff?', Whereas in a remote setting I'm not going to, it's a lot more of a hack to go around everyone check how you are doing, how are things going..."*** **(JP)**

Celebrating outcomes

It emerged that the culture of celebrating ISD success is affected when operating virtually. ISD outcomes are celebrated virtually using emojis and text message. Without those celebrations, team motivation and cohesion get affected resulting in poor team performance. It was also noted that embracing of failures online is also reduced to emojis. Opportunities to reflect and learn from failures are affected when operating within a virtual context. Some participants pointed out that:

> ***"Celebrating wins and building a company culture that celebrates wins is really difficult online, to give you an example…we launched a product and it's on the market for a whole year, that's something to celebrate, well-done everyone, but we didn't get to celebrate it, celebration was a message on a companywide Slack channel and that was it with a bunch of emojis attached to it… and I think it can have an impact on morale and general team cohesion."*** **(RK)**

"I would say this is probably one of our major downfall. In an old era, we used to celebrate things. Everything used to be celebrated in a very big way. 'Hey everyone, we launched in Lima. Let's go have a big party… now everybody sends an emoji, that is it, so we've lost the whole celebrating our victories to a degree. We've also in our losses, we also just add a tear icon, add a sad face. Oh, that's so sad, moving on. We've lost the point of making sure we have the big highs, and the low lows and making sure we embrace them." **(TH)**

4.3.9 Enacting Virtuality

The below section will discuss findings relating to enacting virtuality in ISD. Subthemes that emerged from data analysis are: 1) Virtual culture; 2) Technological infrastructure; 3) Online productivity tools, and 4) Cyber security.

Virtual culture

It emerged that virtuality has a strong effect on company culture. Virtuality takes away natural in-person social elements that are crucial in building remote cultures. One participant pointed out that:

"Building a remote culture is very different to building an in-office culture. Some examples could be like having a drink on the rooftop Friday afternoon …or seeing someone is visibly upset and going up to them and saying, 'let's talk about this', these are all things built into the culture and if you think of company culture as this is the way we do things around here, how you would do things remotely and how you would do things in an office are vastly different." **(RK)**

Another participant argued that it's possible to create a remote culture through virtual social interactions, but deliberate effort should be applied when doing so.

"In a virtual setting we have to create those spaces where people could be comfortable just chatting otherwise there will be no connection made and we have these games nights and cooking classes which I think really add to the culture and that's something that has to be managed very deliberately…" **(EK)**

Furthermore, some participant highlighted the risk of an always-on culture within the virtual context whereby ISD professionally can't disconnect from technology, resulting in health risks that will consequently negatively impact ISD.

> ***"I think the only pressing thing that would be raised here is the culture of I'm always available or I always need to be connected. I've seen my perspective, at least with my team members and part of my team. I've seen people panic when they are not connected. I've seen them actually go. I need an Internet connection to just make sure, I just want to double check, I just need to... and it's becoming sort of to the borderline point of obsession, and we haven't answered the question yet of how do we make sure we have healthy disconnect?"*** **(TH)**

> ***"There is a strong problem with burnout from people because of virtuality they are always on. I've got Slack on my phone; I can be contacted day and night ... I'm available 24/7. I mean, it's honestly happened a lot that I've woken up in the middle of the night, and I've seen that there's a message on Slack and I've answered it at like 2:00 AM and it happens a lot. I feel like when you're working from home, it's much harder to unplug"*** **(IS)**

Technology infrastructure

All participants agreed that technological infrastructure is integral for any virtual work including ISD. Without the technological infrastructure, there is no virtual work as everything happens online. One participant stated: ***"…the fact is that everything is online… you also rely on internet connection…"*** **(SM)**

Virtuality pushes ISD organizations to make the shift to full remote mode. It emerged that the bigger part of technology infrastructure has already been conducive and ISD was already happening virtually even when ISD teams were still collocated with other departments. Virtuality, however, opened technological infrastructure to other business units and made collaboration with ISD teams more effective. A few participants stated:

***"…the way we are working now is ideally the way we would have been working twenty years pre-covid, that was a twenty-year plan which is, people would be working from home, you would have the infrastructure, there would be no location unless specifically requested …. So Covid 19 has broadened the fact that we have the infrastructure, that's what we've been developing. So, virtuality, was the next step, we were just too hesitant to take that step. If you look at the way we've structured our companies, everybody is international, all of our meetings, even though we were collocated were already taking place on online platforms such as teams or Skype … even though we could have one person next to us because we are on international basis, we always look to have it as all-inclusive. So, we already took the first step. It just so happened that this was the catalyst we needed, and companies made the correct decision in moving to a pure remote basis…"* (TH)**

***"We could work from home already because we had all of our development environment setup on our laptops, so the change is not that radical. Most of the stuff was already virtual way before we were virtual it wasn't really that much of a switch…"* (IS)**

Almost all participants pointed out that the technological infrastructure affects performing ISD in a virtual context. For example, internet connectivity and electricity issues have been highlighted as major challenges affecting ISD. Many participants stated:

***"…I've personally had it where my internet died, my hotspot didn't work, I could do nothing… so it becomes more costly if you lose people during a call and having key players have internet problems."* (RP)**

***"… an issue of internet connection, we are diverse group of people, and we are in different areas, certain areas are not serviced, there are certain things which are beyond companies when it comes to internet connection or lines depends on government for example and should be considered."* (KCM)**

"working with Mexico, Peru, Bangkok and South Africa even I think that we all are emerging markets, and we know that our Internet connection it's not going to be the best or from time to time we won't be having electricity…" **(LR)**

"*Internet connectivity is honestly not quite there yet; I feel like we still struggle a lot with people not having good connections…I actually feel like the actual infrastructure isn't good enough."* **(IS)**

"When you are having a meeting in person you can easily bounce off ideas and… your Internet drops and then or there's a lag." **(NN)**

"… computers can fail, infrastructure can fail. So dictating load shedding has not been easy. Trying to mitigate your fibre has gone down has not been easy." **(TH)**

Another important technological component that is being impacted by virtuality when performing ISD is the hardware infrastructure. One participant stated: **"*…the hardware also got a long way to come… I've got a decent laptop, a dev spec laptop, it's 8 gigabytes of RAM, it's pretty good but it struggles with Miro board"*** **(IS)**. In a collocated space, whiteboards, and other visualization tools for activities such as ideation or brainstorming were physically available to everyone but because all these platforms are now digital, more hardware resources are now required. A few participants stated:

"I wish I could have a little white board that I could like draw and writes with a computer to get what's in my head in a scribble in front of the people that I'm trying to talk to you. Right now, the only thing I have is Miro and I'm using a mouse click to kind of draw boxes and it's just not efficient or fast enough for, you know." **(RK)**

"I think that if we all had like some kind of digitizer pad so that we could draw more…I think do make a massive difference, so yeah… the hardware is also got a long way to come." **(IS)**

"…if you have one screen, I've been very honest, worst experience for me was to facilitate a session … I need to know is there enough engagement, are the right people still participating or the right people speaking up and you don't always have that if you only have one screen… that's also very important part of the tools that you have set up at your home." **(RP)**

Online productivity tools

It also emerged that virtuality necessitates the need of online productivity tools. One participant stated: ***"obviously with the move from being in office to being fully remote, I think we've had to look to other tools and other platforms to allow us to communicate, and work together effectively, so I'd say the first impact is obviously that"*** **(TT)**. These productivity tools comprise of communication, collaboration, project or task management and knowledge sharing tools for both synchronous and asynchronous virtual ways of working which facilitate effective and efficient ISD delivery virtually.

Communication tools and platforms that emerged include Slack, Zoom, Google Workspace, Notion, WhatsApp, Signal, Facebook, and Twitter.

"…mostly Slack is the number one, then Zoom for face calls." **(EK)**

"…we probably have six or seven communication apps, you know, we have Facebook, WhatsApp, Twitter, Signal because you just don't know how people will want to reach out to you and being available to them is the biggest thing." **(CL)**

"…***meetings happen through Zoom, Slack is the messaging, we've got emails then we've got G Suite…"*** **(JP)**

Collaboration tools identified consist of Miro whiteboard, Gather, and Google Jamboard.

"… when we collaborate in real time, things like Miro Board, Google Jamboard are on the right track…we need shared workspaces like that…." **(IS)**

***"…we've got Miro for whiteboard…"* (JP)**

***"…Miro and Gather.io, these tools are all out there. I think there's more to come I'm sure…"* (TT)**

Some of the project management tools that emerged include ClickUP, Azure DevOps, and Jira.

***"… we all use ClickUP a lot which is project management tool…"* (EK)**

***"… then we have Click up for project management…"* (JP)**

***"You obviously need something for tracking work items…having a Kanban board, whether it's like Azure DevOPS or whether it's ClickUP or some other tool like JIRA…"* (TT)**

Knowledge repository tools include Notion and Google Docs.

***"…if we look at all the different tools and platforms that we use at the moment, they each serve their purpose very well…then we have Notion for wiki…"* (JP)**

***"… make sure the tools are there… Notion as well for knowledge sharing…"* (TT)**

***"Google Docs that we also use is an amazing tool, because it encourages people to leave comments…"* (RP)**

Some participants pointed out that most of these tools and platforms, were already being utilized to some extent in collocated environments but due to virtuality, ISD teams are forced to be reliant on those tools and platforms to a greater extent for everyday use. Some participants stated:

***"…from the code side of things you obviously want to be using repository management tools like Git. I'd say it's like, a non-negotiable. I think that we would use it anyway, but if you're working remotely, then yeah, that's kind of you can't go without it"* (TT)**

"…when we were sitting in the office, I was still using project management tools. They're still valuable things because we still work on computers, that being said, I think

we're more reliant on them in a fully remote space and we are forced to be reliant on them" **(RK)**

In addition to virtuality's influence in relation to the reliance on technological tools, the rising use of productivity tools within ISD results in increased user feedback on the actual tools, which consequently improve the development of those tools. One participants pointed out that:

"The software definitely has a hell of a long way to come, and the people who make the software need to get out of their own way a little bit and just go back to the basics of what people are trying to achieve with collaborative, remote working and just simplify because at the moment it's just way too complicated […] I feel like Zoom is really focused on a lot of fluff features like virtual backgrounds and all this kind of stuff, whereas I first think they should be working on performance and usability." **(IS)**

Some participants reported some challenges associated with productivity tools and the utilization thereof, which affects the processes of performing of ISD virtually. These challenges include segregation of productivity tools within the same organization, tool functionality, tool adoption challenges and cyber security.

On segregation of productivity tools, some participants felt that there is a segregation of productivity tools within various departments and some serving the same purpose for example the use of Notion and Google drive for knowledge sharing or Zoom and Slack huddles functionality for calls. Some participants stated:

"… there isn't one size fits all for an organization, and it can often be difficult to find a software that works appropriately across teams that's built for what we are supposed to be doing." **(RK)**

"…if we look at all the different tools and platforms that we use at the moment, … What a wonderful world it would be if we had something that was more consolidated, integrated that brought all these different functionalities and features together…" **(JP)**

Some functionality related issues affecting ISD include things like audio-visual, and time-wasting features. Some participants stated:

> ***"…sometimes there's a lag and sometimes people's sound isn't working…"*** **(SJN)**

> ***"…the tools are not really geared for like everyday work, like with Miro, they're constantly giving me tips like highlighting changes, there's all this stuff in the way that I have to get through before I can actually work..."*** **(IS)**

On tool adoption challenges, A few participants reported that it takes more time to learn the tools.

> ***"the usability isn't always easy especially if you're not used to it … and that's a big thing across the board with even senior developers having to use a tool for the first time and there's no description or very quick intro it's not going to be helpful."*** **(RP)**

> ***"it does take some time to especially when people first joined to learn the tools, and maybe because we rely more heavily on some of these tools. It does add time"*** **(SJN)**

Furthermore, few participants pointed out that virtuality forces the adoption and utilization of productivity tools

> **"*…with the remote working approach, we definitely gonna all have to be used to them and be used to like just figuring that out."* (TT)**

> ***"… they're effective because we have to make them effective. If we could be in a room together with the whiteboard, maybe we would be more effective, but we've never had that opportunity and we're not going to let it stop us…"*** **(RK).**

On cybersecurity, it emerged that the use of online tools to facilitate ISD in a virtual context adds extra layers of protection such as security compliance, additional security features and policies to safeguard against cyber-attacks. Some participants noted:

"…there's something you are at the heart of this is GDPR and keeping our participants safe…There's always 3 rules. Protect the participant. Protect yourself, Protect the company and in that order, and so it's built into research, but what we've had to do digitally is become a lot stricter about our consent forms become a lot closed-off in terms of recordings…so that even if we get hacked, or you know, anything happens to that person it won't be attributed to them […] none of our processes are taken on without someone from technology looking at them and going, Yes, this is safe technologically." **(CL)**

"…it does add a layer of complexity in terms of compliance, legalities and administration." **(JP)**

4.4 Improving ISD in a virtual context

To answer RO2, the participants were asked during the interview to provide input on how the company should improve the process of performing ISD in a virtual environment. The responses were thematically analysed in NVivo 12 as shown in Appendix 10, and findings were categorised according to literature. It emerged from data analysis that ISD organizations can improve the process of performing ISD by focusing on factors related to people, tools, processes, and virtual culture. These factors are described and summarised in Table 5 below.

Category	Description	Reference Extracts
People	Ensure you hire the right ISD people, and empower your virtual remote staff (Saraiva et al., 2021; Mangiza & Brown, 2020; Liao, 2017)	• *"There's a lot of qualities that we look for in team members to ensure that they are going to thrive in a remote first environment"* (RK) • *"I've also interviewed candidates like the one we hired right now she really wanted to work in a virtual environment"* (EK) • *"Make sure you've got the right people…"* (TM)
Tools	Provide virtual enabling productivity tools and infrastructure which support effective and efficient ISD (Großer &	• *"make sure the tools are there"* (TT) • *"...make sure that your employees have the best Internet connection that they can get… subsidize it if you need to"* (IS)

Category	Description	Reference Extracts
	Baumöl, 2017; Dulebohn & Hoch, 2017)	
Processes	Implement and maintain agile processes that makes ISD easier in a virtual context (Fowler & Highsmith, 2001),	• *"…continued efforts in the areas of de-siloing that's critical for ISD and generally company performance"* (TM) • *"… try set up your processes and share your ways of working with the team so that you know when you have your regular touchpoints so that people don't disappear."* (TT) • *"ensure that you have very clear and defined sort of communications process"* (IS)
Virtual Culture	Foster a healthy remote culture and conducive spaces (Howard-Grenville, 2020)	• *"understanding how to facilitate a viable and sustainable remote work culture"* (TM) • *"…acknowledge that we're remote, acknowledge that it's going to change things, stop comparing it to being in an office."* (RK) • *"In a virtual setting we have to create those spaces where people could be comfortable just chatting otherwise there will be no connection made and we have these games nights and cooking classes which I think really add to the culture"* (EK)

Table 5: Categorised factors of improving ISD in a virtual context

4.5 Summary

The data analysis and findings in this chapter provide evidence that virtuality affects processes of performing ISD comprising of leading, communicating, collaboration, trusting, knowing, dealing with challenges, developing with agility, and assessing achievements through enacting virtuality. The findings reveal that participant responses were aligned with the key themes in the initial model that was developed from literature and there was consensus on the main processes of performing ISD in a virtual context. There were various views on each process resulting in the emergence of subthemes. Thematic analysis allows for the emergence of subthemes (Braun & Clarke, 2006), thereby justifying the emergence of subthemes in this study.

Pertaining to leading, the sub-themes that emerged included clarifying goals and objectives, adapting leadership styles and providing leadership support. Communicating sub-themes included

synchronous and asynchronous communication, and overcommunication. Collaboration sub-themes comprised of cross-functional collaboration, engagement and participation, and administrative overheads. Sub-themes that emerged under Trusting were relationship-building, honouring commitments, and active involvement. Knowledge gathering, knowledge sharing, and knowledge utilization sub-themes were confirmed by participants under the Knowing process. Two sub-themes that emerged from the analysis under Dealing with Challenges included strengthening social fabric and prioritising employee wellness. Under Developing with Agility, sub-themes that came up were early and continuous software delivery, self-organization, and conducive environment. Assessing Achievements sub-theme included quality assurance, progress tracking and celebrating outcomes. Enacting Virtuality consisted of virtual culture, technology infrastructure and online productivity tools. All other processes of performing ISD are embedded in the context of virtuality, and all themes and subthemes gave a reference to the enactment of virtuality.

These research findings provided a basis for the modification of the initial sd-as-p model identified in literature as in Figure 1 into an updated sd-as-p model shown in Figure 6 below.

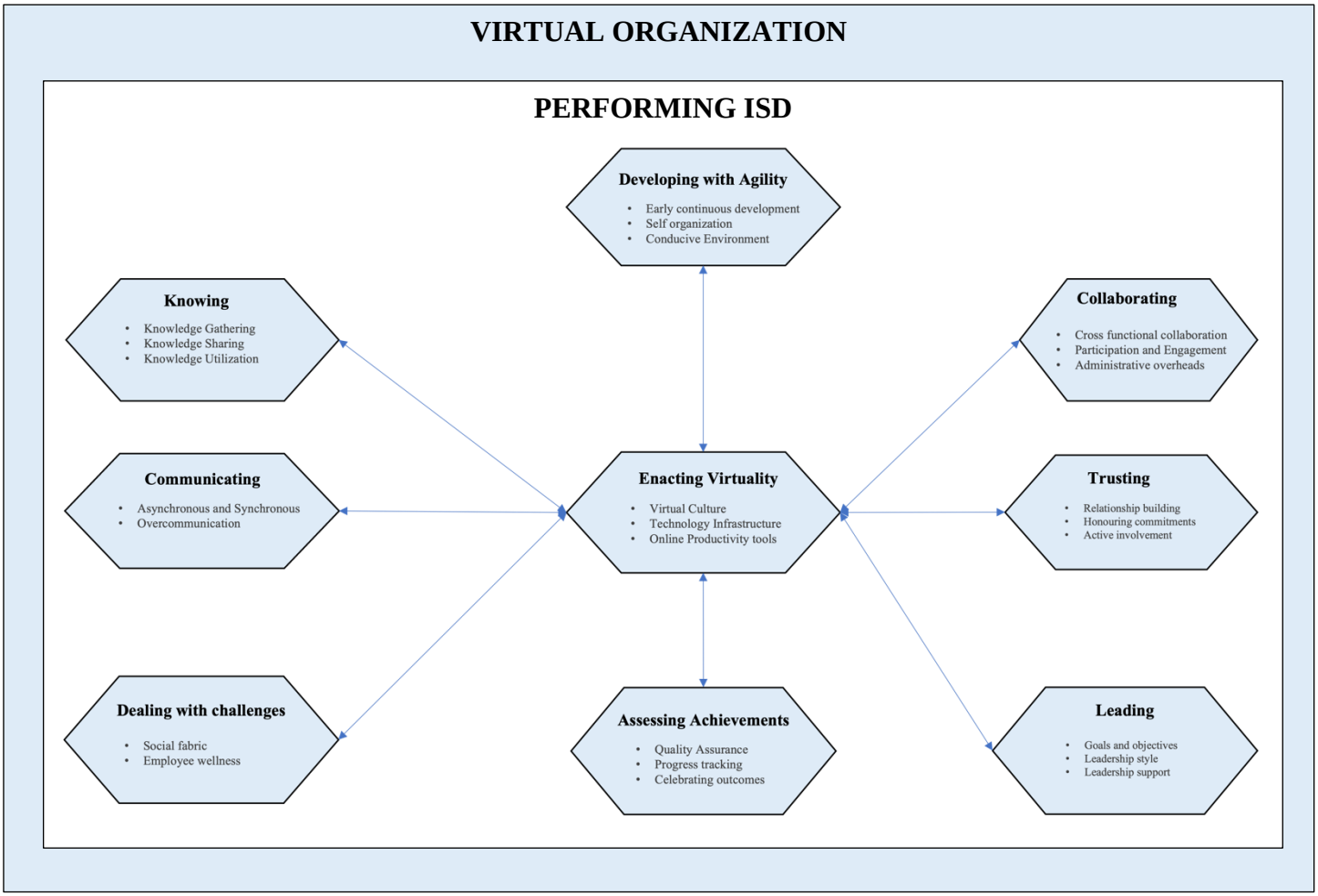

Figure 6: Updated Systems Development as Performing (sd-as-p) model.

The updated sd-as-p shown in Figure 6 above is made up of the main themes initially identified in the initial contextual model of Figure 1, and sub-themes that emerged from the thematic data analysis.

CHAPTER 5: DISCUSSION OF RESEARCH FINDINGS

This chapter will discuss the implications of the research findings in regard to the literature review, and the initial model used as a guide for data collection.

5.1 Processes of performing ISD

The following sections will discuss findings on the processes of performing ISD viz leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements, and enacting virtuality.

5.1.1 Leading

The research findings concur with the literature stance on ISD leaders being responsible for setting, overseeing, communicating team goals, and aligning staff to support the organization's vision (Kirkman & Stoverink, 2021; Newman & Ford, 2021). Geeling et al. (2019) highlight the need for leaders to inspire followers, and the research findings point out various challenges ISD leaders face when leading virtually such as social, psychological, and technological which causes virtual leaders to apply more effort to inspire and lead their teams. Virtual leaders, therefore, ought to adapt their leadership approach by encouraging shared or upward leadership styles for the success of ISD as highlighted by Kozlowski et al. (2021).

Regarding team support, the research findings and literature agree that virtual leaders should be actively involved in guiding relationship-building processes (Kozlowski et al., 2021; Liao, 2017) and increase availability to deal with impediments that affect ISD process (Castellano et al., 2021). The stance that virtuality makes virtual leadership support difficult (Morrison-Smith & Ruiz, 2020; Malhotra et al., 2007) also concurred with the research findings. However, the research findings contradict with Ford et al. (2017) on the notion of using leadership to safeguard against autonomy. The research findings on the contrary highlight the need for autonomy, accountability and self-organization when performing ISD in a virtual context pertaining to team and individuals due to reduced visibility and micromanagement opportunities in a virtual context. The findings concur with the perspective that ISD virtual leaders should leverage the competencies of team members (Hoegl & Muethel, 2016).

5.1.2 Communicating

The research findings concur with Jarvenpaa & Keating (2021) on communication being a multimodal process involving both nonverbal and verbal components. Synchronous and asynchronous ways of communication are used when performing ISD virtually. Furthermore, the research findings noted significant increase of asynchronous and nonverbal communication when operating virtually with most software developers pointing out that they prefer asynchronous communication as it reduces distractions that affect their flow when coding. This contradicts the perspective in agile software development principles that effective communication to and within software development teams is through face-to-face interactions (Beck et al., 2001).

According to Zuofa & Ochieng (2017), challenges in virtual environments include inadequate communication and misinterpretation of information. On this stance, the research findings concur with the challenge of misinterpretation of information when communicating virtually but contradict with the notion of inadequate communication in virtual contexts. It emerged from the findings that there is overcommunication happening in virtual ISD teams due to the need for increased clarity and the availability of various online communication platforms and tools.

The research findings also support literature on the strong reliance on virtual communication technologies when performing ISD virtually (Bundhun & Sungkur, 2021; Gallego et al., 2021) and the associated communication challenges (Schulze & Krumm, 2017; Gilson et al., 2015) experienced when using those tools.

5.1.3 Collaborating

The research findings highlight that cross-collaboration between ISD teams and other teams increases when performing ISD virtually. Literature also concurs with the findings by pointing out the need for the involvement of various stakeholders such as users, researchers, project sponsors, and developers in building software products (Collignon et al., 2022; Liao, 2017; Beck et al., 2001). The research findings confirmed that due to virtuality, collaborative tools and processes that were mostly used in software development teams were now available and being utilised with

other teams. For instance, the research teams would adopt some of the agile ceremonies to improve their research processes.

Virtual collaborative sessions are perceived as less impactful when compared to face-to-face interactions (Dulebohn & Hoch, 2017). The research findings raise the same viewpoint due to challenges such as less engagement and participation when utilizing tools (Bundhun & Sungkur, 2021), differing time zones and administrative overheads experienced when collaborating virtually. Morrison-Smith & Ruiz (2020) further highlight that as the number of teams grows, collaboration on projects become difficult to manage virtually and this stance is also confirmed in the research findings as most participants pointed out that managing collaboration while performing ISD virtually is a huge challenge due to factors such as finding availability in people's calendars, tool-related challenges, and managing participation during collaborative sessions thus adding administrative overheads.

5.1.4 Trusting

Trust is one of the important aspects of team collaboration (Zaitsev et al., 2020), that depends on relationships. The virtual context negatively affects human social norms that are essential for relationship-building among ISD team members. This effect slows down the development of trust among virtual team members and disrupts team cohesion and productivity (Kozlowski et al., 2021) as reported in the research findings. Additionally, the notion that when operating virtually, trust is developed through activities such as active participation, online engagement and honouring of commitments concur with the literature that points out the increased need for frequent and active participation, dependability and responsiveness when performing ISD to build team trust (Yu et al., 2022; Kozlowski et al., 2021; Gilson et al., 2015). The development of an environment that fosters early diagnosis and solving of challenges (Serrat, 2017) is conducive for boosting trust but is a challenge highlighted in the research findings. Measures such as online relationship-building activities like gaming, and cooking classes are being utilised in the case organisation to deal with trust-related challenges and enhance the process of performing ISD.

5.1.5 Knowing

Online training and collaboration via the use of technological resources enhance knowledge sharing (Tyagi et al., 2022; Morrison-Smith & Ruiz, 2020; Hao et al., 2019). The research findings highlighted that the use of technological tools in knowledge-gathering and sharing improves the ISD process. Software developers and other supporting teams can easily develop, share and utilize training materials virtually and across different time zones in real time or asynchronously. Working virtually forced teams including the ISD team to improve their documentation processes whereas in collocated environments knowledge used to sit in the minds of a few skilled and long-serving software developers. ISD teams utilize online sessions like lunch-and-learns, or tech demos that can be run by anyone located anywhere, and sessions are recorded and shared easily with absent members to catchup at their comfort.

The stance in literature on the importance of having knowledge on use of technological tools while performing ISD virtually (Schulze & Krumm, 2017; Weimann et al., 2013) also emerged in the research findings. The research findings further highlighted that the increased variety of technological tools in the virtual context pushes companies to utilise many tools which require both old and new employees to spend more time learning the tools.

The research findings noted that there was a negative effect on sudden creativity and innovation in ISD caused by virtuality's influence on tacit knowledge (Hung et al., 2021; Alsharo et al., 2017).

5.1.6 Dealing with challenges

The research findings highlighted that technological, relational, and wellness-related factors are mostly influenced by virtuality when performing ISD. It emerged that there is a need to strengthen the social fabric through virtual sessions such as online cooking classes, and online gaming in order to deal with challenges such as lack of trust, communication challenges, conflicts, and disagreements (Meluso et al., 2020; Shameem et al., 2017; Zuofa & Ochieng, 2017; Levasseur, 2012; Hinds & Bailey, 2003). The research findings further pointed out that technological tools make it difficult to identify wellness-related challenges such as developer burnouts and Zoom fatigue thereby making it difficult for leaders to deal with such wellness-related challenges. The

findings also revealed that the use of online therapy sessions provided by the company assists virtual employees thus dealing with wellness-related challenges. The findings also reveal that virtuality also encourages empathy as leaders are aware and are also experiencing some of the challenges of virtuality thus concurring with Meluso et al. (2020).

5.1.7 Developing with agility

The research findings concur with most agile principles of software development found in literature consisting of early and continuous and frequent delivery of software, welcoming changing requirements, cross-functional collaboration, self-organization, provision of a conducive environment through leadership support, tools and trust (Kumar & Bhatia, 2012; Beck et al., 2001; Fowler & Highsmith, 2001). However, there was a contradicting view on effective communication. Pertaining to agile software development, the Agile manifesto states that the most efficient and effective method of conveying information to and within a development team is face-to-face conversation (Beck et al., 2001), but the research findings point out that the software developers find asynchronous communication to be a more effective form of communication when performing ISD virtually as it reduces disruptions resulting in them having to context-switch and lose focus. Some raised concerns such as time wastage caused by meetings.

The most highlighted principles of agile software development in the research findings pertain to early and continuous software delivery, self-organization, and the provision of a conducive environment (Fowler & Highsmith, 2001). Early and continuous software delivery was attributed to asynchronous communication, cross-functional collaboration, and technology tool adoption; self-organization increased due to the need for autonomy when working virtually; and the provision of a conducive environment included virtuality's flexibility which forces organizations to trust employees and pushes employees to be accountable of their individual work.

5.1.8 Assessing achievements

The primary measure of progress in ISD is working software (Fowler & Highsmith, 2001). The research findings highlighted some challenges relating to quality assurance found in performing ISD virtually. For instance, due to reduced visibility in cases such as when conducting user research, user

experiences can be incorrectly curated or moderated by the user. Quality checks such as context can be omitted or missed thereby providing incorrect data to the ISD process that consequently results in incorrect ISD outcomes or systems that are malfunctioning.

Software developers and other stakeholders collaborate daily when performing ISD virtually (Collignon et al., 2022; Fowler & Highsmith, 2001). This implies that there is constant progress tracking on ISD outcomes taking place. This concurs with research findings on progress tracking via agile ceremonies such as daily scrums, sprint planning, sprint reviews and sprint retrospectives as well as through the utilization of technological tools such as Azure DevOps, Jira, and ClickUp.

Building projects around motivated individuals (Fowler & Highsmith, 2001) includes celebrating ISD outcomes. The research findings state that virtuality has a negative effect on the culture of celebrating outcomes and embracing failures thus demotivating ISD teams.

5.1.9 Enacting virtuality

Subthemes relating to the enactment of virtuality that emerged from the data analysis included virtual culture, technological infrastructure, and online productivity tools. There was consensus among all participants on the stance that all processes of performing ISD rely on enacting virtuality. Without technological tools and infrastructure such as software, hardware, and internet connectivity all other processes of performing ISD cannot be carried out (Elkordy 2022; Meluso et al., 2020; Dulebohn & Hoch, 2017).

The research findings also highlighted the utilization of online productivity tools in ISD process viz, 1) Communication tools mentioned included Slack, Zoom, Google Workspace, Notion, WhatsApp, Signal, Facebook, and Twitter; 2) Collaboration tools comprised of Miro whiteboard, Gather, and Google Jamboard; 3) Project Management tools such as ClickUp, Azure DevOps, and Jira were mentioned; and 4) Knowledge repository tools such as Notion, Google Docs and Google Drive were mentioned. These findings are in line with literature studies pertaining to tool utilization in a virtual context (Kirkman & Stoverink, 2021; Choi & Cho, 2019; Serrat, 2017)

Another key research finding pertains to virtual culture. It emerged that for successful ISD virtually, a virtual culture has to be deliberately developed throughout the business. This culture includes implementation of virtual social interactions or fun activities and adapting to new technologies and ways of working. The virtual culture, therefore, requires team empowerment and training (Liao, 2017; Kirkman et al, 2004).

Concurring with Uludağ et al. (2022), it was evident throughout the research findings that the enactment of virtuality had an effect on the entire organization. All teams were forced to adapt their ways of working and processes when the organization transitioned to the virtual context. This effect resulted in improved collaboration which resulted in better ISD delivery.

5.2 Modifying the sd-as-p model

The initial conceptual model used for data collection shown in Figure 1, provided broad generic processes of performing ISD identified in the reviewing literature process. These processes comprising of leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, and enacting virtuality provided the basis for a generic open ended data collection process. Upon the completion of the data analysis process, subthemes emerged resulting in the modification of the model as shown in Figure 6. The modified sd-as-p model incorporates subthemes from the research findings thus providing more clarity to which aspects of the processes of performing ISD are mostly influenced by virtuality. The relationships between the processes of performing ISD is through the enactment of virtuality.

Another modification of the initial model is that the process of enacting virtuality was moved to the centre part of the model to denote the reliance of the processes of performing ISD on the enacting virtuality process when working in a virtual context.

According to the research findings, the process of assessing ISD outcomes is a part of the processes of performing ISD hence assessing achievements was grouped with other processes in the modified sd-as-p model.

5.3 Summary

This chapter discussed the research findings pertaining to the influence of virtuality on the processes of performing ISD, the modification of the initial sd-as-p model and the improvement of ISD in a virtual context.

It is evident from the data analysis and findings that virtuality affects the processes of performing ISD comprising of leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements, and enacting virtuality. Findings affirm that the main processes of performing ISD identified in literature were an accurate representation of their experiences on the ground. However, various viewpoints emerged from the participants for each process thereby creating sub-themes as shown in the updated sd-as-p model with the result shown in Figure 6. The main themes and their associated subthemes were consolidated in the updated sd-as-p model in Figure 6 to show a clear representation of the research findings on the influence of virtuality on the processes of performing ISD.

Some of the modifications of the sd-as-d model include the combination of the doing and done thus combining the process of assessing achievements with other processes. The utilisation of technology tools enable real time progress tracking and quality checks when performing ISD virtually.

The enacting virtuality process comprising of virtual culture, technology infrastructure and online productivity tools, was placed at the centre of the updated sd-as-p model in Figure 6 to show its integral position in the process of performing ISD in a virtual context. All other processes of performing ISD are embedded in the context of virtuality, and all themes and subthemes gave a reference to the enactment of virtuality.

Additionally, developing with agility and communicating were highlighted as key components of performing ISD virtually. The processes of developing with agility is a core activity in the development of software. Pertaining to communication, all ISD activities rely on effective asynchronous and synchronous communication. Communication is embedded in all other processes of performing ISD. Asynchronous communication emerged as the preferred way of

communication by ISD engineers when working in a virtual context and that finding was a contrasting viewpoint to agile software development's view that states that the most efficient and effective method of conveying information to and within a development team is face-to-face conversation (Fowler & Highsmith, 2001).

For ISD organizations to improve the process of performing ISD within virtual environments or successfully transition from collocated environments to fully remote environments, factors such as people, tools, processes, and virtual culture must be addressed.

CHAPTER 6: CONCLUSION

The primary purpose of this study was to investigate the influence of virtuality on the process of performing Information Systems Development. To achieve this, the following primary research question and sub questions were formulated:

- **RQ1:** *How does virtuality influence the processes of performing ISD in organizations operating within a virtual context?*
- **RQ1a:** How does virtuality influence the execution of ISD activities when operating in a virtual context?
- **RQ1b:** How does virtuality influence the assessment of outcomes of ISD work?
- **RQ2:** How can organizations improve the processes of performing ISD when operating within a virtual context?

To answer the research questions above, a case study was employed. Qualitative data was collected from participants actively performing ISD in a fully virtual company through interviews and secondary data. The collected data was analysed using the thematic analysis approach proposed by Braun & Clarke (2006).

The study revealed the main processes of performing ISD that are influenced by virtuality viz leading, communicating, collaborating, trusting, knowing, dealing with challenges, developing with agility, assessing achievements, and enacting virtuality. There was coherence between literature findings and the findings of this study pertaining to the influence of virtuality on these main processes of performing ISD. Additionally, several sub-themes emerged during a thematic data analysis. The table below shows a summary of the findings in the form of the main processes of performing ISD and their corresponding subthemes in relation to the primary and secondary research questions:

Research Question	Process of Performing	Sub-themes
RQ1, RQ1a	Leading	• Clarifying goals and objectives • Adapting leadership styles • Providing leadership support
RQ1, RQ1a	Communicating	• Asynchronous and synchronous communication • Overcommunication
RQ1, RQ1a	Collaborating	• Cross-functional collaboration • Engagement and participation • Administrative overheads
RQ1, RQ1a	Trusting	• Relationship building • Honouring commitments • Active involvement
RQ1, RQ1a	Knowing	• Knowledge gathering • Knowledge sharing • Knowledge utilization
RQ1, RQ1a	Dealing with challenges	• Strengthening social fabric • Prioritising employee wellness
RQ1, RQ1a	Developing with agility	• Championing early and continuous software delivery • Encouraging self-organization • Providing a conducive environment
RQ1b	Assessing achievements	• Quality assurance • Progress tracking • Celebrating outcomes
RQ1, RQ1a	Enacting Virtuality	• Virtual culture • Technology infrastructure • Online productivity tools

Table 6: Summary of answers to the research questions

To answer RQ2, the study identified components that enhance ISD in a virtual context viz people, tools, processes, and virtual culture.

6.1 Expected Contributions

The findings in this study have both theoretical and practical contributions. On the theoretical contribution, the revised sd-as-p model can be used to understand how the processes of performing ISD are influenced by virtuality. The methodology employed in this study can be adopted and validated in similar studies involving virtual contexts. The practical contribution is that ISD organizations and teams already operating in virtual contexts can utilize some of the study's findings to streamline their processes and collocated businesses including ISD wishing to transition to the full remote business mode can utilize this study's findings for a smooth transition.

6.2 Future Research and Limitations

Due to factors such as the time constraints and difficulties in finding ISD organizations that had transitioned to fully virtual mode during a pandemic, a single case was investigated. As more companies are now shifting to fully virtual ways of working, the study provides an opportunity for in-depth investigations and analysis on the revised sd-as-p theoretical model by use of multiple case studies. Future studies can further investigate relationships between processes of performing ISD when operating in a virtual context. The updated model could be further investigated and analysed especially relating to the subthemes and whether the subthemes can constitute main themes on their own or more themes and subthemes can be added to the model. Furthermore, more research can be conducted on a larger organization.

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APPENDICES

Appendix 1: UCT Ethics Application

Ethics Approval Request for the Study entitled: Virtuality's Influence on the Performing of Information Systems Development: The case of an organisation in transition

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	Phillip Mangiza signature removed	09-07-2021

This application is approved by:

Supervisor	Irwin Brown signature removed	14-Jul-2021
Co- Supervisor		

Appendix 2: UCT Ethics Approval

Faculty of Commerce
Private Bag X3, Rondebosch, 7701
2.26 Leslie Commerce Building, Upper Campus
Tel: +27 (0) 21 650 4375/ 5748 Fax: +27 (0) 21 650 4369
E-mail: jacques.rousseau@uct.ac.za
Internet: www.uct.ac.za
@Commerce UCT **UCT Commerce Faculty Office**

14 07 2021

Phillip Mangiza

Department of Information Systems

University of Cape Town

REF: REC 2021/07/016

Virtuality's Influence on the Performing of Information Systems Development:

The case of an organisation in transition

We are pleased to inform you that your ethics application has been approved. Unless otherwise specified this ethical clearance is valid until 31-Dec-2022 .

Your clearance may be renewed upon application.

Please be aware that you need to notify the Ethics Committee immediately should any aspect of your study regarding the engagement with participants as approved in this application, change. This may include aspects such as changes to the research design, questionnaires, or choice of participants.

The ongoing ethical conduct throughout the duration of the study remains the responsibility of the principal investigator.

We wish you well for your research.

2021.07.14
20:35:26 +02'00'

Jacques Rousseau
Commerce Research Ethics Chair
University of Cape Town
Commerce Faculty Office
Room 2.26 | Leslie Commerce Building

Office Telephone: +27 (0)21 650 2695 / 4375
Office Fax: +27 (0)21 650 4369
E-mail: jacques.rousseau@uct.ac.za
Website: http://www.commerce.uct.ac.za/com/Ethics-in-Research

Appendix 3: Management Approval letter

Department of Information Systems
Leslie Commerce Building
Engineering Mall, Upper Campus
OR
Private Bag X3 - Rondebosch - 7701
Tel: +27 (0) 21 650 2261 Fax: +27 (0) 21650 2280
Internet: http://www.commerce.uct.ac.za/informationsystems/

09 July 2021

Request to conduct research and interview participation consent form.

Dear Sir/Madam,

In terms of the requirements for completing a Master's degree in Information Systems at the University of Cape Town a research study is required.

The researcher, in this case Phillip Mangiza, has chosen to conduct a study entitled "Virtuality's Influence on the Performing of Information Systems Development: The case of an organisation in transition". The researcher would like to request permission to conduct this study at your organization. The objectives of the research are to:

- Explain how virtuality impacts the process of doing Information Systems Development (ISD) projects inside the IS Industry.
- Explain how virtuality impacts the assessment of Information Systems Development (ISD) projects inside the IS Industry.
- Identify how organizations can improve Information Systems Development (ISD) when working in a virtual context.

We would like to inform you that the ethical aspect of the research ensures the preservation of the identity of the participants, the data collected will be used purely for academic purposes. All personal details will be treated with the highest form of confidentiality. Please note that participation in this research is voluntary and participants can opt out of the study at any time.

The data collection method will be one-on-one interviews with staff who are responsible for all the activities involved in Information Systems development. The interviews will be conducted online (using Zoom or Microsoft Teams) as per the agreement between the researcher and the participant and will last approximately an hour. If you authorise this study to be undertaken at your organization, please kindly sign the attached form and return to me at your earliest convenience.

Should you have any questions regarding this research, please feel free to contact me on 078 107 2774 or email: mngphi019@myuct.ac.za. Your organization's participation in this study would be greatly appreciated.

Sincerely,

Phillip Mangiza

Researcher \ Master's Student, (UCT)
Department of Information Systems
University of Cape Town
Email: mngphi019@myuct.ac.za

Supervisor Irwin Brown

Research Supervisor
Department of Information Systems
University of Cape Town
Email: irwin.brown@uct.ac.za

I, _____, give the researcher of this study consent to conduct their study in the following organization:

_____

I am aware that participation is voluntary and that respondents may choose to withdraw from this study at any time, should they choose to do so.

_____ _____

Signature **Date**

Appendix 4: Participants' Consent form

Department of Information Systems

Leslie Commerce Building
Engineering Mall, Upper Campus
OR
Private Bag X3 - Rondebosch - 7701
Tel: +27 (0) 21 650 2261 Fax: +27 (0) 21650 2280
Internet: http://www.commerce.uct.ac.za/informationsystems/

09 July 2021

Request to conduct research and participation consent form.

Dear Sir/Madam,

In terms of the requirements for completing a Master's Degree in Information Systems at the University of Cape Town a research study is required.

The researcher, in this case Phillip Mangiza has chosen to conduct a study entitled "Virtuality's Influence on the Performing of Information Systems Development: The case of an organisation in transition". The objectives of the research are to:

- Explain how virtuality impacts the process of doing Information Systems Development (ISD) projects inside the IS Industry.
- Explain how virtuality impacts the assessment of Information Systems Development (ISD) projects inside the IS Industry.
- Identify how organizations can improve Information Systems Development (ISD) when working in a virtual context.

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements.

The data collection method will be semi structured one-on-one interviews. The interviews will be conducted online (using Zoom or Microsoft Teams) as per the agreement between you and the researcher and will last approximately an hour. If you are willing to participate in this study, kindly sign the attached form and return to me at your earliest convenience
Should you have any questions regarding this research, please feel free to contact me on 078 107 2774 or email: mngphi019@myuct.ac.za

Your participation in this study would be greatly appreciated but is entirely voluntary.

Sincerely,

Phillip Mangiza

Researcher \ Honours Student, (UCT)
Department of Information Systems
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Email: irwin.brown@uct.ac.za

Research Participant Consent Form

I, _____, consent to participate in the research on "Virtuality's Influence on the Performing of Information Systems Development: The case of an organisation in transition". I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should I choose to do so.

_____ _____

Signature Date

Appendix 5: Research Interview Protocol

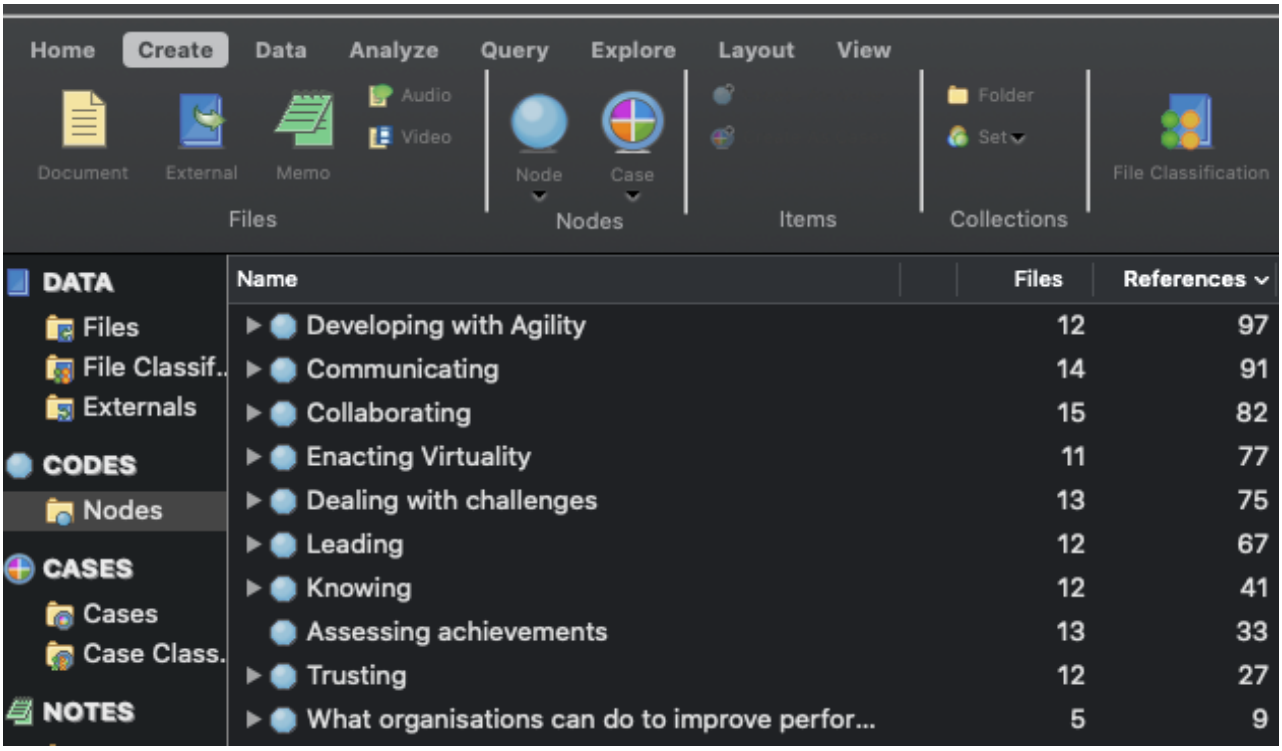
Opening	
	Thank you for taking the time to meet with me and participate in my Master's research study on the "*Virtuality's Influence on the Performing of Information Systems Development: The case of an organisation recently transitioned to a fully virtual context"* I don't wish to take up more than 1 hour of your time today. This study aims to investigate Virtuality's influence on the process of performing Information Systems Development (ISD) in an organization operating within a virtual context. This interview and what we discuss is confidential, it is anonymous and won't be linked back to you in any way and if there are any questions that you wish not to answer you can just say so. I would like to ask for your consent and permission to record the interview.
	Definition of key terms to the participant: ▪ Virtuality: is the movement of physical or in-person processes to online platforms or tools which mimic or replace traditional processes ▪ Performing ISD: is the process of doing which comprises of the actual activities done by individuals in the process of construction of IS solutions and the reasons for doing them ▪ Assessment of ISD: is how the results of ISD efforts are assessed

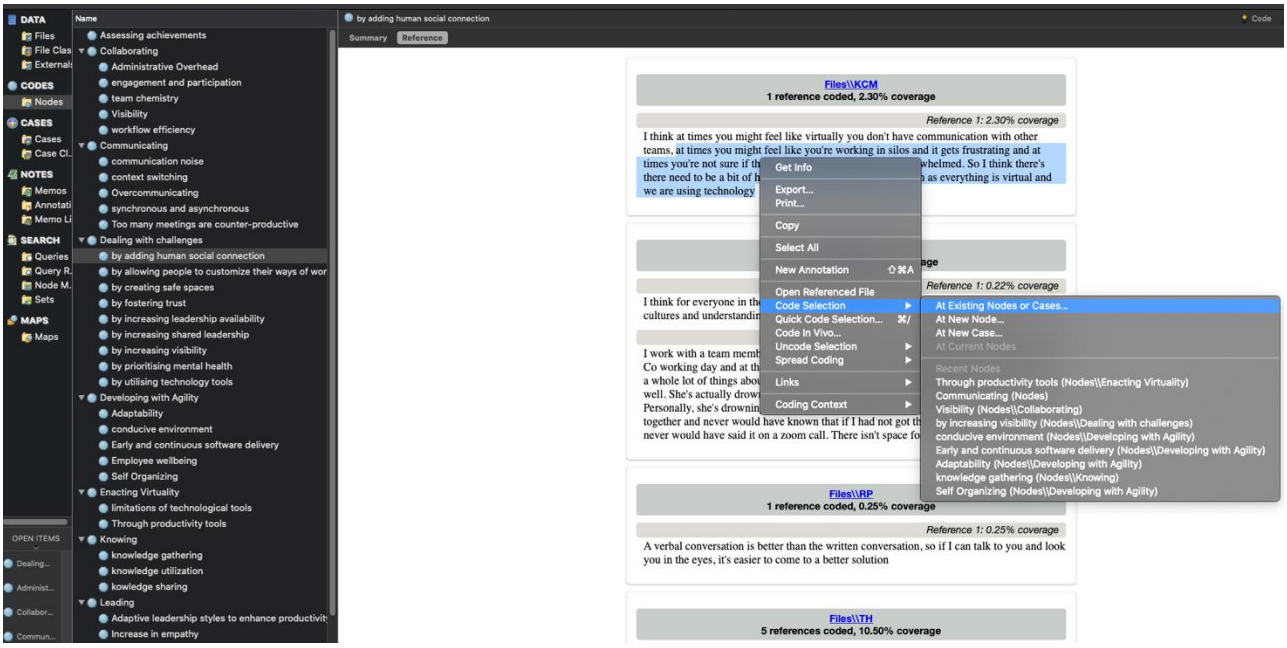
1. Questions on Performing ISD	
1.1	How does virtuality influence the way you communicate when performing Information Systems Development within the organization?

1.2	How does virtuality influence leadership when performing Information Systems Development within your organization?
1.3	How does virtuality influence the way you collaborate while performing Information Systems Development within the organization?
1.4	How does virtuality influence the way your organization deal with challenges when performing Information Systems Development?
1.5	How does virtuality influence trust among team members when performing Information Systems Development within the organization?
1.6	How does virtuality influence the way ISD knowledge is gathered, shared and utilised when performing Information Systems Development within the organization?
1.7	How does virtuality influence the practise of Agile software development in the processes of performing ISD?
1.8	Are there any other missing processes of performing ISD and challenges you encounter in the process of ISD within the Virtual context?

2. Question on Assessing ISD Outcome	
2.1	How does virtuality influence the assessment of ISD outcomes or achievements?
Questions on measures to be considered to improve performing ISD when operating virtually	
2.2	How can an IS organization improve performing ISD in virtual context?

Appendix 6: NVivo Coding





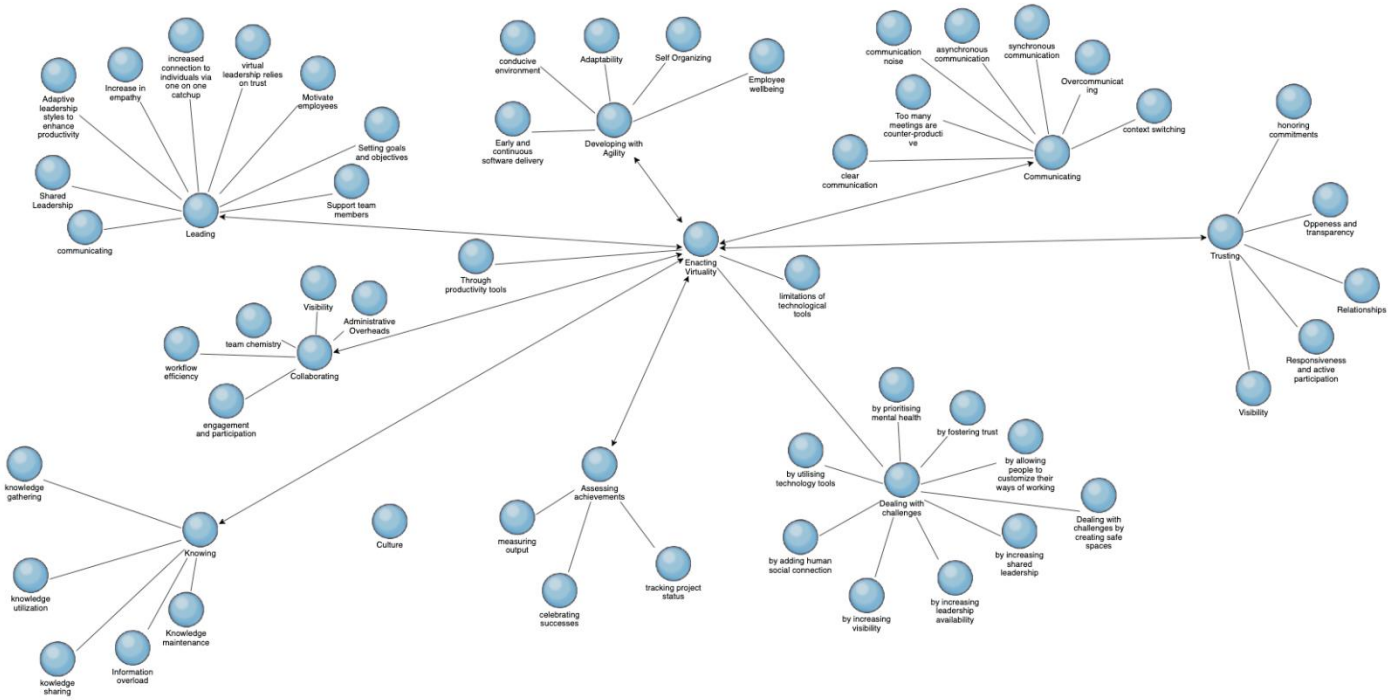
Appendix 7: NVivo Candidate Themes and Sub-themes for ISD processes

Name	Description	Files	References
Assessing achievements	ISD output and outcomes	14	36
celebrating successes		1	1
Project status updates		1	1
Quality output		1	1
Collaborating	Working together for the common goal	18	98
Administrative Overhead		8	14
engagement and participation		6	10
team chemistry		4	7
Visibility		5	10
workflow efficiency		4	5
Communicating		17	106
asynchronous communication		4	7
clear communication		2	3
communication noise		1	1
context switching		1	1
Managing Online meetings		3	17
Overcommunicating		4	10
synchronous communication		1	1
Culture		1	1
Dealing with Challenges		16	91
by adding human social connection		8	18
by allowing people to customize their ways of working		6	9
by creating safe spaces		11	25
by fostering trust		4	7
by increasing leadership availability		12	22
by increasing shared leadership		3	6

Name	Description	Files	References
by prioritizing mental health		3	5
by utilizing technology tools		8	21
Developing with Agility	Anything to do with agile software development	15	121
Adaptability		6	13
conducive environment		6	21
Early and continuous software delivery		8	26
Employee wellbeing		4	11
Self-Organizing		5	10
Enacting Virtuality	relying on technology tools	13	84
limitations of technological tools		4	13
Through productivity tools		7	15
Knowing	gathering, sharing, maintaining and utilization of knowledge	14	58
Information overload		1	1
knowledge gathering		12	26
knowledge sharing		5	16
knowledge utilization		6	8
Knowledge maintenance		1	2
Leading	anything to do with leading people	15	75
Adaptive leadership styles to enhance productivity		3	4
communicate		1	2
Increase in empathy		3	7
increased connection to individuals via one on one catchup		4	5
Motivate employees		2	2
Setting goals and objectives		1	2
Shared Leadership		3	3

Name	Description	Files	References
Support team members		3	6
virtual leadership relies on trust		3	4
Trusting	trust related issues	14	33
honouring commitments		5	5
Openness and transparency		4	4
Relationships		7	7
Responsiveness and active participation		1	2
Visibility		2	2
What organizations can do to improve performing ISD virtually		5	10
Accommodative of people's lifestyles		1	1
Be more people focused		3	3
Consider your employees choice before going virtual		1	1
invest in tools		1	1
Remote support roles		2	2
Training teams on how to use the remote tools		1	1

Appendix 8: NVivo Map of candidate themes and subthemes

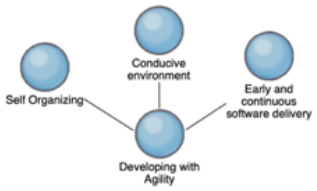


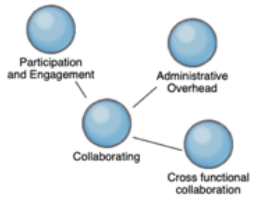
Appendix 9: NVivo Coding : Final Themes and Subthemes

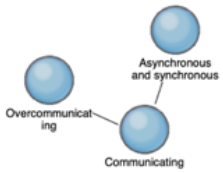
Name	Description	Files	References
Assessing achievements	Process of assessing ISD outcomes	16	39
Celebrating ISD Outcomes		4	4
Progress Tracking		4	5
Quality Assurance		5	7
Collaborating	Process of collaborating	18	110
Administrative Overhead		8	15
Cross functional collaboration		5	6
Engagement and participation		9	23
Communicating	Process of Communicating	19	116
Asynchronous and synchronous		8	18
Overcommunicating		7	22
Dealing with Challenges	Process of dealing with challenges	17	102
by prioritizing employee wellness		9	12
Strengthening social fabric		12	28
Developing with Agility	Process of developing with agility	18	142
Conducive environment		9	42
Early and continuous software delivery		10	30
Self-Organizing		8	18

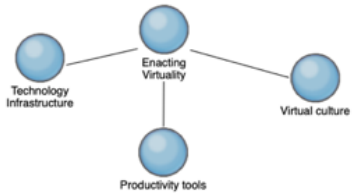
Name	Description	Files	References
Enacting Virtuality	Process of enacting virtuality using technology	17	136
Productivity tools		17	83
Technology Infrastructure		11	21
Virtual culture		10	20
Improving performing ISD virtually	How organizations can improve ISD when operating is a virtual context	8	16
Organizational culture		4	4
People		5	7
Processes		3	4
Tools		3	3
Knowing	Process of gathering, sharing and utilization knowledge	18	71
knowledge gathering		14	41
knowledge sharing		10	33
knowledge utilization		10	19
Leading	Process of leading	16	88
Adapting leadership style		10	12
Clarifying goals and objectives		4	8
Providing leadership support		19	39
Trusting	Process of cultivating trust	17	50
Active Involvement		4	6
building relationships		10	17
honoring commitments		7	8

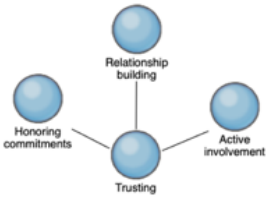

knowledge sharing
knowledge utilization
Knowing
knowledge gathering


Conducive environment
Self Organizing
Early and continuous software delivery
Developing with Agility


Participation and Engagement
Administrative Overhead
Collaborating
Cross functional collaboration


Asynchronous and synchronous
Overcommunicating
Communicating


Technology Infrastructure
Enacting Virtuality
Virtual culture
Productivity tools

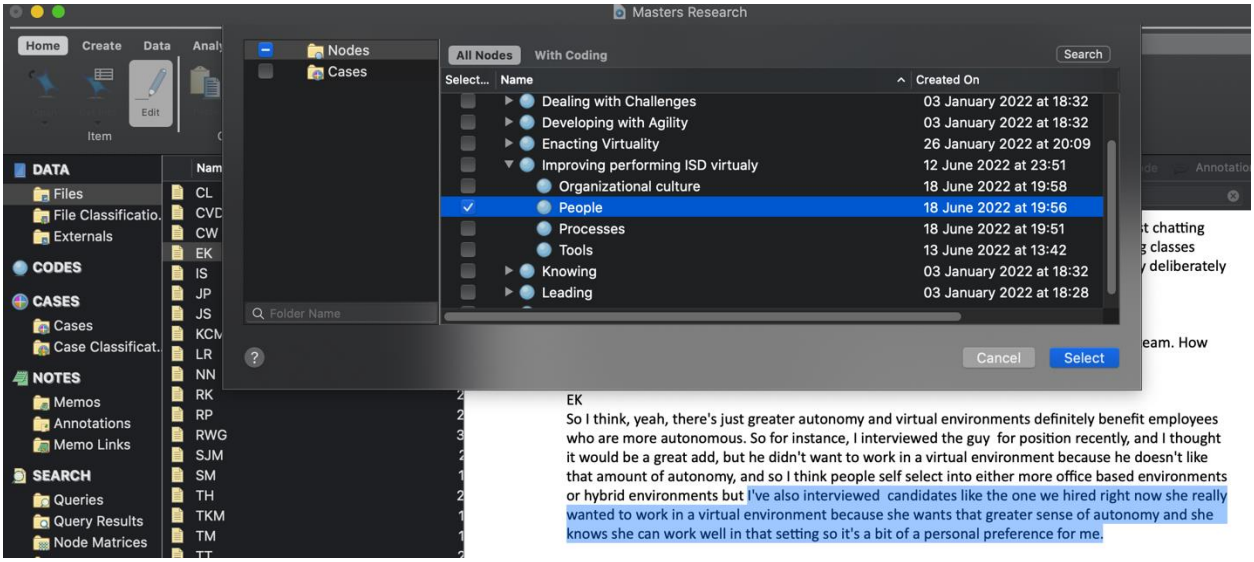

Relationship building
Honoring commitments
Active involvement
Trusting

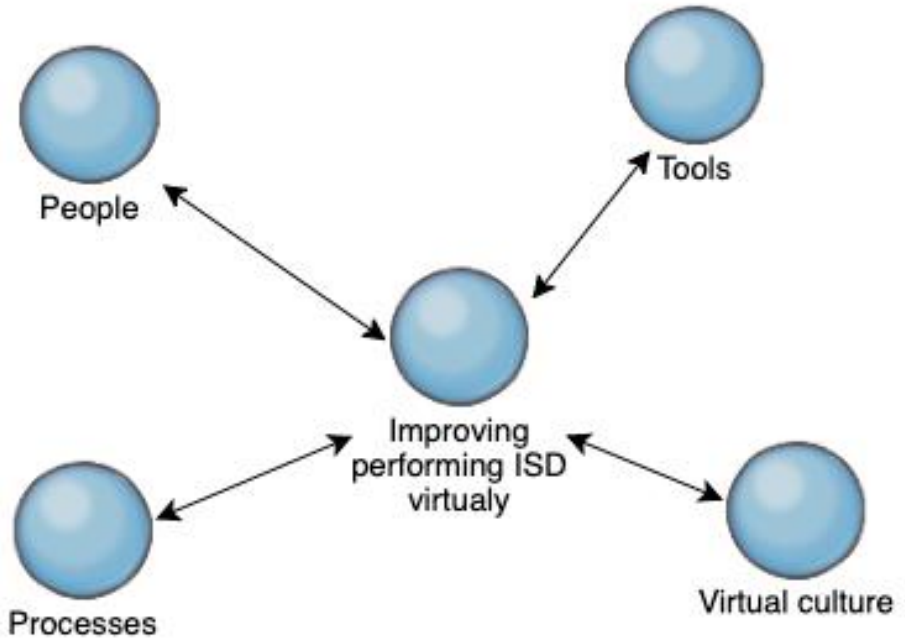

Assessing achievements
Celebrating Outcomes
Progress tracking
Quality Assurance


Social fabric
Dealing with Challenges
Employee wellness


Leading
Goals and objectives
Leadership support
Leadership style

Appendix 10: NVivo Coding: Categorization of ISD improvements

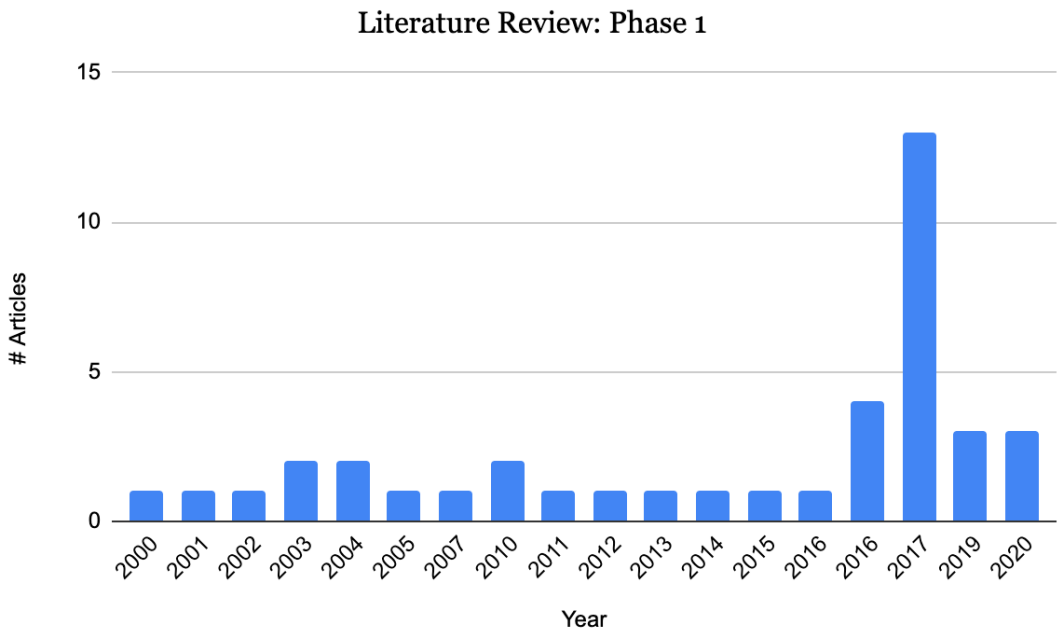




Appendix 11: Literature Review Phases

PHASE	TOTAL FINAL ARTICLES
1	40
2	75

Phase 1



Phase 2

SOURCE	NUMBER OF ARTICLES
Journal	61
Conference	6
Professional publication	4
Dissertation	1
Website	2
Working paper	1